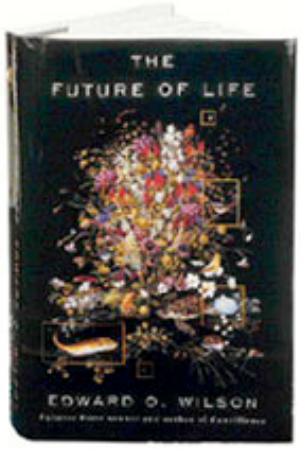
February 24, 2002

The Bottleneck

We have entered the Century of the Environment, in which the immediate future is usefully conceived as a bottleneck: science and technology, combined with foresight and moral courage, must see us through it and out

By Edward O. Wilson



From the book *The Future of Life*,by Edward O. Wilson.

Published by arrangement with Alfred A. Knopf, a division of Random House, Inc., and with Little, Brown in the U.K.,which will publish the book there in April 2002 (£17.99).

The 20th century was a time of exponential scientific and technical advance, the freeing of the arts by an exuberant modernism, and the spread of democracy and human rights throughout the world. It was also a dark and savage age of world wars, genocide, and totalitarian ideologies that came dangerously close to global domination. While preoccupied with all this tumult, humanity managed collaterally to decimate the natural environment and draw down the nonrenewable resources of the planet with cheerful abandon. We thereby accelerated the erasure of entire ecosystems and the extinction of thousands of million-year-old species. If Earth's ability to support our growth is finite--and it is--we were mostly too busy to notice.

As a new century begins, we have begun to awaken from this delirium. Now, increasingly postideological in temper, we may be ready to settle down before we wreck the planet. It is time to sort out Earth and calculate what it will take to provide a satisfying and sustainable life for everyone into the indefinite future. The question of the century is: How best can we shift to a culture of permanence, both for ourselves and for the biosphere that sustains us?

The bottom line is different from that generally assumed by our leading economists and public philosophers. They have mostly ignored the numbers that count. Consider that with the global population past six billion and on its way to eight billion or more by midcentury, per capita freshwater and arable land are descending to levels resource experts agree are risky. The ecological footprint--the average amount of productive land and shallow sea appropriated by each person in bits and pieces from around the world for food, water, housing, energy, transportation, commerce, and waste absorption--is about one hectare (2.5 acres) in developing nations but about 9.6 hectares (24 acres) in the U.S. The footprint for the total human population is 2.1 hectares (5.2 acres). For every person in the world to reach present U.S. levels of consumption with existing technology would require four more planet Earths. The five billion people of the developing countries may never wish to attain this level of profligacy. But in trying to achieve at least a decent standard of living, they have joined the industrial world in erasing the last of the natural environments. At the same time, Homo sapiens has become a geophysical force, the first species in the history of the planet to attain that dubious distinction. We have driven atmospheric carbon dioxide to the highest levels in at least 200,000 years, unbalanced the nitrogen cycle, and contributed to a global warming that will ultimately be bad news everywhere.

For every person in the world to reach present U.S. levels of consumption with existing technology would require four more planet Earths.

In short, we have entered the Century of the Environment, in which the immediate future is usefully conceived as a bottleneck. Science and technology, combined with a lack of self-understanding and a Paleolithic obstinacy, brought us to where we are today. Now science and technology, combined with foresight and moral courage, must see us through the bottleneck and out.

"Wait! Hold on there just one minute!"

That is the voice of the cornucopian economist. Let us listen to him carefully. He is focused on production and consumption. These are what the world wants and needs, he says. He is right, of course. Every species lives on production and consumption. The tree finds and consumes nutrients and sunlight; the leopard finds and consumes the deer. And the farmer clears both away to find space and raise corn--for consumption. The economist's thinking is based on precise models of rational choice and near-horizon timelines. His parameters are the gross domestic product, trade balance, and competitive index. He sits on corporate boards, travels to Washington, occasionally appears on television talk shows. The planet, he insists, is perpetually fruitful and still underutilized.

