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TECHNOLOGY AND/OR NATURE

DENATURED/RENATURED/ ENGINEERED/ARTIFACTED LIFE?

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Abstract

In our high-tech world, do we live at the end of nature? Is the technosphere replacing the biosphere? Can humans control their genetically inherited Pleistocene appetites in an Anthropocene Epoch? Is experience of the urban, rural, and wild a three-dimensional life, with life focused on fewer dimensions under-privileged? Do we, ought we, wish to live on an engineered planet? Would this fulfill human destiny or display human arrogance, failing to embrace our home planet in care and wonder? If we are to solve the escalating technology problem in the right place, we must learn to manage ourselves as much as the planet. True, we must become civilized. Be a resident on your landscape. True, the future holds advancing technology. But equally: we do not want to live a de-natured life, on a de-natured planet.

Technology involves artifacts, both in its etymology, from the Greek *tekhne*, "art" or "skill," and in its central idea, the body of knowledge available to a culture for fashioning and using implements. This has so dramatically escalated in modern times, with the coupling of science and industry, that we have entered the first century in the 45 million centuries of life on Earth in which one species can aspire to manage the planet's future. Since Galileo, Earth seemed a minor planet, lost in the stars. Since Darwin, humans have come late and last on this lonely planet. Today, on our home planet at least, we are putting these once de-centered humans

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back at the center. We have entered the Anthropocene Epoch, the era of the imperial human domain.

The International Commission on Stratigraphy has a working group that has just recommended Anthropocene as a geological unit (Waters et al 2016; Voosen 2016). Beyond the geology, Anthropocene has become an "elevator word," to use Ian Hacking's phrase, and put to use philosophically. The Anthropocene is "humanity's defining moment," according to the American Geosciences Institute (Seielstad 2012). We are "the God species" (Lynas 2011). Humans are in the driver's seat. Erle Ellis, celebrating what he calls the "Planet of No Return: Human Resilience on an Artificial Earth," rejoices in "the beginning of a new geological epoch ripe with human-directed opportunity" (Ellis 2011). Escalating technology enables ever-escalating human domination of the landscape, perpetual enlargement of the bounds of the human empire. We consider here the promise and peril of technological emancipation.

Technology changes the future, but so do ideas. Ideas drive technology, and also drive the values that we choose to carry from past through the present, conserving or reforming them for the future. We are at a hinge point in our history, re-evaluating how we value nature and human nature. We start wondering whether we live at one of the ruptures of history. "Act now, think later," is doubtful advice when what one values is unsettled.

1. THE END OF NATURE

"We live at the end of nature, the moment when the essential character of the world...is suddenly changing," Bill McKibben worries, stating that already "we live in a postnatural world," "a world that is of our own making" in which "there's no such thing as nature anymore" (McKibben 1989, 175, 60, 85, 89). There is only the built environment. Michael Soulé faces this prospect: "The term natural will disappear from our working vocabulary. The term is already meaningless in most parts of the world because anthropogenic [activities] have been changing the physical and biological environment for centuries, if not millennia" (Soulé 1989, 301). We are at "the end of the wild" (Meyer 2006). Nature is over. Forward for me and my kind!

But this is no cause for lament. There is no nature with which humans have not tampered. Since the dawn of culture, humans have rebuilt their natural environments. No civilized humans can live in pure, pristine nature. The only nature we have had for thousands of years is a nature to

which humans have put their hands. This may sometimes be so on long settled landscapes of the Old World, in Denmark, for example, or in India or China. The Chinese may say that China has been in the Anthropocene for thousands of years. Their landscapes have always been a result of people interacting with their surrounding natural systems, encouraging rural technology in agriculture, as with the hydraulic supplies of water to rice paddies. Across many centuries, there has been imperial governance that has actively intervened to manage landscapes, as with water channels and flood control.

In parts of North America, in Siberia, Australia, or the Amazon, the possibilities are different. Even there, we may be told that before the Europeans arrived in the new world, the aboriginals had already extinguished wild nature. There was no wilderness when Columbus arrived in 1492. Perhaps there was none in parts of Central and South America, but this claim is overblown in North America. The Native American technology for larger landscape modification was bow and arrow, spear, and fire. The only one of these that extensively modifies landscapes is fire. Fire is also quite natural.

Forests in the Americas have been fire-adapted for at least thirteen million years, since the Miocene Epoch of the Tertiary Period, evidenced by fossil charcoal deposits. Doubtless the native Americans started some fires too, but it is hard to think that their fires, centuries ago, so dramatically and irreversibly altered the natural fire regime that, before the Europeans arrived, nature was already ended on the expansive American landscape (Lotan et al 1985).

The Europeans did have horses, cattle, wheels, iron axes and plows, with which they set out to rebuild their landscape for agriculture and to exploit its natural resources. Gifford Pinchot, the first head of the United States Forest Service, was a utilitarian who saw the human role as managing natural resources for human benefit. "The first duty of the human race is to control the earth it lives upon.... Out of this attack on what nature has given us we have won a kind of prosperity and a kind of civilization and a kind of man that are new in the world" (Pinchot 1973, 86, 90). The manifest destiny of Americans is to tame the continent, so we today have about 97% of the landscape developed, farmed, grazed, timbered, or designated for multiple use.

