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*Population Growth and Environmental Security**

in memory of Senator John Heinz III,
our friend and a friend of the environment

IT is now almost thirty years since the publication of Rachel Carson's *Silent Spring* launched the modern environmental movement in the United States. During that time a great deal of progress has been made. The environment now has a secure place on the public agenda, and care for it has been institutionalized in laws and government agencies. This might lead one to believe that the environment is being dealt with—that it might, like civil rights or drug abuse, continue to be a concern, but no more so than many others. Such is the "environmentalists as just one more pressure group" viewpoint.

This attitude, in our opinion, is dangerously wrong for two reasons. First, while progress has been made in dealing with environmental problems, these efforts have been totally inadequate. The most serious of the problems—including global warming, the destruction of biodiversity, ozone depletion, and acid deposition—were not even recognized when *Silent Spring* hit the bookshelves. All together these worldwide threats constitute major elements of an assault on global life-support systems that is fast growing more lethal. That assault represents an escalating threat to the security of all nations—one that is probably even more serious today than the threat of large-scale thermonuclear war, for the probability

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of environmental catastrophe is rising rapidly while that of conflict between the United States and the Soviet Union appears to be declining.

Second, the underlying causes of our environmental plight and the complex web of connections between those causes and the increasing insecurity of every human being are rarely recognized. Overpopulation, overconsumption of resources, and the deployment of technologies that are unnecessarily damaging to the environment are the basic disease of which various sorts of environmental deterioration and conflicts over resources are major symptoms. All developed nations share the primary responsibility, but the United States—with its huge population (now more than a quarter-billion people), unprecedented affluence, and reckless use of environmentally malign technologies—is the world's most overpopulated nation in terms of its impact on Earth's fragile environment and limited resources.

Some of the connections between overpopulation, overconsumption, environmental deterioration, and national security were illustrated by recent events in the Persian Gulf. In January of 1991 the United States, in an alliance with several other countries under the banner of the United Nations, launched an attack on Iraq, which had illegally occupied and pillaged the small, oil-rich nation of Kuwait. America's interest in the affair was clear and boiled down to a three-letter word: oil. The war, undertaken in part to protect the access of the United States and other nations to Gulf oil and in part to keep Saddam Hussein from further enhancing his military power, might never have occurred if American population growth had stopped in 1943. At that time, the United States had 135 million citizens and was winning the largest land war in history. No one has ever suggested a sane reason for the United States to have more than 135 million people; indeed, only the need for military manpower in major wars could justify having that many. But even if that number of Americans had gone on to become as wasteful of energy per person as they are now, such a stabilized, smaller population today *would not need to burn one drop of imported oil or one ounce of coal.* And without a continuing need for imported oil, American Middle Eastern policy clearly would have been very different. If other rich nations were less dependent as well, the likelihood of this recent war (and the vast human and ecological tragedy it has entailed) would have been further reduced.

Even small advances in energy efficiency in the United States would have sharply diminished the nation's interest in Middle Eastern military adventures. If Americans had continued the energy conservation pro-

grams begun in the late 1970's, it would not have been necessary to import oil from the Persian Gulf in the 1990's. If the average fuel efficiency of the American private automobile fleet had just been increased by 1990 from 19 to 22 miles per gallon, no oil would have been needed from Iraq or Kuwait. Even now, if the average fuel efficiency of new cars were increased to 31 m.p.g. (well below half that of peppy, nimble, safer automobiles already designed, and just a little better than the 28 m.p.g. of today's new cars), no oil from Saudi Arabia or any other Persian Gulf country would be required.

The relationships between the Gulf situation and the environment are indirect but excellent examples of the complex web of connections in the human predicament. Unwise environmental policies were central to creating the Gulf crisis, and it in turn has caused great destruction of the regional environment. Sadly, the present and potential impacts of the Gulf confrontation on the plight of the poor have been largely ignored—including the possible effects on agriculture in Iran and the Indian subcontinent produced by the smoke from burning Kuwaiti oil fields (estimates ranged from 1 to 5 million barrels per day being destroyed in the months after February 1991). At the moment, it is not possible to evaluate in detail the direct consequences of this smoke on the respiratory systems of Kuwaitis and people in neighboring countries, or the possible long-term cancer risks, but the picture looks grim. And the effects of the Gulf oil spill, reported as many times larger than the Exxon Valdez spill, will almost certainly be catastrophic for regional fisheries and wildlife in general.