The ecologist has a different worldview. He is focused on unsustainable crop yields, overdrawn aquifers, and threatened ecosystems. His voice is also heard, albeit faintly, in high government and corporate circles. He sits on nonprofit foundation boards, writes for *Scientific American*, and is sometimes called to Washington. The planet, he insists, is exhausted and in trouble.

The Economist

"EASE UP. In spite of two centuries of doomsaying, humanity is enjoying unprecedented prosperity. There are environmental problems, certainly, but they can be solved. Think of them as the detritus of progress, to be cleared away. The global economic picture is favorable. The gross national products of the industrial countries continue to rise. Despite their recessions, the Asian tigers are catching up with North America and Europe. Around the world, manufacture and the service economy are growing geometrically. Since 1950 per capita income and meat production have risen continuously. Even though the world population has increased at an explosive 1.8 percent each year during the same period, cereal production, the source of more than half the food calories of the poorer nations and the traditional proxy of worldwide crop yield, has more than kept pace, rising from 275 kilograms per head in the early 1950s to 370 kilograms by the 1980s. The forests of the developed countries are now regenerating as fast as they are being cleared, or nearly so. And while fibers are also declining steeply in most of the rest of the world--a serious problem, I grant--no global scarcities are expected in the foreseeable future. Agriforestry has been summoned to the rescue: more than 20 percent of industrial wood fiber now comes from tree plantations.

"Social progress is running parallel to economic growth. Literacy rates are climbing, and with them the liberation and empowerment of women. Democracy, the gold standard of governance, is spreading country by country. The communication revolution powered by the computer and the Internet has accelerated the globalization of trade and the evolution of a more irenic international culture.

"For two centuries the specter of Malthus troubled the dreams of futurists. By rising exponentially, the doomsayers claimed, population must outstrip the limited resources of the world and bring about famine, chaos, and war. On occasion this scenario did unfold locally. But that has been more the result of political mismanagement than Malthusian mathematics. Human ingenuity has always found a way to accommodate rising populations and allow most to prosper.

"Genius and effort have transformed the environment to the benefit of human life. We have turned a wild and inhospitable world into a garden. Human dominance is Earth's destiny. The harmful perturbations we have caused can be moderated and reversed as we go along."

The Environmentalist

"YES, IT'S TRUE that the human condition has improved dramatically in many ways. But you've painted only half the picture, and with all due respect the logic it uses is just plain dangerous. As your worldview implies, humanity has learned how to create an economy-driven paradise. Yes again--but only on an infinitely large and malleable planet. It should be obvious to you that Earth is finite and its environment increasingly brittle. No one should look to gross national products and corporate annual reports for a competent projection of the world's long-term economic future. To the information there, if we are to understand the real world, must be added the research reports of natural-resource specialists and ecological economists. They are the experts who seek an accurate balance sheet, one that includes a full accounting of the costs to the planet incurred by economic growth.

"This new breed of analysts argues that we can no longer afford to ignore the dependency of the economy and social progress on the environmental resource base. It is the content of economic growth, with natural resources factored in, that counts in the long term, not just the yield in products and currency. A country that levels its forests, drains its aquifers, and washes its topsoil downriver without measuring the cost is a country traveling blind.

"Suppose that the conventionally measured global economic output, now at about $31 trillion, were to expand at a healthy 3 percent annually. By 2050 it would in theory reach $138 trillion. With only a small leveling adjustment of this income, the entire world population would be prosperous by current standards. Utopia at last, it would seem! What is the flaw in the argument? It is the environment crumbling beneath us. If natural resources, particularly freshwater and arable land, continue to diminish at their present per capita rate, the economic boom will lose steam, in the course of which--and this worries me even if it doesn't worry you--the effort to enlarge productive land will wipe out a large part of the world's fauna and flora.

The pattern of human population growth in the 20th century was more bacterial than primate.