But even on these managed landscapes, we could not say that nature was over. The farmers (as well as those in town) depended, for example, on what we now call "ecosystem services." These include photosynthesis,

sunshine, nutrient dispersal and cycling, pollination, rain, rivers, air, groundwater, soil, microbial decomposers, and living space that is habitable and pleasant. Farmers have to be attuned to passing seasons, to the rhythms of nature. They garden nature. Yes, they have technology, but their technology has to "go with the flow" of natural processes.

In the course of human history, there have been epochal changes of state, such as the transition from hunter/gatherer cultures to agriculture, from oral to written cultures, the discovery of fire, the discovery of iron, the discovery of the New World, of Earth as a planet to circumnavigate, the discovery of motors, gears, electricity, electronics. This new century will indeed launch a new millennium: the super-industrial age, the high-technology age, the postnatural world? So perhaps we are passing into a new style of life where nature is less and less any limit or determinant in our lives. Our grandparents did have to "go with the flow," but we have the power to go upstream into a novel non-natural world.

Evolutionary history has been going on for billions of years, while cultural history is only about a hundred thousand years old. But certainly, from here onward, culture increasingly determines what natural history shall continue. In that sense, it is true that Earth is now in a post-evolutionary phase. Culture is the principal determinant of Earth's future, more than nature; we are passing into a century when this will be increasingly obvious. The next millennium, many are saying, is the epoch of the "end of nature." The new epoch is the Anthropocene.

Lest we be too boastful of the skills of the technicians in this Anthropocene Epoch, it is worth remembering that the research scientist stays in search of, mindful of, the remarkable natural properties on which technology depends. The engineer does craft novel and non-natural machines, but the thoughtful engineer will always recall that human art has no independent powers of its own. Yes, there are essential differences between artifacts and spontaneous nature, but there is a foundational sense in which human craft can never produce any unnatural chemical substances or energies. All we can do is shift natural things around, taking their properties as givens.

There is nothing unnatural about the properties of a computer or a rocket; as much as a warbling vireo or a wild strawberry, both are assemblages of completely natural things operating under natural laws. Nature has a rich utilitarian pliability, due both to the plurality of natural sorts and to their splendid multifaceted powers. Nature is, as it were, a fertile field for human labor, but that agricultural metaphor (which applies as

well to industry) praises not only the laborer but his surrounding environment. Despite the prefix, resource preserves the word source, and recalls these generative qualities so profuse in their applications.

It is sometimes thought that the more civilized we become, the further we get away from nature—released from dependency on the spontaneous natural course. This is true, but science and technology also take us further into nature. A smart phone is, in this perspective, not so much nature ended, not just an exploitation of nature, but also a sophisticated appreciation of the intriguing electronic and mathematical structure of matter-energy, properties enjoying an even more sophisticated natural use in the brain of the human fabricator of the smartest phone-calculator.

To be sure, the function and value of the cell phone is keyed to the state of science, but it is also a function of available natural properties, which often quite unpredictably mix with human ingenuity to assume value. Given the striking advances of technology, an endangered ecosystem is likely to contain some members of potential use. If we accordingly conserve nature, we hope in the genius of the human mind; but we also reveal our expectations regarding the as-yet undiscovered wealth of natural properties, which we may someday convert into artifacted value. From this perspective, nature is never ended; if it were, we would all be dead and our gadgets kaput.

2. TECHNOSPHERE AND BIOSPHERE

In the future, the technosphere could supercede the biosphere. Until now, our technosphere (the world of technological artifacts) was contained within the biosphere (the living natural world of fauna, flora, ecosystems). In the future this will change; the technosphere will supercede the biosphere.

The focus of science will no longer be the laws of nature and how we can use them. Classical science has been grouped into the natural and the social sciences, depending on the object of study, nature or culture. Interestingly, today we have a new domain of science: the sciences of the artificial. Computer science, for example, is a science of artifacts. Other scientists study Teflon, or the transuranic, superheavy elements (like plutonium), or the engineered biotas that Soulé envisions. These sciences do not, of course, violate any laws of nature, neither those of physics or chemistry; thermodynamics and gravity still reign. But they do bring into play forces hitherto unknown in nature—their constructions are not

natural kinds, but artifacts. The processes that govern such artifacts are not those of wild nature, but those that scientists have elected to create. Scientists will sometimes need new laws which did not operate and were only potentially there in old nature. Or, if you prefer, they were always there, but there were no empirical instantiations of such laws; they were empty sets.

There is reasoned intentionality in science and technology. Scientists routinely state the nature of the problem that needs to be attacked. They start by reviewing what others have learned, do their research, and a standard conclusion suggests what research needs to be done next. Models and paradigms focus our attention on likely revisions of the theory. Scientists are guided by heuristic rules. "Generate and test" is standard scientific procedure, in some ways analogous to natural history, which also generates and tests novel organisms. But engineers make deliberated trials (replacing a gear that is failing frequently with one made of stronger alloy), which often succeed because they are made with an overview of the entire mechanism and an analysis of where the problem area is located. The result is engineered artifacts without parallel in nature.

