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Can Our Species Escape Destruction?

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Here on Earth: A Natural History of the Planet
by Tim Flannery
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Toby Smith/Reportage by Getty Images
Drax Power Station, a coal-fired power plant in Yorkshire, England, 2008

Here is the anguished cry of another distinguished scientist distressed by our collective incapacity to grasp the enormity of the earth's looming environmental crisis. It has been obvious for a long time—many decades—to legions of individual scientists, and to prestigious scientific organizations like the Union of Concerned Scientists and the National Academy of Sciences, that the global human enterprise is on a collision course with the physical and biological limits of the earth.

Estimates of how bad the situation is, of course, differ, but various assessments agree that the global economy is consuming resources at a rate equivalent to 1.3 to 1.5 times the earth's capacity to supply them sustainably. The only way this can happen is for us to be consuming the resource capital from which we should be harvesting only the interest. The consumption of resource capital is evident in the sluicing of millions of tons of topsoil into the oceans, the drawing down of underground aquifers, the salinization and desertification of erstwhile croplands, the depletion of fisheries stocks, the overharvest of forests, and on and on. We, the prodigal sons of the modern era, collectively seem powerless to stop any of this. Efforts to date, such as international fisheries commissions, the Rio biodiversity treaty, and the Kyoto Protocol have been feeble and ineffective. The much-anticipated Copenhagen summit on climate change of December 2010 flopped.

On top of this already dire situation we face the added stress of climate warming, which promises heat waves, droughts, torrential flooding, forest fires, Class-5 hurricanes, coastal inundation, and the melting of the glaciers that serve as the vital water supply for millions of people. Can it get any worse, one wonders? It can, and worse will be our reward for disregarding the warnings of a generation of scientists.

In *Here on Earth*, Tim Flannery softens the frightening reality of these inconvenient truths by resorting to an overzealous use of metaphors to engage the reader and create a sense of the individual's connection to nature. The subtitle, "A Natural History of the Planet," would have been apt for one of his earlier books, *The Eternal Frontier* (2001), but fails to suggest that this new book is a galloping history of man's relationship to the environment with chapters on overpopulation, financial discounting, the role of markets, global governance, and other topics far afield from natural history.

Flannery is a consummate storyteller who has written a series of fascinating books on human prehistory and the history of life. His earlier works, including *The Future Eaters* (1994), *Throwim Way Leg* (1998), and others are rich in detail and drama, and leave a lasting impression. I wish I could say as much of *Here on Earth*. Flannery describes the book as "an investigation of sustainability—not how to achieve it, but what it is." The subject matter is wide-ranging, encompassing human history from the out-of-Africa diaspora to exploring the dimensions of our "War against Nature." The presentation is consequently fast-paced, almost breathless, as Flannery attempts to cover the history of man's interactions with the environment from *Homo erectus* to the future in 281 pages. Many topics are necessarily skipped over lightly in a work designed more to impress than to grapple with intricacies. Trying to cover too much too quickly, he fails to achieve coherence and momentum.

By the end, one doesn't know quite what to make of it. Does the book have a clear message other than that we humans have to cooperate with one another better than we have in the past? As the brief chapters fly by, punctuated with anecdotes and biographical snapshots, the answer to the question is not clear. Many books concerned with the earth's future thunder doom and gloom on every page. Flannery handles the material with a lighter touch, buoyed by the soothing principle of Gaia, the earth's propensity to maintain a stable environment congenial to life.

The concept of Gaia as a metaphor for how the earth maintains conditions congenial to life appears to captivate Flannery. James Lovelock, the originator of the Gaia hypothesis,* is a chemist who marveled at the composition and stability of the atmosphere, necessary conditions for the evolution and continuity of life on earth. Lovelock was bemused by "the image of the Earth as a living organism able to regulate its temperature and chemistry at a comfortable steady state." His musing has found enthusiastic reception among those of a mystical persuasion, but the reality is much less ethereal and better explained by the laws of chemistry. Gaia is woolly romanticism; it is not science because it is not subject to refutation.