"The appropriation of productive land--the ecological footprint--is already too large for the planet to sustain, and it's growing larger. A recent study building on this concept estimated that the human population exceeded Earth's sustainable capacity around the year 1978. By 2000 it had overshot by 1.4 times that capacity. If 12 percent of land were now to be set aside in order to protect the natural environment, as recommended in the 1987 Brundtland Report, Earth's sustainable capacity will have been exceeded still earlier, around 1972. In short, Earth has lost its ability to regenerate--unless global consumption is reduced or global production is increased, or both."

By dramatizing these two polar views of the economic future, I don't wish to imply the existence of two cultures with distinct ethos. All who care about both the economy and environment, and that includes the vast majority, are members of the same culture. The gaze of our two debaters is fixed on different points in the space-time scale in which we all dwell. They differ in the factors they take into account in forecasting the state of the world, how far they look into the future, and how much they care about nonhuman life. Most economists today, and all but the most politically conservative of their public interpreters, recognize very well that the world has limits and that the human population cannot afford to grow much larger. They know that humanity is destroying biodiversity. They just don't like to spend a lot of time thinking about it.

The environmentalist view is fortunately spreading. Perhaps the time has come to cease calling it the "environmentalist" view, as though it were a lobbying effort outside the mainstream of human activity, and to start calling it the real-world view. In a realistically reported and managed economy, balanced accounting will be routine. The conventional gross national product (GNP) will be replaced by the more comprehensive genuine progress indicator (GPI), which includes estimates of environmental costs of economic activity. Already a growing number of economists, scientists, political leaders, and others have endorsed precisely this change.

What, then, are essential facts about population and environment? From existing databases we can answer that question and visualize more clearly the bottleneck through which humanity and the rest of life are now passing.

On or about October 12, 1999, the world population reached six billion. It has continued to climb at an annual rate of 1.4 percent, adding 200,000 people each day or the equivalent of the population of a large city each week. The rate, though beginning to slow, is still basically exponential: the more people, the faster the growth, thence still more people sooner and an even faster growth, and so on upward toward astronomical numbers unless the trend is reversed and growth rate is reduced to zero or less. This exponentiation means that people born in 1950 were the first to see the human population double in their lifetime, from 2.5 billion to over six billion now. During the 20th century more people were added to the world than in all of previous human history. In 1800 there had been about one billion and in 1900, still only 1.6 billion.

The pattern of human population growth in the 20th century was more bacterial than primate. When Homo sapiens passed the six-billion mark we had already exceeded by perhaps as much as 100 times the biomass of any large animal species that ever existed on the land. We and the rest of life cannot afford another 100 years like that.

By the end of the century some relief was in sight. In most parts of the world--North and South America, Europe, Australia, and most of Asia--people had begun gingerly to tap the brake pedal. The worldwide average number of children per woman fell from 4.3 in 1960 to 2.6 in 2000. The number required to attain zero population growth--that is, the number that balances the birth and death rates and holds the standing population size constant--is 2.1 (the extra one tenth compensates for infant and child mortality). When the number of children per woman stays above 2.1 even slightly, the population still expands exponentially. This means that although the population climbs less and less steeply as the number approaches 2.1, humanity will still, in theory, eventually come to weigh as much as Earth and, if given enough time, will exceed the mass of the visible universe. This fantasy is a mathematician's way of saying that anything above zero population growth cannot be sustained. If, on the other hand, the average number of children drops below 2.1, the population enters negative exponential growth and starts to decline. To speak of 2.1 in exact terms as the breakpoint is of course an oversimplification. Advances in medicine and public health can lower the breakpoint toward the minimal, perfect number of 2.0 (no infant or childhood deaths), while famine, epidemics, and war, by boosting mortality, can raise it well above 2.1. But worldwide, over an extended period of time, local differences and statistical fluctuations wash one another out and the iron demographic laws grind on. They transmit to us always the same essential message, that to breed in excess is to overload the planet.