The rapid development of contemporary technology opens the possibility that, in the next millennium, nature will be less and less constitutional, as it is more and more modified, in an increasingly technologically sophisticated world. Nature will become not so much redundant as increasingly plastic. The technicians can get houses out of trees, clothing out of crude oil, a turkey with more white meat by gene-splicing. They can make this molecule out of that molecule, even this atom out of that one, whatever x out of whatever y. Human life will depend less and less on working with natural kinds (feldspar, turkeys, cellulose, or carbon) and more and more on artifacted kinds (vinyl, transgenic turkeys, fiberglass, or Teflon). How far might this go? Engineers are hard at work on artificial photosynthesis. Biochemists have already made artificial blood, where the hydrogen atoms are replaced by fluorine atoms. Such blood is being tested in medical treatments because it is resistant to leukemia and to certain toxins. So, we have in prospect people with artificial blood eating artificial food.

It does then seem possible to end nature by transforming it into something humanized. This has already been taking place, and the future promises more, at an escalating pace. Humans also belong on the planet—the epoch of evolutionary nature, and even of ecological nature, is over. That is what is right about the view that with the arrival of humans, their

cultures, and their technologies, pristine nature vanishes. Nature does not vanish equally and everywhere, but there has been loosed on the planet such a power that wild nature will never again be the dominant determinant of what takes place on the inhabited landscapes.

We have escalated our technological powers. Humans move more earth and produce more reactive nitrogen than all other terrestrial processes combined (Galloway 2004). Human agriculture, construction, and mining move more earth than do the natural processes of rock uplift and erosion (Wilkinson and McElroy 2007). These human activities alter the composition of the atmosphere, the soil, levels of biodiversity, energy flows within food webs, and produce novel ecosystems.

But before we congratulate ourselves on these novel ecosystems we might worry. Ecosystem services are still needed for persons living in contact with nature; many ecosystem services operate and must be conserved at global levels. Any advancing technology, ought to focus on a sustainable biosphere as much as on sustainable development. The Ecological Society of America has a different focus: "Achieving a sustainable biosphere is the single most important task facing humankind today" (Risser, Lubchenco, Levin 1991). In emphasizing "reconnecting to the biosphere," a Royal Swedish Academy of Sciences research team agrees (Folke et al 2011). Such sustaining and reconnecting will produce benefits for humans no doubt, but this account finds these benefits to be inseparable from concern for an ongoing biosphere, with its larger communities of life.

Asking about a "safe operating space for humanity," in a feature article in *Nature* in 2009, Johan Rockström argues, using scientific data, that there are nine planetary systems on which humans depend. These can be seen by analysis of: chemical pollution, climate change, ocean acidification, stratospheric ozone depletion, biogeochemical nitrogen-phosphorus cycles, global freshwater use, changing land use, biodiversity loss, atmospheric aerosol loading. Since the Industrial Revolution, in three of these systems the boundaries have already been exceeded: biodiversity loss, climate change, and the nitrogen cycle (Rockström 2009). Do we want to conserve all nine of these systems or do we want to re-engineer them to suit humans better? For at least 10,000 years (what geologists call Holocene times) these systems have remained stable. Surely the wisest course is to keep these major life support systems of Earth in place as they are.

Rather than think of a biosphere/technosphere flip flop, one can think of degrees of naturalness. The 100% natural system no longer

exists anywhere on Earth (consider, for example, the DDT found in the bloodstream of penguins in Antarctica). Yet there are still areas where the human influence is minimal and the prevailing processes are those of spontaneous wild nature. On Earth, the settled continents (excluding Europe) are between one-third and one-fourth wilderness (McCloskey and Spalding 1989). Inside the dominant technosphere, we can have large reserves (up to one fourth of the continent), or pockets of small ones: islands, vignettes, colonies of wildland nature. Even in Europe there is much concern for rewilding. Naturalness is a continuous variable, ranging from completely natural (100% natural) to completely artificial (0% natural).

One study has an eight-point scale (Peterken 1996). Another has twelve landscape zones, placed on axes of human "controlled" to autonomously "self-willed" and "pristine" to "novel" (Aplet 1999). There are multiple dimensions of naturalness (Siipi 2008). One can claim that there are on differing places on the landscape, various degrees of the Anthropocene (0% Anthropocene to 100% Anthropocene), with most of the terrestrial Earth only part way there—and with options about how much further into the technosphere we want to go.

In another survey, using three categories, researchers find the proportions of Earth's terrestrial surface altered as follows: 1. Little disturbed by humans, 51.9%. 2. Partially disturbed, 24.2%. 3. Human dominated, 23.9%. Factoring out the ice, rock, and barren land, which supports little human or other life, the percentages become: 1. Little disturbed, 27.0%. 2. Partially disturbed 36.7%. 3. Human dominated 36.3%. Most habitable terrestrial nature is dominated or partially disturbed by people (73.0%). Still, nature that is little or only partially disturbed remains 63.7% of the habitable Earth (Hannah et al 1994).

