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—AMORY AND L. HUNTER LOVINS, Rocky Mountain Institute



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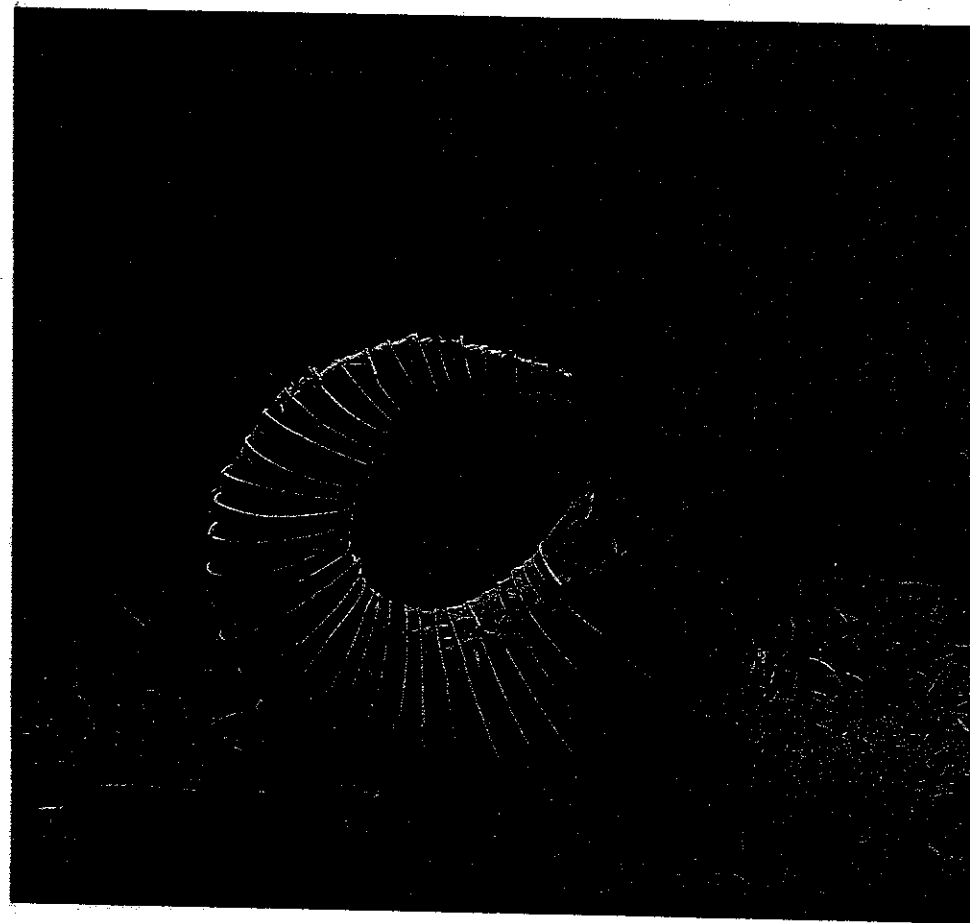
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The Ecology of Commerce • Paul Hawken

THE PROVOCATIVE NATIONAL BESTSELLER

# The Ecology of Commerce

A Declaration of Sustainability



## Paul Hawken

AUTHOR OF *GROWING A BUSINESS* AND *THE NEXT ECONOMY*

"A daring, urgent vision of a kind of 21st century Canaan that Hawken yet believes we can reach." —*San Francisco Chronicle*

## The Death of Birth

Whenever a disturbance or perturbation such as a road violates an established ecosystem, aggressive and invasive weeds like thistle and broom take over bare ground and spread quickly, establishing temporary primacy. These opportunistic species are suited to what are sometimes called "immature" systems. The plants compete for sunlight in order to capture the maximum available energy while trying to cover the raw earth as quickly as possible. In such a system, energy is wasted, diversity is minimal, and the plants are generally of lower quality and usefulness. Their life cycles are short, being mostly annuals; while their output is prodigious, their use of resources is not very efficient. As anyone who has observed, day by day, the changes on a patch of land cleared in the spring knows, this colonization can happen within weeks.