By 2000 the replacement rate in all of the countries of western Europe had dropped below 2.1. The lead was taken by Italy, at 1.2 children per woman (so much for the power of natalist religious doctrine). Thailand also passed the magic number, as well as the nonimmigrant population of the U.S.

When a country descends to its zero-population birth rates or even well below, it does not cease absolute population growth immediately, because the positive growth experienced just before the breakpoint has generated a disproportionate number of young people with most of their fertile years and life ahead of them. As this cohort ages, the proportion of child-bearing people diminishes, the age distribution stabilizes at the zero-

population level, the slack is taken up, and population growth ceases. Similarly, when a country dips below the breakpoint, a lag period intervenes before the absolute growth rate goes negative and the population actually declines. Italy and Germany, for example, have entered a period of such true, absolute negative population growth.

The decline in global population growth is attributable to three interlocking social forces: the globalization of an economy driven by science and technology, the consequent implosion of rural populations into cities, and, as a result of globalization and urban implosion, the empowerment of women. The freeing of women socially and economically results in fewer children. Reduced reproduction by female choice can be thought a fortunate, indeed almost miraculous, gift of human nature to future generations. It could have gone the other way: women, more prosperous and less shackled, could have chosen the satisfactions of a larger brood. They did the opposite. They opted for a smaller number of quality children, who can be raised with better health and education, over a larger family. They simultaneously chose better, more secure lives for themselves. The tendency appears to be very widespread, if not universal. Its importance cannot be overstated. Social commentators often remark that humanity is endangered by its own instincts, such as tribalism, aggression, and personal greed. Demographers of the future will, I believe, point out that on the other hand humanity was saved by this one quirk in the maternal instinct.

The global trend toward smaller families, if it continues, will eventually halt population growth and afterward reverse it. What will be the peak, and when will it occur? And how will the environment fare as humanity climbs to the peak? The Population Division of the United Nations Department of Economic and Social Affairs released a spread of projections to the year 2050 that ranged from 7.3 billion to 14.4 billion, with the most likely scenario falling somewhere between nine billion and 10 billion.

Enough slack still exists in the system to justify guarded optimism. Women given a choice and affordable contraceptive methods generally practice birth control. By 1996 about 130 countries subsidized family-planning services. More than half of all developing countries in particular also had official population policies to accompany their economic and military policies, and more than 90 percent of the rest stated their intention to follow suit. The U.S., where the idea is still virtually taboo, remained a stunning exception.

The encouragement of population control by developing countries comes not a moment too soon. The environmental fate of the world lies ultimately in their hands. They now account for virtually all global population growth, and their drive toward higher per capita consumption will be relentless.

The consequences of their reproductive prowess are multiple and deep. The people of the developing countries are already far younger than those in the industrial countries and destined to become more so. The streets of Lagos, Manaus, Karachi, and other cities in the developing world are a sea of children. To an observer fresh from Europe or North America, the crowds give the feel of a gigantic school just let out. In at least 68 of the countries, more than 40 percent of the population is under 15 years of age.

A country poor to start with and composed largely of young children and adolescents is strained to provide even minimal health services and education for its people. Its superabundance of cheap, unskilled labor can be turned to some economic advantage but unfortunately also provides cannon fodder for ethnic strife and war. As the populations continue to explode and water and arable land grow scarcer, the industrial countries will feel their pressure in the form of many more desperate immigrants and the risk of spreading international terrorism. I have come to understand the advice given me many years ago when I argued the case for the natural environment to the president's scientific adviser: your patron is foreign policy.

Stretched to the limit of its capacity, how many people can the planet support? A rough answer is possible, but it is a sliding one contingent on three conditions: how far into the future the planetary support is expected to last, how evenly the resources are to be distributed, and the quality of life most of humanity expects to achieve.

Consider food, which economists commonly use as a proxy of carrying capacity. The current world production of grains, which provide most of humanity's calories, is about two billion tons annually. That is enough, in theory, to feed 10 billion East Indians, who eat primarily grains and very little meat by Western standards. But the same amount can support only about 2.5 billion Americans, who convert a large part of their grains into livestock and poultry. There are two ways to stop short of the wall. Either the industrialized populations move down the food chain to a more vegetarian diet, or the agricultural yield of productive land worldwide is increased by more than 50 percent.