There were global environmental effects as well. Throughout the developing world since the oil shocks of the 1970's, periodic rises in the costs of liquid fuels have been a major factor in increasing the unsustainable use of fuelwood. Two decades ago when oil was cheap, kerosene began replacing wood in the stoves of poor families. As the price of kerosene rose again after the Kuwait invasion, poor people turned more to local forests and woodlots for fuel. If a long-term effect of the Gulf war is that oil prices stabilize at higher levels or remain volatile, the scarcity of fuelwood will become ever more acute, land will be even further degraded, and crop yields may fall.

A failure to grasp the new dimensions of security was made crystal clear by the Bush administration's belligerent approach to solving the problem of Western dependence on petroleum from the Persian Gulf. Before the massive transfer of American armed forces to the Gulf, oil from

that area was already costing an additional *hidden* amount of roughly $25 per barrel (beyond the market price), if one included the very real expense of routine military preparations to secure supplies. After the transfer of massive ground forces to Saudi Arabia, the hidden price jumped an *additional* $4 to $25 per barrel, depending on the assumptions allowed. And the total price, of course, escalated much further with the onset of combat.

Yet even after the war began, the Administration did not declare a domestic "war for energy efficiency." The money spent on military operations—if it had been applied instead to such measures as distributing efficient light bulbs, subsidizing the retirement of gas-guzzling automobiles, and encouraging other forms of energy efficiency—could have substantially reduced the dependence of the United States on imported oil in a relatively few years and increased the world's environmental security. But when the administration finally did promulgate an energy "policy," it was in essence an oilman's dream: drill, drill; burn, burn.

One can hope that an outcome of the Gulf War will be a strengthened United Nations with the power to intervene multilaterally to suppress resource-environment wars before they get started, although there is little sign of that now. What is clear is that sound national resource-environment policies and international efforts to reduce the scale of the human enterprise (and thus the competition for resources and the threat of transnational pollution) would greatly reduce the need for such interventions.

The questioning and reduction of swollen military budgets has already begun in both the Soviet Union (under the pressure of near economic collapse) and in the United States. The conversion of those budgets (and of defense industries and military personnel) to addressing problems of *environmental* security needs to proceed rapidly, despite the "lessons" of the Gulf war as propounded by some right-wing pundits. For instance, George Will stated (ABC's *This Week*, 20 January 1991) that the Gulf War was basically a justification for past large arms build-ups, "Star Wars," the military-industrial complex, and so on, implying that U.S. military power would be much needed in the future to defend American interests. Unfortunately, he is blind to the larger interests that most need to be protected, even as he argues for protecting access to resources to continue our wasteful lifestyle.

The Gulf confrontation and war were just recent dramatic symptoms of a much deeper problem. Although too few people realize it, the

gigantic and still-expanding scale of human activities has already set the stage for far greater environmental disasters. A substantial portion of the life that shares Earth with us is now doomed to go extinct. Partly as a consequence, a billion or more people could starve in the first few decades of the next century; hundreds of millions of environmental refugees could be created; the health and happiness of virtually every human being could be compromised; and social breakdown and conflict could destroy civilization as we know it.

Human population growth, of course, is a major factor in the increasing impact of humanity on its life-support systems. In 1950 the world population was 2.5 billion people and growing by some 40 million annually. When *The Population Bomb* was first published in 1968, there were 3.5 billion people and the annual increase was about 70 million. The fears of biologists then that the population explosion would degrade the human environment, lead to massive starvation, and generally diminish the quality of life, were dismissed by some people as unfounded. Technological advances (including such things as "nuclear agro-industrial complexes"), they claimed, would easily allow 5 or 10 billion people to be given adequate diets, housing, medical care, social security, employment opportunities, and so on. The basic message of the Pollyannas was comforting: keep on having lots of kids and encourage each one to consume more and more—because technological rabbits would be pulled out of the hat as needed to save us from any untoward consequence of that behavior.

Our own response to this technological optimism has always been the same: Why not stop population growth as soon as possible and see whether humanity can properly care for the number of people present when growth ends? Once everyone has some version of the "good life," then the utility of further increasing the human population could be discussed: Could there be a bigger population without declines in per-capita standards of living? Could human numbers keep growing without degrading the future carrying capacity of the planet? What would be gained or lost if the population were to increase further or to shrink? Could the droppings from those technological rabbits prove toxic in large quantities?

For the last twenty-three years, however, humanity has followed the easy course. In 1991 the world has 5.4 billion people to support, not 3.5 billion; and the population will increase by almost 95 million this year, not 70 million. At least 200 million children have died of hunger and hunger-related diseases since the *Population Bomb* was written, and more

than a billion and a half people now lack clean water and the sanitary facilities necessary for a healthy life—at least half a billion more than were so handicapped in 1968. According to the United Nations Children's Fund (UNICEF), 14 million children die annually from causes related to environmental degradation—what Mustafa Tolba, director of the United Nations Environment Programme (UNEP), calls "the shambles of global environmental destruction." Fewer than 1.5 billion people, less than half the number alive in 1968, have yet achieved a standard of living that most Americans (or citizens of other rich nations) would find acceptable. In short, the test has been run. Very few of the technological rabbits and sociopolitical miracles imagined by the optimists have materialized. Furthermore, none is in prospect to support another population doubling.