The constant transformation of ecosystems by organisms is the subject of ecology. Plants and organisms do not simply occupy an environment; they alter and transform it creating increasingly varied and complex forms of organization. The second law of thermodynamics informs us that as energy is dissipated, systems tend to descend into reduced states of organization and ultimately to chaos and entropy. Only life prevents entropy from extending to all things in nature: the intricate, mysterious interaction of organisms that captures

sunlight and evolves into higher levels of order and complexity. This state of organization and succession, the opposite of entropy, is called negentropy. It is this evolving order that should humble us respectfully before nature. While the origins and "meaning" of life may be unknown, the way nature transforms the non-living to the living, the simple to the complex, the inefficient to the efficient, is better known and understood. All industrial systems and designs pale when compared to the efficiency of natural systems of production. Nothing does more with less. This knowledge makes nature the logical exemplar for an increasingly evolved form of commerce.

An ecosystem evolves from pioneering, immature states that emphasize growth, through several intermediate stages, until it evolves into mature systems that are highly efficient and resource-conserving. Mature, climax systems comprise an association of organisms that reach a state of equilibrium which leaves the habitat largely unchanged from year to year. Because no environment remains unchanged, even climax communities do not last forever, but they are the most diverse, stable, and complex of communities, and are thus more resilient to disturbances in the greater environment.

Through their complex interchanges of nutrients, gases, and information, mature systems create the greatest amount of biomass with the least amount of resources. Pioneer systems create the foundation for more mature ecosystems because they stabilize the soil, check erosion, bring trace elements up from the subsoil, and prevent further deterioration of the area. Once a pioneer state is established, the initial colonizers are succeeded by increasingly complex organisms and relationships. This process continues until the most adapted system the setting will allow is reached. The differences between pioneer and climax systems are instructive. In immature systems, most energy is used to create new growth, so that bare soil is quickly covered. In a climax system, the greater part of energy is devoted to the continuation of the existing plant and animal communities, since all of the ecosystem is, in fact, colonized and inhabited. All present agriculture, whether it is slash-and-burn or sod-breaking, involves the reversion of a climax system to a pioneering one. We exchange stability and sustainability for short-term abundance and production.

In ecological terms, our present industrial economy is an immature ecosystem. Environmental scientist David Wann states this bluntly

when he says: "It may not be flattering to our national concept, but the present American culture is still the bare field full of colonizing weeds, struggling toward something more sophisticated, interwoven, and permanent. Until now we've consistently chosen the resource-hungry path of least resistance." At the dawn of the Industrial Revolution, a vast new world of apparently unlimited natural resources became available for the taking. By constructing an economy that demanded ever-increasing supplies of all resources, but particularly energy—specifically, sunlight stored in the form of timber, plants, and fossil fuels—humans successfully mimicked the processes of a newly formed ecosystem. Like pioneer plants, we were aggressive and competitive. We emphasized untrammelled growth and didn't worry about efficiency, conservation, or diversity. In technical terms, we set up a "linear" industrial ecology of low information quality.

Less than two centuries later, the environment for economic growth changed dramatically, for that vast array of natural resources is dwindling. We have watched economic indexes climb, as measured in gross national product, but we have not yet formulated a nationally accepted index of what that progress is costing on the environmental side. Despite the fact that environmental issues are now accepted internationally as the most pressing problem of our age, the institutions that embody and guide our economic progress have hardly responded at all.

To change this state of affairs, business will have to deal directly with the three issues of what it takes, what it makes, and what it wastes. This chapter deals with our methods of taking.

A business is similar to an organism insofar as it takes food and energy from the environment. However, creatures in their natural habitat consume only renewable resources: leaves, nuts, seeds, grass, water, berries, insects, fungi, bark, fish. Companies consume renewables, too, in addition to nonrenewable resources, including oil, coal, and natural gas. While use of renewables can theoretically be sustained perpetually, resources such as fuels and minerals are irreplaceable. And renewables, if over-consumed or depleted, can become nonrenewable. The ability to over-exploit the earth's stored-up supply of resources is what we call economic progress. One statistic makes clear the demand placed on the earth by our economic system: every day the worldwide economy burns an amount of energy the planet required 10,000 days to cre-

ate. Or, put another way, 27 years worth of stored solar energy is burned and released by utilities, cars, houses, factories, and farms every 24 hours.