The constraints of the biosphere are fixed. The bottleneck through which we are passing is real. It should be obvious to anyone not in a euphoric delirium that whatever humanity does or does not do, Earth's capacity to support our species is approaching the limit. We already appropriate by some means or other 40 percent of the planet's organic matter produced by green plants. If everyone agreed to become vegetarian, leaving little or nothing for livestock, the present 1.4 billion hectares of arable land (3.5 billion acres) would support about 10 billion people. If humans utilized as food all of the energy captured by plant photosynthesis on land and sea, some 40 trillion watts, the planet could support about 16 billion people. But long before that ultimate limit was approached, the planet would surely have become a hellish place to exist. There may, of course, be escape hatches. Petroleum reserves might be converted into food, until they are exhausted. Fusion energy could conceivably be used to create light, whose energy would power photosynthesis, ramp up plant growth beyond that dependent on solar energy, and hence create more food. Humanity might even consider becoming someday what the astrobiologists call a type II civilization and harness all the power of the sun to support human life on Earth and on colonies on and around the other solar planets. Surely these are not frontiers we will wish to explore in order simply to continue our reproductive folly.

The human brain evidently evolved to commit itself emotionally only to a small piece of geography.

The epicenter of environmental change, the paradigm of population stress, is the People's Republic of China. By 2000 its population was 1.2 billion, one fifth of the world total. It is thought likely by demographers to creep up to 1.6 billion by 2030. During 1950-2000 China's people grew by 700 million, more than existed in the entire world at the start of the industrial revolution. The great bulk of this increase is crammed into the basins of the Yangtze and Yellow rivers, covering an area about equal to that of the eastern U.S. Hemmed in to the west by deserts and mountains, limited to the south by resistance from other civilizations, their agricultural populations simply grew denser on the land their ancestors had farmed for millennia. China became in effect a great overcrowded island, a Jamaica or Haiti writ large.

Highly intelligent and innovative, its people have made the most of it. Today China and the U.S. are the two leading grain producers of the world. But China's huge population is on the verge of consuming more than it can produce. In 1997 a team of scientists, reporting to the U.S. National Intelligence Council (NIC), predicted that China will need to import 175 million tons of grain annually by 2025. Extrapolated to 2030, the annual level is 200 million tons--the entire amount of grain exported annually in the world at the present time. A tick in the parameters of the model could move these figures up or down, but optimism would be a dangerous attitude in planning strategy when the stakes are so high. After 1997 the Chinese in fact instituted a province-level crash program to boost grain level to export capacity. The effort was successful but may be short-lived, a fact the government itself recognizes. It requires cultivation of marginal land, higher per acre environmental damage, and a more rapid depletion of the country's precious groundwater.

According to the NIC report, any slack in China's production may be picked up by the Big Five grain exporters: the U.S., Canada, Argentina, Australia, and the European Union. But the exports of these dominant producers, after climbing steeply in the 1960s and 1970s, tapered off to near their present level in 1980. With existing agricultural capacity and technology, this output does not seem likely to increase to any significant degree. The U.S. and the European Union have already returned to production all of the cropland idled under earlier farm commodity programs. Australia and Canada, largely dependent on dryland farming, are constrained by low rainfall. Argentina has the potential to expand, but due to its small size, the surplus it produces is unlikely to exceed 10 million tons of grain production per year.