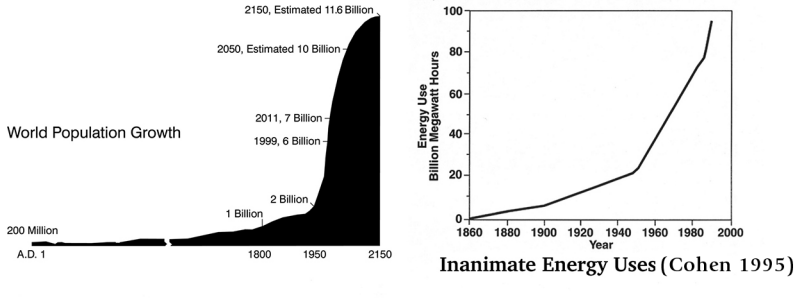
Estimating degrees of transition from biosphere to technosphere, we should consider criteria such as the following: What is the historical genesis of processes now operating on the landscape? Were they introduced by humans, or do they continue from the evolutionary and ecological past? What is the species constitution compared with the pre-human makeup? How much cultural energy is required for the upkeep of the modified system? The more such management requires large amounts of labor, petroleum, electricity, fertilizer, pesticides, the further we are from a system that has ecological integrity or ongoing stability. How much self-organizing nature remains? What would happen without humans? Would the system re-organize itself, if not to the pre-human integrity, then at least to a

flourishing system? Planetary climate management, however, would overarch all these degrees of naturalness.

3. PLEISTOCENE APPETITES IN AN ANTHROPOCENE EPOCH

Why can't we manage ourselves? The problem seems to be that we are driven by Pleistocene appetites, still in our genes, in an era with postmodern powers. Our evolutionary past did not give us many biological controls on our desires for goods that were in short supply. We love sweets and fats, of which in Pleistocene times humans could seldom get enough. But now we overeat and grow fat. Generally, that is a model for the whole overconsumption problem. There are few biological controls on our desires to amass goods, to consume. For most humans it has always been a struggle to get enough (indeed for most it still is). When we can consume we love it, hence, we overconsume.

Compared to our ancestors, we have the same desires, but we have suddenly acquired vast amounts of power to satisfy these desires. Consider, for instance, a pair of graphs: population increase and increased use of power. The two are closely related. With engines, gears, tractors to produce food, there is population growth, escalated by modern medicine saving us from diseases. The billions of new people have the same appetites with greatly increased power to satisfy these desires.



Inanimate Energy Uses (Cohen 1995)

Compare the almost right-hand turns about mid 20th century, made possible by vastly increasing technological power. Technology (medicine, engines, electricity, fertilizers, tractors, trucks) makes possible escalating population with escalating appetites (better homes, cars, more food, television, cell phones, widgets). The transition from muscle and blood (whether of humans or of horses) to engines and gears shifts by many orders of magnitude the capacity of humans to transform their world.

Consumer capitalism transmutes a once-healthy pattern of desires into avarice. With escalating opportunities for consumption, escalating technological power, driven by markets in search of profits, we need more self-discipline than comes naturally. Our self-interested tendencies overshoot; we find it difficult to know when and how to say "enough." We may have powerful engines and gears, but we still have muscle and blood appetites.

Consider our power to travel. We now have high-tech bulldozers building a burgeoning road network to gain access to resources, forests, minerals, with extensive radiating side effects—uncontrolled development build-out, loss of ecosystem services, loss of carbon sequestration, loss of soil, wildlife, arriving invasive species, pollutants (Haddan 2015). Or consider our power to fly. Once we walked on foot. For thousands of years we used horses or camels, still muscle and blood. Sailboats added wind power. A century back we engineered trains and cars. Now, there are over 100,000 air flights per day. My great-grandfather finished medical school in Philadelphia, and wanted to see the country, so he rode horseback to Texas. It took him six months. I can fly across the continent in a few hours. The pace change in three generations is from horse and buggy to jet plane.

Even more recently, the capacity to produce has been augmented by the capacity for information transfer. Consider the transition from handwriting to printing, from communication by written mail to e-mail, social media, radio and television, from information processing in books to information processing by computers. All this has occurred in a hundred years, much of it in decades that I can recall. Technology gives us advanced capacity for data-processing. But much of the chatter and gossip on social media is little advanced in quality over what we might have heard at firesides ten thousand years ago.

One might first think, since humans presumably evolved as good adapted fits in their environments, that human nature will complement wild nature. Biologists may call this "biophilia," an innate, genetically based disposition to love animals, plants, landscapes with trees, open spaces, running water. Critics find this to be a half-truth because disconfirming evidence is everywhere. Biophilia might be a positive Pleistocene relic. But any residual biophilia is weak before our much more powerful desires for the goods of culture.