Another measure of our wholesale plunder of the ecosystem is provided by estimating the net primary production (NPP) of the planet, defined as the sum of all photosynthetic production minus the energy required to maintain and support those plants. The annual figure arrived at is in the area of 225 billion metric tons of wood, grass, fiber, and food. Of this total, 60 percent is produced on land and 40 percent in the oceans. An oft-quoted study suggests that our human economy currently utilizes, consumes, converts, burns or clear cuts annually 40 percent of the total NPP on land. In short, one species—our own—out of 5 to 30 million species (no one is sure how many there are) is directly and indirectly claiming 40 percent of the earth's production for itself. This fact alone should give businesspeople pause when they think their taking of water, forests, land, or minerals has minimal impact. If, as predicted, our population doubles sometime in the next forty or fifty years, we will usurp 80 percent of the primary production of the planet, assuming no increase in the standard of living. If our standard of living doubles in the next forty years—the accepted projection—we will quadruple our impact, a physical impossibility.

In fact, we may have already reached the diminishing point. We are already seeing many dangerous signs of this usurpation of planetary production, foremost of which is the loss of other forms of life—extinctions. Before we reach 60 or 70 percent utilization of the NPP, we will witness an ecological crash. Hundreds of thousands of species will vanish, because they will not be able to compete with us for food. These newly depleted ecosystems will be reduced to soil substrates into which we will have to force increasing amounts of chemicals to grow decreasing amounts of food.

Every natural system in the world today is in decline. In the past twenty years, the world's forests have been reduced by 120 million hectares (296 million acres). In 1991 alone, 17 million hectares were cut or destroyed, the highest rate of reduction in the history of humankind. The burning associated with the clearing of tropical forests placed 52 trillion kilograms of CO<sub>2</sub> into the atmosphere last year, an amount that is equal to 40 percent of all industrial emissions. According to the United Nations Environment Programme, since

1945, we have been losing 108 million acres of productive agricultural land to degradation yearly, a total of 4.85 billion acres worldwide. Since 1950 world agriculture has tripled its use of irrigation, a practice that depletes groundwater and also decreases long-term fertility because of the excessive buildup of salts in the soil. Despite surpluses in industrial nations and isolated increases in the Third World, overall world production of food is declining in relation to world population. Grain production per person has peaked in every area of the world except for Asia, where it has slowed substantially. Much of the increase witnessed in grain production from 1950 until 1984 was the result of a ninefold increase in the use of fertilizer. But as every farmer knows, constant increases in fertilizer usage do not produce equal gains in production, for a point is reached where additional increments produce little or no benefit. Worldwide crop losses due to pollution are already estimated at between 5 and 10 percent and continue to rise.

There are many other examples—locally, regionally, and globally—where demand is exceeding supply, causing a deterioration of the living systems that provide our present standard of living. We are drawing down resources that took millions of years to create in order to supplement current consumption. This is the ecological perspective of the industrial age; we cannot hold onto it indefinitely, in fact, industrialism itself may not last for even one more human lifetime. At present, to compensate for the limitations placed on production by the carrying capacity of the environment, we are speeding up the rate at which we fish, farm, deforest, and extract. In other words, rather than facing the creative challenges posed by ecosystem limits, we are temporarily bypassing the problem by harvesting resources more rapidly, by driftnetting, mechanical deforestation, and factory farming. Science and common sense both dictate that such extravagance must eventually lead to disaster. It not only borrows from the future, thus threatening human societies in the long term, but it also puts intense pressure on other species in these ecological niches which depend on the same resources. As a consequence, habitats are destroyed, species become extinct, and in the process, the productive health of the environment is compromised and decreased.

Human populations are already being severely affected by damage to the environment due to depletion and degradation of resources. For decades, scientists and experts such as Robert Heilbroner, Paul

Ehrlich, and Jessica Tuchman Matthews have predicted that resource shortages would engender widespread social discord, but there were no studies to support or refute those views. Recently, however, a team of thirty researchers, assembled under the auspices of the University of Toronto and the American Academy of Arts and Sciences, formed the Project on Environmental Change and Acute Conflict. This group examined a number of societies and countries where resource shortages were already occurring, and their findings were disturbing: "Scarcities of renewable resources are already contributing to violent conflicts in many parts of the developing world. These conflicts may foreshadow a surge of similar violence in coming decades, particularly in poor countries where shortages of water, forests and, especially, fertile land, coupled with rapidly expanding populations, already cause great hardship." Land shortages in Bangladesh, for example, have led to mass migrations to India involving as many as 15 million people. These migrations have in turn led to fierce ethnic clashes. To those who discount such theories by arguing that resource conflicts have been an enduring element of human history, the authors warn: "We maintain ... that renewable-resource scarcities of the next 50 years will probably occur with a speed, complexity and magnitude unprecedented in history. Entire countries can now be deforested in a few decades, most of a region's topsoil can disappear in a generation, and acute ozone depletion may take place in as few as 20 years."