In a formal sense, the Gaia concept rests on a circularity. Modern multicellular life evolved under conditions we regard as benign and conducive to life because life is adapted to precisely these conditions. An essential feature of the earth's atmosphere is that 20 percent of it is oxygen, a fact that could be regarded as mysterious because oxygen is a reactive element, readily forming oxides, compounds of oxygen with the most abundant elements in the earth's crust, including silicon, iron, and aluminum. For roughly half of the earth's history, the atmosphere lacked oxygen and was replete with noxious gases: carbon dioxide, ammonia, and methane. Still, life originated under these alien conditions. Oxygen appeared much later with the ascendancy of photosynthesis as the dominant process by which the energy of sunlight converts carbon dioxide into organic compounds. The oxygen in the atmosphere today was derived through the photochemical splitting of water into its components hydrogen and oxygen through photosynthesis. The hydrogen combines with carbon dioxide to form carbohydrates and the oxygen is released into the atmosphere as a byproduct. The atmosphere contains oxygen because plants produce it faster than it is lost to the oxidation of iron and other minerals.

The earth's environment has not always been so benign. Early earth history includes a massive collision that liquefied the earth's core and spun off the moon, a long period when the atmosphere was replete with greenhouse gases but lacked oxygen, and a time about a billion years ago when the entire earth froze over. Where was Gaia then? On a time scale of millions of years the earth's geological processes can attain a dynamic quasi equilibrium that permits life to flourish and diversify; but on a scale of billions of years, the story becomes, from a human perspective, one of forbidding strangeness and intolerable conditions.

Life evolved in the absence of oxygen. The legacy of that early time is an extraordinary array of organisms known as extremophiles. Principally bacteria, extremophiles live in unimaginably hostile environments, such as superheated hot springs, sulphurous vents in the ocean floor, anaerobic muck, and Antarctic deserts. If catastrophe were to befall the earth, another meteorite impact, for example, such as the one that ended the age of dinosaurs, extremophiles would inherit the earth and perhaps launch a new experiment in evolution. The existence of extremophiles lends credence to the notion that life has evolved many times, perhaps millions of times in an essentially infinite universe. But how often has life evolved into sentient beings capable of achieving self-awareness through science? That is certainly a much smaller number. Perhaps we're not far from obtaining an estimate as previously unknown planets are being discovered at an accelerating rate and means are being developed of gathering information about their atmospheres.

Whether one regards Gaia as merely a convenient rhetorical device or a manifestation of supernatural guidance, it doesn't really matter in a practical sense. What matters is the delicate checks and balances that make the earth habitable, even congenial to human well-being. The earth maintains a stable environment because it is a dynamic system and dynamic systems possess stable equilibriums. Less widely recognized is that the earth is a complex dynamic system. A cardinal feature of complex dynamic systems is that they can attain multiple forms of equilibrium. One such alternative equilibrium would be an ice-free Northern Hemisphere: this appears inevitable unless greenhouse gas emissions are sharply curtailed. Once the Northern Hemisphere has shifted to an ice-free state, a new stable equilibrium would prevail. Most of the solar energy that falls on the top of the world now is reflected back to space by snow and ice, but in the absence of ice, most of the energy would be retained, creating a warmer climate that would no longer accumulate ice.

The self-regulating qualities of the earth that led James Lovelock to conceive of the Gaia hypothesis fall into the domain of biogeochemistry, a multidisciplinary field that, as the name implies, combines elements of biology, geology, and chemistry. Whereas Gaia holds the Earth's physical homeostasis in awe, biogeochemistry endeavors to understand it by picking it apart, measuring its component processes, and putting them back together in the form of global balance sheets. Often the balance sheets don't balance, as in the case of both carbon dioxide and methane, the two greenhouse gases that are contributing most to the increasing heat-trapping capacity of the atmosphere.