True, people like a house with a view, with a garden, but they do like a house, a big one. True, we like landscapes with running water, but none

of us could live as we do without managing that water, re-directing, engineering that water to bring it into the faucets and toilets of our homes. People are builders; their construction industry is what is destroying nature. People prefer culturally modified environments.

"Man is the animal for whom it is natural to be artificial" (Garvin 1953, 378). *Homo sapiens* is "the natural alien" (Evernden 1993). The really natural thing for humans to do (our genetic disposition) is to build an inhabited landscape differentiating (alienating) ourselves from nature. Human agriculture, business, industry, development consumes most of our lives, and the search for nature is only avocational recreation.

For all of human history, we have been pushing back limits. Humans have more genius at this than any other species. Especially in the West, we have lived with a deep-seated belief that life will get better, that one should hope for abundance, and work toward obtaining it. Economists call such behavior "rational"; humans will maximize their capacity to exploit their resources. Moral persons will also maximize human satisfactions, at least those that support the good life, which must not just include food, clothing, and shelter, but an abundance—more and more goods and services that people want. Such growth is always desirable, and technology makes this ever more attainable.

In the West, we have built that into our concept of human rights: a right to self-development. Such an egalitarian ethic scales everybody up and drives an unsustainable world. When everybody seeks their own good, there is escalating consumption. When everybody seeks everybody else's good, there is, again, escalating consumption.

Humans are not well equipped to deal with the sorts of global-level problems we now face. The classical institutions—family, village, tribe, nation, agriculture, industry, law, medicine, even school and church have shorter horizons. Far-off descendants and distant races do not have much "biological hold" on us. Across the era of human evolution, little in our behavior affected those remote from us in time or in space, and natural selection shaped only our conduct toward those closer. Global threats, resulting from technology feeding ancient appetites, require us to act in massive concert at a scale of which we have previously been incapable. As such, humans may bear within themselves the seeds of their own destruction.

More bluntly, more scientifically put: our genes, once enabling our adaptive fit, will in the next millennium prove mal-adaptive and destroy us. What then? Should we proceed to high-tech germline editing and

revise our genome with redesigned human desires, a human nature better suited for life in the Anthropocene Epoch? Even if we could do this in a select few, the prospects of revising the germlines of eight billion persons is nowhere on any future horizon.

Both policy and ethics will be required to enlarge the scope of concern. Humans are attracted to appeals to a better life, to quality of life. If environmental ethics can persuade large numbers of persons that an environment with biodiversity and wildness is a better world in which to live than one without these, then some progress is possible—using an appeal to still more enlightened self-interest, or perhaps better: to a more inclusive and comprehensive concept of human welfare. That will get us clear air, water, soil conservation, national parks, some wildlife reserves and bird sanctuaries. Environmental ethics cannot succeed without this, nor is this simply pragmatic; it is quite true. This may be the most we can do at global scales, even national scales, with collective human interests.

We may prove able to work out some incentive structures. The European Union has transcended national interests with surprising consensus about environmental issues. Kofi Annan, Secretary General of the United Nations, praised the Montreal Protocol, with its five revisions, widely ratified (197 nations) and implemented as the most successful international agreement yet. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has been adopted by 182 nations. There are over 150 international agreements (conventions, treaties, protocols, etc.) registered with the United Nations that deal directly with environmental problems (United Nations Environment Programme 1997).

We have just seen in Fall 2015 the most promising such agreement involving almost every nation on Earth, to seek to limit global warming to less than two degrees Celsius, compared to pre-industrial levels. The Paris agreement also calls for zero net anthropogenic greenhouse gas emissions to be reached during the second half of the 21st century. Pope Francis' recent encyclical is enlisting the Catholic church toward concern for global care and justice.

Humans have proved capable of advanced skills never dreamed of in our ancient past: flying jet planes, building the internet, decoding their own genome, and designating world biosphere reserves. It would be tragic in the future if we let our leftover Pleistocene appetites become a useful alibi for continuing our excesses. *Homo sapiens* can and ought

to be wiser than that. The recent Paris agreements on climate change are encouraging.

So there is hope. But now and forever in the future we need to remember Lord Acton's caution: "Power tends to corrupt and absolute power corrupts absolutely" (Acton 1887, 1949, 364). Technology, coupled with capitalism, drives people, rich and poor, ever to want more, more, more, with increasing power to get it. Human nature continuing into the Anthropocene Epoch, Pleistocene appetites or not, can at once offer promise of success and simultaneously escalate the threat of our undoing. For the first time in history, the future of Earth is at stake.

4. URBAN, RURAL, WILD: THREE-DIMENSIONAL LIFE

The totally urban (urbane) life is one-dimensional. To be a three-dimensional person, one needs experience of the urban, the rural, and the wild. In that sense, the more humans enter the high-tech, artifacted Anthropocene, the more they will be under-privileged. Pushing the 97% to 100% human dominated, pushing the 97% we inhabit into ever diminishing naturalness is not good for us. In this future Earth, our three-dimensional life on a three-dimensional Earth is at stake.