Because resource supplies are declining, we as a species are exceeding our "carrying capacity"—the uppermost limit on the number of species an ecosystem or habitat can sustain, given the supply and availability of nutrients. In island systems, where ruminants browse and graze, grass, leaves, and berries might be the chief limiting factor to carrying capacity. In the Sahel desert, brushwood used for cooking might be the limiting factor on the human population. The industrialized world has more extensive needs and wants, so a larger number of resources can become limiting factors. Not only food, but fuel, water, electricity, and cars—the "food" of our industrial civilization—can serve as limits to carrying capacity. What is most dismaying about our political and commercial unwillingness to examine such limits on a global level is that there is absolute agreement on what it means on a local level. Range management experts can properly assess grazing limits that maximize yield while preserving the health of a habitat. In

a pasture or range, one can temporarily increase herd size and output, but it is a short-lived phenomenon that eventually results in lower production and eroded soil, requiring a long period of recovery. Estimating carrying capacity of fisheries and other large, complex systems is difficult, and not always accurate, partially due to inexperience and lack of concerted effort. Transnational corporations, the World Bank, and politicians have not yet determinedly integrated the processes involved with the estimation of carrying capacity into the act of development. Exceeding carrying capacity does not prove that carrying capacity does not exist, but merely that we know how to evade it temporarily, further damaging the sustainable yield of a given habitat.

Natural and human history are full of examples in which animals or humans exceeded carrying capacity and went into steep declines, or extinction. A haunting and oft-cited case of such an overshoot took place on St. Matthew Island in the Bering Sea in 1944 when 29 reindeer were imported. Specialists had calculated that the island could support 13 to 18 reindeer per square mile, or a total population of between 1,600 and 2,300 animals. By 1957, the population was 1,350; but by 1963, with no natural controls or predators, the population had exploded to 6,000. The original calculations had been correct; this number vastly exceeded carrying capacity and was soon decimated by disease and starvation. Such a drastic overshoot, however, did *not* lead to restabilization at a lower level, with the "extra" reindeer dying off. Instead, the entire habitat was so damaged by the overshoot that the number of reindeer fell drastically below the original carrying capacity, and by 1966 there were only 42 reindeer alive on St. Matthew Island. The difference between ruminants and ourselves is that the resources used by the reindeer were grasses, trees, and shrubs and they eventually returned, whereas many of the resources we are exploiting will not.

Until recently, declines or wipe-outs of species were largely local or regional problems because carrying capacity was a local phenomenon. Today, industrial civilization has increased the reach of human beings, at least the wealthier peoples, far beyond their own lands to the entire world. Tropical forests in Brazil have been razed to grow soybeans which are fed to cows in Germany that produce surplus butter and cheese that is piling up in refrigerated warehouses. This artificial ecosystem has "increased" Germany's carrying capacity, but drastically *lowered* it for the one million displaced forest settlers

now disenfranchised and living in squalor in Rio de Janeiro and other urban centers.

Because the richer northern countries do not see or experience the impact they have on their poorer southern nations, we do not realize what a powerful and destructive impact our demand on carrying capacity is having. In the time it takes to read this page, one hundred people will have succumbed to pesticide poisoning: 48 per minute, 25 million every year. In some Third World countries, pesticides kill more people than do major diseases. Because we have globalized our capacity to draw from an expanded environment, our world appears to be more secure and stable. While, for example, food surpluses from one region can be shipped to drought-stricken areas, preventing starvation and disease, such succor can be maintained only if the *overall* impact by humans is less than the *overall* carrying capacity. This, in fact, is the opposite of what is occurring.

Defenders of the status quo sometimes cite the Book of Genesis, in which God grants dominion over the planet and over all the creatures to mankind. We can take what we want because it has been given by God who likewise endowed us with special gifts and genius. So when we "take" entire species, extinguishing them, business ideologues may ask, "So what?" They argue that a high percentage of all the species that have ever lived are extinct. The process of which human activity is part is the natural order, and thus, they argue, extinctions caused by human activity are part of that evolution.