Uncertainties in rectifying the balance sheet for carbon dioxide, for example, contribute to uncertainties in the projections of climate change. The problem is immensely complicated because carbon dioxide has many sources in addition to the burning of fossil fuels. Plants consume carbon dioxide while animals and microbes produce it. Volcanoes contribute to the atmospheric pool. Huge reservoirs of carbon reside in standing forests, peat deposits, and permafrost, and underground in the soil and buried sediments, in amounts dwarfing that in the atmosphere. Human activities, from clearing forests to plowing the ground to overgrazing grasslands to making cement, often disturb nature's equilibrium and complicate the task of quantifying fluxes of carbon dioxide.

On the other side of the balance sheet are processes that consume carbon dioxide: the growth of forests and other vegetation, absorption by the sea, formation of coral reefs, and losses to sedimentation. Human activities disturb all of these processes and by different amounts in different parts of the world. When one realizes this (and a lot more), it can be appreciated why it took more than two thousand experts to compile the latest (2007) report of the Intergovernmental Panel on Climate Change. To trivialize a collaborative global effort of this magnitude as "the biggest hoax ever perpetrated on the American people," as Oklahoma senator James Inhofe recently claimed, would be farcical if attitudes such as this weren't driving our public policy on an issue that threatens the well-being of billions of people. It should not be difficult to understand why we scientists are exasperated.

Flannery rightly warns that any notion of a sustainable world economy is ultimately constrained by the earth's biogeochemical cycles. Water, carbon, nitrogen, trace gases in the atmosphere (e.g., methane, ozone), and mineral elements essential to plant growth are all involved. Human activities are altering the equilibriums of nearly all biogeochemical cycles as well as releasing huge amounts of fertilizers, herbicides, pesticides, and heavy metals that are poisoning surface waters and underground aquifers throughout all the densely settled portions of the planet.

Many of the chemicals being released into the environment are new and their effects on organisms or ecosystems are poorly known. Here is another case where we seem blind to history. Several classes of compounds, notably chlorinated diphenyls (DDT and related compounds), polychlorinated biphenyls (PCBs), and chlorofluorocarbons (CFCs) were banned only after it was discovered—decades after they had been in widespread use—that they impose unacceptable burdens on the environment, other species, and ourselves. Many more will surely follow, but after how much damage has been done?

What can a scientist do to bring rationality to a political debate that is often decidedly nonrational? Scientists are forever being berated by nonscientists for failing to communicate effectively with the public. Apart from the serious practical issue of how scientists are supposed to communicate with the public, the complaint that we are shirking our duty to society is overstated. Science is rarely the fodder for prime-time television, so we write books that very few people read.

Some of the very best scientists have dedicated major portions of their careers to informing the public, including Carl Sagan, Paul Ehrlich, Edward O. Wilson, Jared Diamond, James Hansen, Richard Dawkins, and, among this distinguished company, Tim Flannery. Such scientists have had to face the challenge of learning how to write and speak in an unfamiliar and unpracticed style; some must endure negative reactions on the part of colleagues and deans who tend to regard public-spirited writing as a frivolous extracurricular activity. In the most nightmarish scenarios, hapless scientists are subpoenaed to appear before hostile congressional committees.

But perhaps most unforgivable is that the public, and especially the political class, cherry-picks its science. If a scientist finds a promising treatment for AIDS or cancer, then he is a hero; if he warns about overpopulation, climate change, or toxic contamination of the environment, then he risks either being ignored or, worse, being subjected to ridicule. Such negative incentives reduce to a handful the number of scientists who are willing to speak out.

If the message is not edifying, it will often be rejected. A clear example is evolution. Polls show that roughly 60 percent of the American people reject evolution as the explanation for the origin of man, although Darwin published his thesis more than 150 years ago. Rejection of evolution presents a huge obstacle to the future well-being of humanity. A deep understanding of the “selfish gene” sheds light on many facets of human behavior that the value systems of our society would regard as both positive and negative. Such understanding can help explain why people are clannish and often compulsively greedy, why married men philander, and why we are so prone to violence as a means of resolving disputes. On the positive side, the science of evolution can help explain why we are mostly monogamous, why mothers obsessively cherish their babies, why we tend to care for our relatives more than strangers, even why we strive to succeed economically.