What has materialized instead is a series of nasty environmental surprises. In 1968, biologists did not realize how swiftly tropical moist forests would be chopped down; the role of Freon (chlorofluorocarbons or CFC's) in destroying Earth's precious ozone shield had not been discovered; acid rain was essentially unknown; and global warming, with its potential for massive disruption of agriculture, was projected as a possible problem for late in the twenty-first century. The theoretical threat of new viral diseases invading an ever-larger population of increasingly hungry (and thus immune-compromised) people in an era of rapid intercontinental transportation *had* been recognized, but the reality of the AIDS epidemic was still more than a decade in the future.

Indeed, the only big surprise not entirely nasty was the success of the "green revolution" in increasing food production in poor nations such as India. That, however, has been a mixed blessing, since higher yields often have been obtained at the cost of depleting irreplaceable soils, ancient groundwater, and the diversity of nonhuman organisms. True, the worldwide expansion of food production now supports *2 billion* more people. But the gains achieved at the expense of nonrenewable supplies of soil and underground water—as well as of the genes, plants, animals, and microorganisms that help to sustain agricultural ecosystems—may well turn out to be temporary in many areas, including India. As anyone doing a household budget knows, you can always increase consumption today by eating into your capital. Living on capital, however, has direct consequences for security tomorrow.

Humanity is rapidly consuming its capital. We're not referring here primarily to fossil fuels, supplies of which are more than adequate (although the environmental costs of using them are so high that there will

be increasing pressure to stop for that reason). Neither is our capital in the form of other minerals critically short (even though the environmental costs of mining ever-poorer ores are escalating). But three other kinds of capital are being depleted at a frightening rate. First, some 24 billion tons of topsoil (roughly the amount that once covered Australia's wheatlands) are being eroded annually *above and beyond the natural rate of renewal.* Soils are generated on a time scale of inches per millennium; over too much of the planet they are being destroyed on a time scale of inches per decade. Soil is a "renewable" resource that is thus being converted into a nonrenewable one by overly intense exploitation.

Similarly, people are pumping trillions of gallons more water from aquifers than enters them—another example of taking the capital rather than living on the interest. At the southern end of the giant Ogallala aquifer that underlies the U.S. Great Plains, the rate of withdrawal is feet per year while the recharge rate is fractions of an inch. The situation in much of the rest of the world is the same. Overpumping is causing some aquifers to collapse or is allowing saltwater intrusion, permanently reducing or destroying their capacity to supply water, while seepage of toxic wastes into many aquifers is making them unusable. Furthermore, in places like Long Island, the paving over of recharge areas is diverting water that once percolated downward into the ground into storm sewers leading to the sea.

The third and perhaps most serious destruction of natural capital is the extermination of other organisms at a rate unprecedented in 65 million years. Biodiversity is also, in theory, a renewable resource, but the rate of renewal is extremely slow. At the moment, the extinction rate is on the order of 1000 times the rate of the generation of new species—and the extinction rate itself is rising rapidly. A recent assessment suggests that the rate of destruction of tropical forests, where at least half of the planet's species reside, increased from about 1 percent to about 1.8 percent annually during the 1980's.

As this capital is consumed, the life-support services supplied free to Homo sapiens by Earth's ecosystems are being compromised. Those services include the maintenance of a benign mix of gases in the atmosphere. Living organisms have supplied all of the oxygen now in the atmosphere and remain important in regulating the concentration of key trace gases. Until photosynthesis had built up a sufficient concentration of oxygen for an ozone shield to form, life was confined to the sea because the land was bathed in poisonous ultraviolet radiation. Somewhat over 400 million

years ago, enough ozone had built up in the stratosphere to permit life to venture out on land for the first time, and it did so in a remarkably short time. Destruction of biodiversity can seriously interfere with this atmosphere-stabilizing service. Deforestation, especially in the tropics, has been a significant contributor to the rise in atmospheric concentration of carbon dioxide in the past decade or two. Carbon dioxide is the leading greenhouse gas, and its increase (along with several other gases) threatens climatic change that could imperil civilization.