China relies heavily on irrigation, with water drawn from its aquifers and great rivers. The greatest impediment is

again geographic: two thirds of China's agriculture is in the north, but four fifths of the water supply is in the south--that is, principally in the Yangtze River Basin. Irrigation and withdrawals for domestic and industrial use have depleted the northern basins, from which flow the waters of the Yellow, Hai, Huai, and Liao rivers. Starting in 1972, the Yellow River Channel has gone bone dry almost yearly through part of its course in Shandong Province, as far inland as the capital, Jinan, thence down all the way to the sea. In 1997 the river stopped flowing for 130 days, then restarted and stopped again through the year for a record total of 226 dry days. Because Shandong Province normally produces a fifth of China's wheat and a seventh of its corn, the failure of the Yellow River is of no little consequence. The crop losses in 1997 alone reached $1.7 billion.

Meanwhile the groundwater of the northern plains has dropped precipitously, reaching an average rate of 1.5 meters (five feet) per year by the mid-1990s. Between 1965 and 1995 the water table fell 37 meters (121 feet) beneath Beijing itself.

Faced with chronic water shortages in the Yellow River Basin, the Chinese government has undertaken the building of the Xiaolangdi Dam, which will be exceeded in size only by the Three Gorges Dam on the Yangtze River. The Xiaolangdi is expected to solve the problems of both periodic flooding and drought. Plans are being laid in addition for the construction of canals to siphon water from the Yangtze, which never grows dry, to the Yellow River and Beijing, respectively.

These measures may or may not suffice to maintain Chinese agriculture and economic growth. But they are complicated by formidable side effects. Foremost is silting from the upriver loess plains, which makes the Yellow River the most turbid in the world and threatens to fill the Xiaolangdi Reservoir, according to one study, as soon as 30 years after its completion.

China has maneuvered itself into a position that forces it continually to design and redesign its lowland territories as one gigantic hydraulic system. But this is not the fundamental problem. The fundamental problem is that China has too many people. In addition, its people are admirably industrious and fiercely upwardly mobile. As a result, their water requirements, already oppressively high, are rising steeply. By 2030 residential demands alone are projected to increase more than fourfold, to 134 billion tons, and industrial demands fivefold, to 269 billion tons. The effects will be direct and powerful. Of China's 617 cities, 300 already face water shortages.

The pressure on agriculture is intensified in China by a dilemma shared in varying degrees by every country. As industrialization proceeds, per capita income rises, and the populace consumes more food. They also migrate up the energy pyramid to meat and dairy products. Because fewer calories per kilogram of grain are obtained when first passed through poultry and livestock instead of being eaten directly, per capita grain consumption rises still more. All the while the available water supply remains static or nearly so. In an open market, the agricultural use of water is outcompeted by industrial use. A thousand tons of freshwater yields a ton of wheat, worth $200, but the same amount of water in industry yields $14,000. As China, already short on water and arable land, grows more prosperous through industrialization and trade, water becomes more expensive. The cost of agriculture rises correspondingly, and unless the collection of water is subsidized, the price of food also rises. This is in part the rationale for the great dams at Three Gorges and Xiaolangdi, built at enormous public expense.

In theory, an affluent industrialized country does not have to be agriculturally independent. In theory, China can make up its grain shortage by purchasing from the Big Five grain-surplus nations. Unfortunately, its population is too large and the world surplus too restrictive for it to solve its problem without altering the world market. All by itself, China seems destined to drive up the price of grain and make it harder for the poorer developing countries to meet their own needs. At the present time, grain prices are falling, but this seems certain to change as the world population soars to nine billion or beyond.

The problem, resource experts agree, cannot be solved entirely by hydrological engineering. It must include shifts from grain to fruit and vegetables, which are more labor-intensive, giving China a competitive edge. To this can be added strict water conservation measures in industrial and domestic use; the use of sprinkler and drip irrigation in cultivation, as opposed to the traditional and more wasteful methods of flood and furrow irrigation; and private land ownership, with subsidies and price liberalization, to increase conservation incentives for farmers.