This syllogism sounds logical enough, but the logic is wrong and disingenuous, because a key point is conveniently omitted: Excluding the five previous mass extinctions such as those that occurred in the Final Permian and Cretaceous periods, past extinctions opened new opportunities for greater speciation. These mass extinctions were caused by extraordinary, catastrophic events, such as a meteorite strike. Today, we are experiencing the first mass extinction in the 3.8 billion year history of life forms caused by another organism—*homo sapiens*. The general rate of species extinction today is 1,000 to 10,000 times greater than the "background" level of extinction that has existed for the past 65 million years of the Cenozoic Age. Human activity is part of the natural world, in the largest sense, but human activity ignores the means-and-ends, give-and-take factors that are inherent in any maturing ecosystem. The most radical example of such ignorance is a

nuclear explosion; less dramatic but also devastating is the clear-cutting of rain forests and the mismanagement of wetlands. Ecologically, the only difference among these three intrusions is how much we pay now or how much we pay later.

The ecologist who fights for the preservation of bowhead whales, Oregon silverspots, snail darters, Gooding's nodding onion, and periwinkles does so not just for their intrinsic value, but because he or she respects the fact that we remain largely ignorant of how the infinitely complex interconnections between different biotic communities affect the well-being of all species, including human beings. When species disappear, we can delude ourselves that human life exists independently of grackles and goatfishes, but that is only true to a limited extent. What concerns ecologists is that extinctions are a direct indication of ecosystem health, which bears directly on our own survival.

Biological diversity, in the end, is the source of all wealth, and with a developed and practiced knowledge of nature, it could be even more so. These "pilgrims of evolution," species that have embarked upon a 3.4 billion year journey, are still largely unknown, unexamined, and unnamed. Thus far, we have identified only 1.41 million life-forms, a figure that was once considered equivalent to 28 percent of the species on the planet. The estimate of 5 million kinds of organisms might have endured for many years were it not for the experiments of Terry Erwin of the National Museum of Natural History. In 1983, Erwin and his team of entomologists on a windless early morning fumigated a single tree in the Panamanian rain forest with a deadly insecticide. The gasses not only caused the insects to move out from their crevices and hiding places, but it killed them quickly enough so that they fell to the ground where 1 meter funnels over solutions of 70 percent alcohol were ready to collect them. Based on Erwin's count of 163 distinct beetles exclusive to this one species of tree, he calculated that the 50,000 distinct tree species in the rain forest may well contain over 8 million new species. Taking into consideration that beetles constitute about 40 percent of the population of insects, spiders and other types of arthropods, and that the number of species in the rain forest canopy is approximately twice the number found on the ground, Erwin calculated that there may be as many as 30 million different species of these groupings alone. Although it is highly extrapolated, it has led scientists to conclude that the closest estimate of the

range of possible species that exists on the earth is within a factor of ten, from 10 to 100 million species.

Because every species contains a vast amount of information about the world, how it evolved, how it continues to develop, and how we may find a harmonious place within it, the loss of a species is the loss of a biological library. A tropical forest does not resemble Levittown; it is thousands of times more complex than the Mall of America. Biota crawls, swims, swoops, and slithers; it buzzes, bores, and burrows; it rots and oozes through forest floors, and estuaries; it takes wing, and is submerged in rich black gumbo soils; it permeates, devours, and is fecund. But this life has no voice other than our own because extinction is silent and mute. The lost tamarins of Brazil's Atlantic clear-cut forests cannot speak to us through the tropical plywood paneling in a mobile home; cannot explain that our new habitat wiped out their own. They will not be heard from again. The poet and essayist Gary Snyder writes: "The ending of the lines of so many creatures with whom we have traveled this far is an occasion of profound sorrow and grief. Death can be accepted and to some degree transformed. But the loss of lineages and all their future young is not something to accept. It must be rigorously and intelligently resisted. Defend all of these plants, bugs, and animals equally? Little invertebrates that have never been seen in a zoo or a wildlife magazine? Species that are but a hair away from one another? It isn't just a case of unique lineages but the lives of overall ecosystems (a larger sort of almost-organism) that are at stake. Some archly argue that extinction has always been the fate of species and communities alike. Some quote a Buddhist teaching back at us: 'all is impermanent.' Indeed. All the more reason to move gently and cause less harm. Large highly adapted vertebrates, once lost, will never return in the forms we have known them. Hundreds of millions of years might elapse before the equivalent of a whale or an elephant is seen again, if ever. The scale of loss is beyond any measure the planet has ever known. 'Death is one thing, an end to birth is something else.'"