Two other important ecosystem services are amelioration of the weather and regulation of the hydrologic cycle, which provides fresh water in a manner that minimizes the occurrence of floods and droughts. Likewise, the generation and preservation of soils and the restoration of soil fertility are crucial, especially to agriculture and forestry. Natural ecosystems also dispose of wastes and, in the process, recycle the nutrients essential for plant growth, services without which civilization would be doomed. In addition, those systems control, at no cost to humanity, the vast majority of agricultural pests and organisms that can cause human diseases. Animals from natural ecosystems pollinate many desirable plants, including numerous crops, and these systems also provide civilization with forest products and food from the sea. Indeed, maintenance of nature's vast "genetic library," from which humanity has already drawn the very basis of civilization—in the form of crops, domestic animals, and timbers—is one of the most important ecosystem services.

In aggregate, these ecosystem services support the human economy. Without them no nation or person would be secure, yet their integrity is severely threatened by the expanding scale of the human enterprise, which mows down natural areas without a thought. Houses and freeways are erroneously deemed more important for human security than communities of plants and animals. The security of civilization is thus imperiled by its own growth.

Civilization's future is shadowed by the challenge of supporting an ever-increasing human population with a food-production system already staggering under the burdens of continued soil depletion, water shortages, air pollution, and acid precipitation—and soon to be threatened by global climate changes. The prospect of tens of millions of ecological refugees fleeing famines and coastal flooding, epidemic disease becoming rampant as more and more people become malnourished (and therefore immune compromised), and wars over water and other resources breaking out ever more frequently, is not a pretty future to contemplate. To

brighten the outlook, it is absolutely essential that efforts be made to reduce the human impact on ecosystems.

One can view that impact (I) of any group of people as roughly the product of three factors: the size of the population (P), its per-capita consumption or affluence (A), and the environmental damage done by the technologies (T) used to supply each unit of consumption. In mathematical shorthand, $I = P \times A \times T$, or $I = PAT$.

The $I = PAT$ equation has great heuristic value. It shows immediately, for example, why the United States can be considered (in terms of its impact) the world's most overpopulated nation. Its population size is huge, the average American is a superconsumer, and the nation generally uses inefficient, environmentally damaging technologies (gas-guzzling autos being an outstanding example). Indeed, if we use energy consumption as a surrogate for per-capita impact ($A \times T$), the average American is on the order of fifty times the threat to the ecosystems of the planet posed by an average citizen of a very poor nation like Bangladesh or Haiti.

The $I = PAT$ equation shows why even a small amount of new development fueled by coal in nations such as India and China would be disastrous for the planet. Their population multipliers are so large that gigantic amounts of carbon dioxide would be dumped into the atmosphere with even tiny per-capita increases in their fossil-fuel combustion. Suppose, for example, that both India and China made heroic efforts to stop their population growth, and suppose further that both nations were willing to limit severely the use of coal in their development, while doubling their present modest energy use per person. Even so, India and China *each* would eventually put more *additional* carbon dioxide into the atmosphere annually than the United States could avoid emitting by forgoing all use of coal, which accounts for almost a quarter of American energy use. And, of course, more than a billion people live in the rest of the developing world and also need to use more energy to improve the quality of their lives.

If the integrity of vital ecosystems is to be preserved, humanity clearly must strive to limit all three factors in the $I = PAT$ equation. Population growth must be halted everywhere as soon as possible, and a gradual decline must be initiated towards human numbers that can be supported largely on income. A great deal is known about how to accomplish this humanely. In poor countries, for example, the most effective measures to reduce birth rates appear to be empowering and educating women, providing adequate maternal-child health care and family plan-

ning services, and installing social security systems. Population policies are just as necessary, however, in wealthy nations, where even greater leadership is needed to promote population reduction in order to diminish those societies' heavy impact on Earth's life-support systems. They also should be offering generous assistance to change conditions in poorer nations so that people will *want* smaller families and can be supplied the means to have fewer children. And much more work needs to be done to discover exactly what will be required to bring completed family sizes everywhere to an average of about 1.8 children, which will end population growth within a few decades and begin a gradual shrinkage.

Societies also need to learn to extract much more "good" from each unit of energy or materials used and to analyze carefully their patterns of consumption so that waste can be minimized. Again, many of the basic answers are in hand—from installing energy-efficient lighting and deploying solar-hydrogen technologies for mobilizing energy to gradually redesigning cities so they are no longer hostage to the automobile. And other new technologies must be developed and deployed that are much more environmentally benign than those used today in all economic sectors.

Humanity basically knows how to do all of these things, but attitudes both toward the environment and toward our fellow human beings must change before the necessary global cooperation will be possible. It is unlikely that a world rent by racism, sexism, religious prejudice, xenophobia, and gross economic inequity will be able to halt the plunge towards ecocatastrophe. But if the political and social will to address global problems can be mustered, people could quickly transform the way they think and then could move rapidly towards environmental security. All of us will have to work very hard to assemble that will.