Meanwhile the surtax levied on the environ-ment to support China's growth, though rarely entered on the national balance sheets, is escalating to a ruin-ous level. Among the most telling indicators is the pollution of water. Here is a measure worth pondering. China has in all 50,000 kilometers of major rivers. Of these, according to the U.N. Food and Agriculture Organization, 80 percent no longer support fish. The Yellow River is dead along much of its course, so fouled with chromium, cadmium, and other toxins from oil refineries, paper mills, and chemical plants as to be unfit for either human consumption or irrigation. Diseases from bacterial and toxic-waste pollution are epidemic.

We are innately inclined to ignore any distant possibility not yet requiring examination. It is a hardwired part of our Paleolithic heritage.

China can probably feed itself to at least midcentury, but its own data show that it will be skirting the edge of disaster even as it accelerates its lifesaving shift to industrialization and megahydrological engineering. The extremity of China's condition makes it vulnerable to the wild cards of history. A war, internal political turmoil, extended droughts, or crop disease can kick the economy into a downspin. Its enormous population makes rescue by other countries impracticable.

China deserves close attention, not just as the unsteady giant whose missteps can rock the world, but also because it is so far advanced along the path to which the rest of humanity seems inexorably headed. If China solves its problems, the lessons learned can be applied elsewhere. That includes the U.S., whose citizens are working at a furious pace to overpopulate and exhaust their own land and water from sea to shining sea.

Environmentalism is still widely viewed, especially in the U.S., as a special-interest lobby. Its proponents, in this blinkered view, flutter their hands over pollution and threatened species, exaggerate their case, and press for industrial restraint and the protection of wild places, even at the cost of economic development and jobs.

Environmentalism is something more central and vastly more important. Its essence has been defined by science in the following way. Earth, unlike the other solar planets, is not in physical equilibrium. It depends on its living shell to create the special conditions on which life is sustainable. The soil, water, and atmosphere of its surface have evolved over hundreds of millions of years to their present condition by the activity of the biosphere, a stupendously complex layer of living creatures whose activities are locked together in precise but tenuous global cycles of energy and transformed organic matter. The biosphere creates our special world anew every day, every minute, and holds it in a unique, shimmering physical disequilibrium. On that disequilibrium the human species is in total thrall. When we alter the biosphere in any direction, we move the environment away from the delicate dance of biology. When we destroy ecosystems and extinguish species, we degrade the greatest heritage this planet has to offer and thereby threaten our own existence.

Humanity did not descend as angelic beings into this world. Nor are we aliens who colonized Earth. We evolved here, one among many species, across millions of years, and exist as one organic miracle linked to others. The natural environment we treat with such unnecessary ignorance and recklessness was our cradle and nursery, our school, and remains our one and only home. To its special conditions we are intimately adapted in every one of the bodily fibers and biochemical transactions that gives us life.

That is the essence of environmentalism. It is the guiding principle of those devoted to the health of the planet. But it is not yet a general worldview, evidently not yet compelling enough to distract many people away from the primal diversions of sport, politics, religion, and private wealth.

The relative indifference to the environment springs, I believe, from deep within human nature. The human brain evidently evolved to commit itself emotionally only to a small piece of geography, a limited band of kinsmen, and two or three generations into the future. To look neither far ahead nor far afield is elemental in a Darwinian sense. We are innately inclined to ignore any distant possibility not yet requiring examination. It is, people say, just good common sense. Why do they think in this shortsighted way? The reason is simple: it is a hardwired

part of our Paleolithic heritage. For hundreds of millennia, those who worked for short-term gain within a small circle of relatives and friends lived longer and left more offspring--even when their collective striving caused their chiefdoms and empires to crumble around them. The long view that might have saved their distant descendants required a vision and extended altruism instinctively difficult to marshal.

The great dilemma of environmental reasoning stems from this conflict between short-term and long-term values. To select values for the near future of one's own tribe or country is relatively easy. To select values for the distant future of the whole planet also is relatively easy--in theory, at least. To combine the two visions to create a universal environmental ethic is, on the other hand, very difficult. But combine them we must, because a universal environmental ethic is the only guide by which humanity and the rest of life can be safely conducted through the bottleneck into which our species has foolishly blundered.