We need to be put in our place, in our places: urban, rural, and wild. Aristotle said that humans are by nature "political animals" (Greek polis, town, Aristotle, *Politics*, 1, 2). We live in towns. Cultures shape our identities. He was right. But towns are not our only environment. In the United States in 1850 less than twenty percent of Americans lived in towns and cities. Today, resulting from our development, both industrial agriculture and skyscraper cities with their suburbs, more than eighty percent are urban.

That brings a threat of being place-less, rather like sitting in front of a television, which takes you virtually everywhere in momentary flashes, and actually nowhere, or being in "digital space" on a computer. Children stay glued to TV, or their cell phones, playing computer games, suffering from "nature deficit disorder." "The last child in the woods" is gone (Louv 2005). When my son was a teen-ager, we went camping, and he took along a friend, Andy. Next morning, we packed a lunch, and took a hike. Late morning, the two began to ask, "Is it time to eat lunch?" I said, "Let's hike another half hour and we can eat at the spring." I knew there was a good one ahead, with water safe to drink. Andy looked puzzled: "What's a spring?" A teen-aged boy who has never quenched his thirst at a mountain spring is suffering from nature-deficit disorder.

The urban still requires the support of a rural environment for its food supply. But this is more than just vacations in parks and a reliable supply of wheat from the plains. People have a sense of place. Americans love their landscapes: the Shenandoah Valley, the Chesapeake Bay, Cape Cod, the Great Lakes, the Ohio rivers, the Sierras, the Adirondacks, the desert Southwest, the Pacific Northwest, the Rocky Mountains. Oklahomans sing: "We know we belong to the land, and the land we belong to is grand!" (Richard Rodgers and Oscar Hammerstein, *Oklahoma!*). Montana takes its name from its mountains. West Virginia is the "mountain mamma." All of us sing, with goose pimples, "America the Beautiful." Yearning for a sense of place is a perennial human longing. All peoples need a sense of "my country," of their social communities in place on a sustaining landscape they possess in care and in love. What we do to manage such places ought also be sensitive to values that are already "in place" before we humans arrive to dwell there. Yes, humans will construct their places, urban and rural, but a person also needs an embodied sense of residence on a landscape.

Experience of the beauty in nature can be quite powerful. Ask people why save the Grand Canyon or the Grand Tetons, and the ready answer will be, "Because they are beautiful;" they are "grand." There is an easy move from *is* to *ought*. One hardly needs commandments, certainly not laid onto otherwise unwilling agents. Take a drive to the mountains, enjoy the drive in your high-tech automobile. But the main point of the drive is to enjoy the view, look at the fields en route—the waving wheat, and think how air soil, water are basic human needs. One ought to celebrate and conserve beauty in nature. There is aesthetic stimulation in the sense of abyss overlooking the canyon, staring into space, or in following the sweep of the mountains up to the sky, then spotting an eagle in flight. Life would be impoverished with reduced experience of natural beauty, rural and wild.

5. THE ENGINEERED PLANET

The editors of a *Scientific American* special issue, *Managing Planet Earth*, speaking with some global "we," claim that the two central questions today are: "What kind of planet do we want? What kind of planet can we get?" (Clark 1989). The claim may now be that environmental policy and ethics is mostly about intelligently domesticating landscapes. Nature as it once was, ecosystem integrity, with wild nature continuing, is no longer an appropriate focus. Most of life for most people takes place

on those anthropogenic biomes that are a hybrid tapestry of nature and culture. More than 80% of all people live in densely populated rural, village, and urban landscapes (Ellis and Ramankutty 2008). Natural systems are inextricably entwined with cultural systems, which introduce new levels of complexity (Liu et al, 2007). In the Anthropocene, we need planning for a socially re-constructed, anthropogenic nature.

"Whether we accept it or not, human beings now shoulder the responsibility of planetary management; once the planet was larger than us, but it no longer is" (Thompson 2009, 97). "What we call 'saving the Earth' will, in practice, require creating and re-creating it again and again for as long as humans inhabit it" (Shellenberger and Nordhaus 2011, 61). "The living world can now be viewed as a vast organic Lego kit inviting combination, hybridisation, and continual rebuilding. Life is manipulability…. Thus our image of nature is coming more and more to emphasize human intervention through a process of design" (Yoxen 1983, 15). "The biosphere itself, at levels from the genetic to the landscape, is increasingly a human product" (Allenby 2000, 11).

These Anthropocene proponents have little interest in keeping things as they were, not even in the "sustainability" of ecosystem services to which we have been admonished in the last two decades. What we must push for, according to the Royal Society of London (the world's oldest scientific society), is "sustainable intensification" of reaping the benefits of exploiting the Earth (Royal Society 2009). The focus has shifted to going forward by improving nature, dedicated to remaking the planet with one species in mind: us.

A popular idea is that we will seek adaptive ecosystem management. We set our directions through an ongoing dialogue between stakeholders negotiating their interests in a participatory community, a parliament where each advocacy group pushes its own agenda always realizing and respecting the interests of the whole—the whole human community at least—recognizing the feedback loops between human interests and ecosystem services. This may be called "human computation," distributed systems where human populations with their desires interact with computers analyzing what is possible in social, ecological, and natural resource systems (Michelucci and Dickinson 2016). Although adaptive and communitarian, this is still aggressive human management. The root of "manage" is the Latin "manus," hand. Humans will handle the place.