Despite the explosion of scientific knowledge in this century, we have no idea how many species exist on earth today. The biologist E. O. Wilson has suggested that we mount an effort to record the entire spectrum of biological diversity on the planet, a taxonomic undertaking that would allow us to fully develop and apply evolu-

tionary biology on a global scale. If 10 million species were classified, the effort would require 25,000 professional lifetimes and would create two-fifths of a mile of shelved books. Were we to recognize that our long-term interests rest in preserving biological diversity, such an inventory would be an investment of the highest order. Because we are losing 27,000 species a year, seventy-four per day, one every twenty minutes, due in no small part to the 500,000 trees that are cut every hour in tropical forests, a large-scale biological survey should take precedence for federal funding over underground nuclear testing and at a fraction of the cost. A project like this would offer us a means to understand what is happening with life on earth, as well as a way to measure our impact upon it.

Despite our exaggerated dependence on them, we use or currently derive benefit from only 1 percent of all the species known to us. As food crops, we use, one way or another, only 7,000 of the some 75,000 known edible plants. Besides edibles, thousands of insects, yeasts, bacteria, and fibers may have unknown potential for bettering our lives, providing natural oils, fuels, pollinators, medicines, restoration materials for degraded environments, and countless other useful products. But as matters stand now, we seek progress not by responsible interactions with biological diversity, but by its elimination.

At the present rate of extinction—estimates range from 20,000 to over 100,000 species every year—we may lose 20 percent of all the species on the planet within the next twenty to forty years, most of these in the tropical rain forests. In the United States, if present global warming projections are correct, we will face losses of 20 percent of our 20,000 plant species. It's also worth noting that many species, even though not yet at risk of completely disappearing, are being so severely depleted genetically that their ability to reproduce and adapt is increasingly impaired. The loss of evolutionary potential is being called the "death of birth." This is tantamount to marching backward through the Cenozoic Age, losing millions of years of evolutionary development in a matter of decades. We will face what naturalist Jack Turner calls the "final loss"—that point in the not-too-distant future when environmental degradation on the planet will no longer require our active participation.

An illustrative example of this principle is a pond when it begins to receive large run-offs of phosphate-containing detergents. Ordinarily

ily, as fish create waste and die, detritivores decompose the waste into inorganic products that feed the algae population and invertebrates, that become in turn food for the stable fish population. When phosphates drain into a pond, the influx causes the algae to bloom faster than it can be consumed by the slower-breeding fish. As the algae dies, the decomposition uses up much of the available oxygen, causing a die-off in the oxygen-deprived fish. The dead fish are more waste, creating more algae, since the fish are not consuming it. The increased levels of decomposition lower the oxygen levels even further and what was once a carefully constructed and balanced closed system collapses under the burden of rapid and accelerating growth. Today, we face similar prospects on a global level. Because of potential interactions and feedback loops within the global climate system, a global warming cycle, once begun, may well progress on its own, regardless of whether we continue to combust fossil fuels or not due to the release of methane gasses in the Arctic tundra.

Commentators sometimes draw the distinction between economists who take the "moral" position that human life is superior to natural life and environmentalists who take the opposite position. This is not a useful polarization. We can't turn our backs on the web of life that sustains us, and live in a biological vacuum engineered by technology. Even if God did grant us dominion over life, I do not believe she had in mind the kind of stewardship we are practicing today. In the Old Testament, Eliphaz the Temanite admonishes a caterwauling old man by the name of Job: "Have you listened in at God's keyhole and crept away with his plans?" Job did not have a convincing reply. Neither do we.

In the past thirty years—since the birth of the current environmental movement with the publication of Rachel Carson's *Silent Spring*—people who have tried to present the concept of ecological drawdown have been marginalized and depicted as a doom-oriented, splinter sect of radicals fixated on the "Chicken Little" syndrome. Good-willed scientists and observers have been depicted as hortatory and shrill. Business has viewed problems with the environment as largely remote and extraneous. Government regulations, well-intended but nevertheless complex and difficult, have been fought in the courts and resisted by industry every step of the way. Although this pattern is changing quickly and dramatically in some corporations, there is still a

yawning gulf between the kind of friendly "green" environmentalism that business wants to promote—one that justifies growth and expansionary use of resources—and the kind that actually deals with the core issues of carrying capacity, drawdown, biotic impoverishment, and extinction of species. Business, despite its newly found good intentions with respect to the environment, has hardly changed at all.