I’m convinced that we won’t have lasting harmony in our global society until we recognize the facts and implications of evolutionary biology and put them to work in creating laws to counteract our most unfortunate tendencies, tendencies that were advantageous during our hunter-gatherer origins but that have become decidedly disadvantageous in a highly integrated society of strangers. With engineers designing ever more powerful and destructive weapons capable of erasing our entire civilization, our salvation must be to construct a legal architecture informed by evolution that will thwart the worst tendencies of the selfish gene so that such figures as Hitler, Stalin, or Saddam Hussein cannot acquire power.

A recurring theme in Flannery’s musings is the contrast between Darwin and his compatriot Alfred Russel Wallace, who nearly scooped Darwin in proposing the idea of evolution by means of natural selection. Through a hasty maneuver, Darwin’s friend, Charles Lyell, then president of the Royal Society, arranged for the two to coauthor the seminal publication announcing the theory. Darwin’s famous book *The Origin of Species* came a year later.

In Flannery’s account, Darwin is portrayed as a reductionist, compelled to delve ever deeper into the details of evolutionary mechanisms. Wallace is extolled as a visionary who wondered about how the earth functions as an

integrated system. Of course, both approaches to science are valid and necessary, complementary rather than antagonistic. Flannery's concern is that the triumph of reductionism in modern science has led us to underemphasize the holistic aspects and thereby to lose sight of important global trends.

Darwin's understanding of natural selection as "unspeakably cruel and amoral" led him to abandon religion. The expression "nature red in tooth and claw" captures the gist of it. It is an unbreachable rule of nature that many more offspring are produced than ever survive to reproduce. This means quite simply that most individual plants and animals, the overwhelming majority in many species, die young. Recent studies in the Serengeti, for example, have determined that the smaller species of antelopes share a single fate, to die in the jaws of a predator. It is a world without sympathy or remorse. Only the wary, the fleet, and the lucky ever survive to reproduce. Technology has removed man from nature and greatly altered (but not eliminated) the process of natural selection as it applies to our species. We are, however, but one of millions of species, all the rest of which still must obey the laws of nature.

Our species emerged with a brain molded by natural selection to succeed in this unforgiving milieu. Survival required just the right combination of boldness and caution tempered with intelligence—let's call it astuteness. The most successful left more than the average number of offspring and we are the linear descendants of those successful individuals.

One has to ask what was it that favored reproductive success. Anthropologists are debating answers to this question, but a large brain capable of assessing risk and reward was surely one. The successful members of our species were those who appropriated sufficient resources to raise above-average numbers of healthy children. Resources can be obtained through diligent application, competition, and cooperation in proportions that vary with circumstances. And, indeed, we know individuals today who succeed by pursuing each of these pathways. Though possessed of selfish genes, we are not all of a kind.

Flannery extols the harmonious organization of an ant colony and likens it to the bustling networks of supply and waste removal that sustain our modern cities. The analogy has heuristic value, but biologically it is off the mark. Ant colonies are composed of sterile workers, all closely related to one another, who sacrifice their individual reproductive fitness for that of the colony as a whole. In contrast, a city is a collection of genetically unrelated individuals, each of whom competes in a diffuse environment to acquire resources to support a family.

Instead, it is the contrast between the metaphor and the reality that should concern us. An ant colony, with its unity of purpose and near-perfect cooperation among members, is the antithesis of the individualistic and competition-based human enterprise. It is our fundamentally competitive social organization that lies at the core of the human predicament and our destructive assault on the environment that sustains us. Notwithstanding the hubris associated with Adam Smith, what is good for the individual is not always good for the collective, because individuals act in self-serving ways that can be detrimental to the commonweal. The ecologist Garret Hardin expressed this eloquently in his famous essay, "The Tragedy of the Commons." To the extent that the economy is a zero-sum game, then some individuals gain at the expense of many others, just as has been happening in the US over the past several decades.