No one wishes to oppose intelligent management. Everyone wants to be "adaptive" (especially biologists, who want humans too to be adapted fits in their environments). But ought humans to place themselves at the center, claiming management of the whole in their human self-interest? This can even mean that *Homo sapiens* is the professional manager of an otherwise valueless world. The managers may call this "geoengineering." Is our only relationship to nature one of engineering it for the better? Perhaps what is as much to be managed is the human earth-eating, managerial mentality that has caused the environmental crisis in the first place.

On the larger planetary scales, it is better to build our cultures in intelligent harmony with the way the world is already built, rather than take control and rebuild this promising planet by ourselves and for ourselves. Managing the planet for our benefit is not the best paradigm; it is a half-truth which, when taken for the whole, becomes dangerous and self-defeating. "Hands" (the root of "manage," again) are also for holding in loving care. What kind of planet ought we humans wish to have? One we resourcefully manage for our benefits? Or one we hold in loving care? Yes. Manage. But what do you manage for? Will these managers produce either sustainable technological development or a sustainable biosphere? So far the "managers" seem mostly to have produced an environmental crisis—managing for escalating consumption, managing to make the rich richer, managing maximally to exploit natural resources.

The human activity that might appear most to justify Anthropocene geoengineering is global warming. Nobody wanted it; it is, alas, an undesired side effect of what we desired. Global climate change is making everything on Earth unnatural, as well as threatening human societies. Upsetting the climate upsets everything: air, water, soils, forests, fauna and flora, ocean currents, shorelines, agriculture, property values, international relations, because it is a systemic upset to the elemental givens on Earth. A frequent fear is that we may trigger a runaway greenhouse effect, where negative feedback processes, tending to keep equilibrium in atmospheric and oceanic circulations, are replaced by positive feedback—non-linear or cascading shifts—spinning Earth into a dis-equilibrium that humans are powerless to correct.

One big worry for the planetary engineers is that geoengineering promises an ultimate technofix that does not address the deeper causes of the problem. Indeed, having such a prospective cure will make us more likely to procrastinate and less likely to seriously address the problem

where it arises: in our relentless consumption of fossil fuels pursing our ambition for endless growth and wealth. We are on track toward a planet that is dramatically warmer, facing catastrophic impacts. Calling geoengineering a last resort is masking our inability to bring ourselves under self-control, making matters worse. The political reality is that we can't fix it, without switching our ambitions. We can't manage ourselves, so we propose to manage, re-mange, the planet to suit ourselves.

Do we want the future of Earth to turn entirely on us humans? Do we want "nature" to end? Perhaps we are post-evolutionary, but do we wish to be post-ecological? What kind of planet do we want? What kind of planet can we get? Maybe we also ought to ask: What kind of planet do we have? What kind of planet ought we want? Maybe we ought to develop our capacities for gratitude, wonder, respect, and restraint. Maybe an engineered planet ceases to be a wonderland. Maybe we live on a wonderland Earth that we ought to celebrate as much as to develop.

Those zealous for engineering the planet do well to recall the myth of Icarus. Icarus escaped prison with a pair of wings made of feathers and wax by his father Daedalus. His father cautioned him not to fly too high, lest the sun melt the wax. Euphorbic from the thrill of flight, Icarus soars too high, his wings melt and he crashes to his death. The Anthropic Epoch might turn out to be the Epoch of Icarus, overly ambitious humans, euphorbic with high technology, killing themselves and their Earth.

Or, if you prefer Hebrew to Greek mythology, once humans boldly resolved: "Come, let us build ourselves a city, and a tower with its top in the heavens, and let us make a name for ourselves, lest we be scattered abroad upon the face of the earth." The Lord saw arrogance in this tower of Babel: "This is only the beginning of what they will do; and nothing that they propose to do will be impossible for them." The divine judgment was scattered confusion, frustrated babel, the inevitable result of overweening ambition (Genesis 11). Are such myths only quaint antiquity? Or do they enshrine perennial wisdom? Could the recent heroic Anthropocene presumptions be the return of the ziggurat, babel for the next millennium?

This is more than seeing ourselves as users, rather than as caretakers. This is more than tending the garden of Eden. This is more than inhabiting a promised land, received as a gift of God. This is seeing ourselves as making a name for ourselves, as grand-scale, geological-scale developers,

improving the planet. The concerns are only initially geological. They soon elevate to linguistic, epistemological, metaphysical, cosmological, theological issues. This proposal to name a geological epoch after ourselves is an invitation to see ourselves in a new light, as justifying our claims to dominate the Earth, to remake the Earth in our own image. At this juncture of history, we can finally play God.