In the early days of environmental regulation, it was as if the corporate ship of state, having sailed magnificently to postwar ascendance, was suddenly having its electrical wiring nibbled by mice. Environmental lobbyists, pressure groups, competing scientific studies, and politicians became a nuisance; their evidence was specific on present problems but frustratingly vague regarding the future. Was industry supposed to turn its back on "growth" and "progress" because the eggshells of raptors were thinning, or because an obscure species of fish would be wiped out by a hydroelectric project? Why should it spare the few remaining native forests to save the spotted owl when jobs and prosperity were at stake? Business missed the point.

Industry responded by invoking its duty to protect shareholders, markets, and profits. Efforts to clean up were expenses that came straight off the bottom line. Regulations were attacked as regressive, reducing competitiveness. This contention is still given credence despite the fact that our two most successful competitors, Japan and Germany, both have less access to resources, pay more for them, and charge higher energy taxes to encourage conservation. These restrictions have produced economies which are significantly more efficient and less wasteful than our own, improving their competitiveness at our expense, although in other respects their impact on the world environment is as damaging as our own. We should not be surprised that *no* major piece of environmental legislation has ever been supported by corporate America.

Today, because business has refused to face and confront environmental issues, there are tens of thousands of environmental groups in the world trying to abate or at least ameliorate the destruction of the world by commerce. As important as their gains have been, this battle cannot be won, because commerce and industry are growing faster than nature. No amount of isolated actions will transform the system. We're still operating under commercial rules, placing the reputed needs of humankind above the health of the planet.

When business does acknowledge ecological issues, as it is increasingly forced to do, it proclaims unbounded optimism in the power of technology. When scientific data foretell resource depletion, toxic contamination, or detrimental impacts on human communities, these predictions are overridden by a religious belief in the ability of humankind to devise new technologies for offsetting the hazards of the old technologies. Common sense advises us to doubt this logic, which not only requires faith in technology, but—predictably—rationalizes the further unshackling of industrial capitalism to use more of the earth's resources to fuel future ingeniousness.

Technology has dramatically expanded the boundaries of various systems—crop yields from farm land, for example. However, increasing technology and exploitation in the hope of further overcoming such boundaries does not work, for the simple reason that every system has a final limit. Human society has already collided with this outer limit in the realm of fisheries, ozone depletion, and possibly the capacity of the atmosphere to absorb carbon dioxide without causing the greenhouse effect. As author Dennis Meadows explains it, "Economists assume the future will be much like the past. Since markets and technology have avoided catastrophe in the past, we can count on them to do the same in the future. Ecologists believe they see unique problems in the future, which will demand solutions outside the capacity of our present market mechanisms. Economists tend to see evolution as a series of continuous reversals: problems leading to solutions, new problems leading to new solutions. Ecologists are worried about irreversibilities. When species are lost, no change in price or technology will bring them back."

The global economy has already exceeded carrying capacity—that point beyond which further growth will decay and effectively destroy its host. If our planet—its land and sky and oceans—were growing 2 percent a year, we could posit sustainable economic growth of a similar rate. But the earth is stable. It does not grow. The input of the sun likewise remains constant, while much of the wealth derived from that input, stored over tens of millions of years in fossil fuels, has already been consumed in less than two centuries. No technology in the world can alter this equation.

If capitalism has one pervasive untruth, it is the delusion that business is an open, linear system: that through resource extraction and

technology, growth is always possible, given sufficient capital and will. In other words, there are no inherent limits to further expansion, and those who wish to impose them have a political agenda. This cornucopian paradigm asserts that the limits before us are irrelevant, that finiteness is a Malthusian misconception, and that economic growth can be extended indefinitely into the future. Such a position would be analogous to the reindeer on St. Matthew Island having a leader who proclaimed, when the population hit 4,600, "We've proved the ecologists and doomsayers wrong: We've doubled the estimates given by the limits to growth crowd and are continuing to grow."

This counter myth of "no limits" is so powerful that it appears ironically to be gaining ground, in a reflexive, psychological reaction of denial, even as knowledge of the carrying capacity of the earth becomes more evident. Ever-expanding abundance is not a theory based on science, or history, or nature. It is based solely on self-interest. Whether willfully ignorant or unabashedly hypocritical, at some point we must ask business to look candidly at the real world and see the skull-and-crossbones posted alongside ecological pathways, so that we can begin to create real solutions instead of illusory techniques of evasion.