The question needs to be asked whether this kind of system is sustainable. There is a Zoroastrian tension between competition and cooperation that permeates our human institutions. Our political parties split along this fault line. Cooperation is necessary to achieve any goal that is beyond the capacity of an individual, but it is achieved through harnessing the competitive energy that drives us to succeed as individuals. A society based entirely on cooperation—the Marxist ideal—is clearly unworkable because we are, at the deepest level of our psyches, self-centered and competitive. But many scientists, Flannery included, fear that a society based on laissez-faire competition will also prove unworkable, for entirely different reasons.

Humans compete for resources, living space, mates, social status, and almost everything else. Each living human is at the apex of a lineage of successful competitors that extends back to the origin of life. We are nothing if not

fine-tuned competitors. The compulsion to compete enters into nearly everything we do, whether we recognize it or not. And the best competitors among us are often the best rewarded. One needs to look no further than Wall Street for a flagrant example.

It is becoming increasingly apparent that competition has a dark side, for a competitive system provides no rewards for restraint; to the contrary, lack of restraint is often rewarded. Being born into a competition-based society can be likened to entering a major marathon. Thousands surge forward at the starting gun and about two hours and ten minutes later, one person crosses the finish line. Most runners are far behind, not even within sight. Economic competition produces similar outcomes.

One can legitimately argue about the fairness of such a system and its enormously skewed distribution of rewards, but there are deeper issues in an overcrowded world pressing hard against the limits of the earth's renewable resources. Without restraint there is nothing to prevent the exhaustion of resources and a global calamity of unprecedented proportions. So far, as demonstrated by the failure of the world's nations to agree at Copenhagen on a plan for curbing carbon emissions, we have yet to muster the necessary political will to embark upon a program of collective restraint.

The human predicament of overpopulation and overexploitation of resources is fundamentally driven by the primordial impulses that drove our ancestors to achieve above-average reproductive success. In the contemporary world, these impulses form the self-interest of competitively driven entities, be they individuals, corporations, or nation-states. Will giving license to human greed bring us all down, or will the collective assert itself in time to tame the worst excesses of the few? This is the existential question that lurks in the background of every chapter of Flannery's book.

The world needs to impose collective restraints on many fronts, but so far self-interest and competitiveness have trumped most efforts to respond to the needs of the collective whole. We are like ants in our tribalism—feeling greater affinity and sympathy for our kin and our countrymen than we do for people half a world away. Most insidious are the illusion of limitless growth and the self-serving notion that economic growth can eliminate poverty. These illusions have reigned largely unchallenged for more than a century and have taken us far down the road to Armageddon. Flannery has it right when he reflects that "it is not so much our technology, but what we believe, that will determine our fate."

In his timely book *Collapse* (2004), Jared Diamond found that societies confronted by environmental crisis either succeeded or failed depending on whether they were able to reevaluate their most fundamental assumptions. Those that failed ignored warning signs and continued in a business-as-usual mode, whereas those that succeeded recognized inconvenient truths and made appropriate adjustments. Thus far, I do not see many encouraging signs that we are yet committed to a process of reevaluating the fundamental precepts of our society, most crucially, the credo of limitless economic growth.

Malthus foresaw more than two hundred years ago that exponential population growth could not be sustained in a world of finite resources. Malthus's thesis is not a conjecture; it is a truism. Dismissing Malthus has become a popular talking point because global society has not collapsed—yet—but we must remember that Malthus put no time limit on his prediction.

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See Tim Flannery's review of James Lovelock's *The Vanishing Face of Gaia: A Final Warning* (Basic Books, 2009), *The New York Review* , November 19, 2009. ↩