A more considered if still Anthropocene future is celebrated in *An Ecomodernist Manifesto*, advocated by a dozen and a half international environmental leaders. These ecomodernists hope for "an ecologically vibrant planet" (Asafu-Adjaye et al 2015, 31). Surely this modern humanism will treasure ecosystem services. But no. These ecomodernists anticipate what they call "decoupling." "Human technologies…have made humans less reliant upon the many ecosystems that once provided their only sustenance" (9). Yes, technology can be "double-edged" (7); there is serious threat of environmental deterioration, such as with climate change, or pollution, but future humans can fix these human-caused problems.

With increasing industrial agriculture and rising harvest yields, there are no foreseeable limits to producing food. People now are free to and prefer to live in cities, and they will prefer fewer children. This frees up landscapes no longer needed. So, the freer humans are the more they can let selected natural areas go free, wildlands, restored forests. Humans will, of course, often want to recreate in such areas, they are even freer if they have such opportunity. Human encounters with original nature can be "important for their psychological and spiritual well-being" (25).

"Taken together, these trends mean that the total human impact on the environment, including land-use change, overexploitation, and pollution, can peak and decline this century. By understanding and promoting these emergent processes, humans have the opportunity to re-wild and re-green the Earth—even as developing countries achieve modern living standards, and material poverty ends" (15). Such decoupling results in more freedom for humans and more freedom for nature. "Decoupling raises the possibility that societies might achieve peak human impact without intruding much further on relatively untouched areas. Nature unused is nature spared" (19).

By this account, we need to be increasingly high tech to save nature. The dominant hope is that "the trajectory of the Anthropocene" is "The Great Acceleration" (Steffen et al 2015). When human progress is progressively upscaled, peaked out, managing an engineered planet, the

importance of ecosystem services is downscaled. There is nothing here of nature in symbiosis with technology, nothing of interdependence, only high-tech decoupling.

6. THE HOME PLANET

Rocket science is super high-tech. Rocket scientists, loving their marvelous, high-tech machines, are still concerned to celebrate our organic, vital planet. Viewing Earthrise from the moon, the astronaut Edgar Mitchell, was entranced:

> Suddenly from behind the rim of the moon, in long, slow-motion moments of immense majesty, there emerges a sparkling blue and white jewel, a light, delicate sky-blue sphere laced with slowly swirling veils of white, rising gradually like a small pearl in a thick sea of black mystery. It takes more than a moment to fully realize this is Earth…home. (Mitchell, quoted in Kelley 1988, at photographs 42–45)

The astronaut Michael Collins recalled being Earthstruck: "Earth is to be treasured and nurtured, something precious that must endure" (Collins 1980, 6). Instead of re-engineering, we should respect our home planet.

Here is what our high-technology has revealed to us: A universe 13 billion years old, exploding from a vacuum, fine-tuned from the start to generate complexity, immense in size, coming to a unique and most complex expression point in Earth, generating a natural history with rich biodiversity, at the apex of which we humans stand, finding out who and where we are. We discover, searching across forty orders of magnitude, from quasars to galaxies, across scales from DNA to global biosystems, that we humans ourselves have staggering possibilities, able to think more thoughts than there are atoms in the universe, with escalating powers for good: caring for each other and this Earth. The same technology brings escalating powers for evil: exploiting each other, jeopardizing our home planet. When we really do understand all this storied achievement taking place on our home planet, an *ought* arises from an *is* that is of *value*, *valuable*, able to generate momentous value. Any engineer with integrity will recognize that this Earth is already too ingenious to try to reinvent.

Those who took physics a century back were taught that there are two fundamental things in the world: matter and energy. Einstein found that matter and energy are different forms of the same thing. Recently the biologists have been insisting on another metaphysicial level: information. That is what is coded in the DNA, a "cybernetic" molecule. In

result, events on Earth stand in marked contrast with events on other planets, such as the gases that swirl around Jupiter. Even on Earth there is no learning with the passing of cold and warm fronts; they just come and go. Climatological and geomorphological agitations continue in the Pleistocene period more or less like they did in the Precambrian. But the life story is different, because in biology, unlike physics, chemistry, geomorphology, or astronomy, something can be learned. What life can learn is how to reconstruct itself to be a better adapted fit, a more highly advanced adapted fit.

If we are to solve the escalating technology problem in the right place, we must learn to manage ourselves as much as the planet. Be a good citizen, and more. Be a resident on your landscape. No matter what kind of exodus humans make from nature, humans are going to remain male or female, with hearts and livers, and blood in their veins, walking on two feet, and eating energies that were originally captured in photosynthesis by chlorophyll (even if technology learns to mimic it). Culture remains tethered to the biosystem and the options within built environments, however expanded, provide no release from nature, which remains as a life-support system.

Humans today depend on air flow, water cycles, sunshine, nitrogen-fixation, decomposition bacteria, fungi, the ozone layer, food chains, insect pollination, soils, earthworms, climates, oceans, and genetic materials. An ecology still lies in the background of culture, natural givens that underlie everything else. In any future that we can presently envision, some sort of inclusive environmental fitness is required of even the most advanced culture. True, we must become civilized. True, the future holds advancing technology. But equally: we don't want to live a de-natured life, on a de-natured planet.

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