Business often invokes the Darwinian maxim of "survival of the fittest" to defend its competitive actions. The phrase is, in fact, a misinterpretation of Darwinism. Darwin did not speak of survival of the fittest; rather, he described those who survived as *fittest for a specific ecological niche*. There is a big difference between those two ideas.

But this is the way of industrialism—"the survival of the fittest" as it has been incorrectly interpreted. The "winners" are the companies that consistently overstep and exceed carrying capacity. Corporate capitalism recognizes no limit; has no habitat. General Electric initially produced light bulbs. It now also sells bonds, makes jet engines, and produces the "Today" show. DuPont made its fortune selling gunpowder and is now producing biogenetically engineered crops that are resistant to its own brand of chemical herbicides. Corporations have been more intent on reorganizing the world to make it more habitable for themselves, rather than the other way around.

The idea that the economy must respect limits and that everything is not for the taking is not reflected in the competitive world of business because our economic institutions measure success only by scale

and garner capital through growth. "Moral outrage should result from the dawning realization that we are destroying the capacity of the Earth to support life and counting it as progress, or at best as the inevitable cost of progress," writes Herman Daly, economist at the World Bank. "'Progress' evidently means converting as much as possible of Creation into ourselves and our furniture. 'Ourselves' means, concretely, the unjust combination of overpopulated slums and over-consuming suburbs. Since we do not have the courage to face up to sharing and population control as the solution to injustice, we pretend that further growth will make the poor better off instead of simply making the rich richer. The wholesale extinctions of other species, and some primitive cultures within our own species, are not reckoned as costs. The intrinsic value of other species, their own capacity to enjoy life, is not admitted at all in economics, and their instrumental value as providers of ecological life-support services to humans is only dimly perceived. Costs and benefits to future humans are routinely discounted at 10 percent, meaning that each dollar of cost or benefit 50 years in the future is valued at less than a penny today."

Businesses do not need to recognize sustainability in order to succeed. They don't have to take into account that their present demands on resources are tantamount to stealing from the future, or that selling today's wants is at the expense of tomorrow's needs. Nor does business have to acknowledge the devastating legacy of toxins and waste it is passing off to future generations. In fact, businesses are usually "better off" ignorant of these facts and principles if they intend to prosper in the present economic system. Conversely, setting out to redesign or start up a business so that it does maintain a holistic relationship between economy and ecology, the ethical entrepreneur is handicapped financially since he bears the costs of the additional responsibilities he's assumed and which his competitors have shunned. Thus, the commercial acts that would lead us away from runaway economic devastation, although sound in the principles of nature, are unsound by the standards of the economy.

In our pursuit of growth at any cost, we have mimicked an immature ecosystem with unlimited resources. A mature economic system would appreciate an ancient forest or undisturbed grassland as the ideal for qualitative growth—fecund, abundant, and dynamic, mature but

highly evolved. Developers and business interests who can always earn headlines by expressing outrage that a species of freshwater clam might stop the construction of another dam must now address the essential question implied whenever a species disappears: How are we going to stop the loss of our genetic heritage? Every threatened species potentially plays the role of the canary in the coal mine, signaling not merely its own demise, but possibly our own.

Business must change its perspective and its propaganda, which has successfully portrayed the idea of "limits" as a pejorative concept. Limits and prosperity are intimately linked. Respecting limits means respecting the fact that the world and its minutiae are diverse beyond our comprehension and highly organized for their own ends, and that all facets connect in ways which are sometimes obvious, and at other times mysterious and complex. If our economy is "limited" by inclusion as part of the greater closed system of nature, those limits are no more necessarily constricting to a sound economy than a blank canvas was to Cézanne or a flute to Jean-Pierre Rampal. The natural world of sunlight, rainfall, and photosynthesis, of topsoil and coral reefs, of raptor birds and tropical fishes, of stamens and pistils and genes is a limit which can be circumvented only at the cost of the world itself. It is precisely in the discipline imposed by the limitations of nature that we discover and imagine our lives. It is only in the fullest context of the world as it is presented to us, and not as we manipulate it, that we may celebrate our humanity and create true prosperity. Such perspectives can lead us to a very different type of economy and way of doing business, one that will be healthier for all species, not only the butterfly and the owl, but our own.