Can We Survive?

(Part 1)

The Changes Required to Deal Effectively with Global Warming

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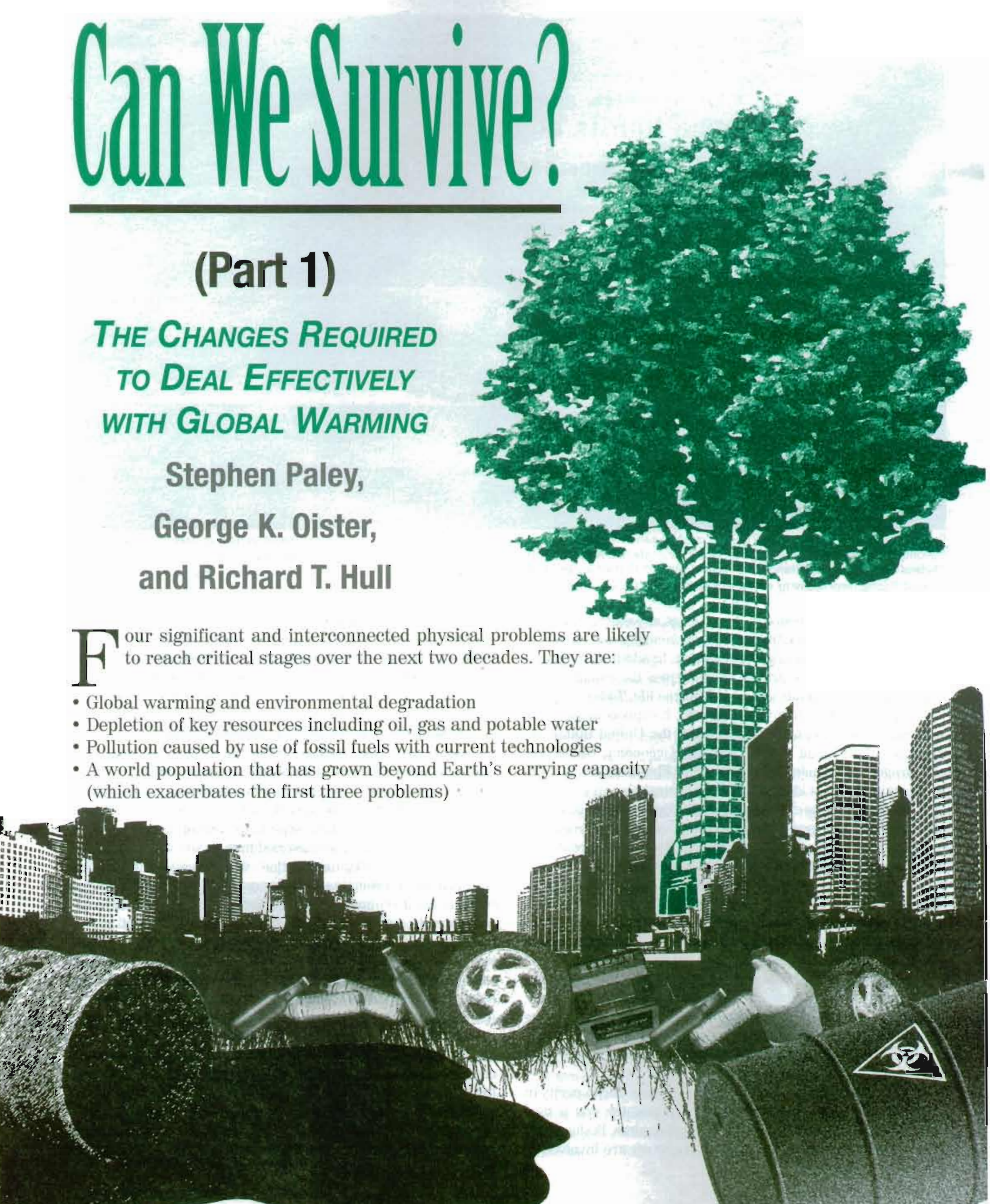

Four significant and interconnected physical problems are likely to reach critical stages over the next two decades. They are:

- Global warming and environmental degradation
- Depletion of key resources including oil, gas and potable water
- Pollution caused by use of fossil fuels with current technologies
- A world population that has grown beyond Earth's carrying capacity (which exacerbates the first three problems)

Keeping these problems within tolerable limits will require defining the actions that must be taken and the sequence in which they must be taken, followed by rapid deployment of the largest set of integrated, knowledge-based changes the world has ever seen. Included in these changes is the deployment of certain "survival" technologies. Much of this article will discuss fundamental impediments to their creation, adoption, and deployment.

The compartmentalization of knowledge, along with various cultural, economic, and business realities, has created a severely limited understanding of the changes necessary for our survival, and has also delayed implementation of those changes. These realities are:

- Economic self-interest
- Profit motive as the sole determinant of action
- Lack of appropriate institutions to promote and manage the required changes
- Limitations on the range of practical solutions that experts can create, often imposed by their own specializations
- Limitations associated with (nonexpert) decision makers who formulate decisions that require expert knowledge

We suggest that an institution be created and designed to orchestrate solutions to the first three of the four problems above. The institution's role regarding the fourth, overpopulation, would be to promote understanding of the need for population reduction as necessary for human survival and to help create improved birth-control technology that might make that possible.

The Nature of Survival Technologies

The fact that these basic physical problems are coupled together renders the creation of survival technologies exceedingly difficult and not always achievable by those possessing a narrow range of specialized knowledge. By "survival technologies," we mean those that are sustainable and provide to a significant extent for:

- Human needs for energy, fresh water, and population reduction
- Reduced human impact upon the environment
- Restricted global warming to within tolerable limits
- Facilitation of adjustment to the negative environmental changes caused by global warming

Survival technologies must be sparing in their use of nonrenewable resources, and must perform without producing much pollution or harming the environment. The wish list of survival technology characteristics calls for them to be robust, relatively low-cost, rapidly deployable if possible, and compatible with existing infrastructure. As shorthand, we will refer to a survival technology exhibiting these characteristics as "practical."

But even this formidable list is incomplete when discussions turn to energy technologies. Practical energy technologies must also have a high "energy gain." Energy gain ratio is the energy obtained by say, burning a gallon of gasoline, compared to the energy expended to obtain that gallon. "Energy expended," in this case, includes that required to drill, produce, transport, and refine the oil and also the energy (prorated) required to make pipes, erect oil-drilling platforms, construct refineries, and so forth. For other forms of energy, such as electricity generated by wind power, we similarly need to compare the total energy generated by a wind turbine over its lifetime with the energy needed to mine the metals, forge the blades, build the generator and the support structure of the turbine, and other factors requiring the expenditure of energy.

Unless all of these parameters are favorable, the technologies upon which we depend for our survival will at some point fail us.

Finally, we must be certain that in regions where climate change is most evident, the resources that proposed survival technologies will require are not depleted by climate change. For example, a recent summer drought in Western Europe diminished the water supplies needed to cool nuclear reactors. Consequently, reactor power levels (and the electricity they generate) had to be reduced, which led to strain on the power supply and limited the availability of air conditioning that used reactor-generated electricity. This, in turn, resulted in the death of several thousand elderly people who could not adjust to the sudden heat stress that they had to endure. Thus, the water-cooled nuclear reactor must not be considered a future survival technology in any region susceptible to permanent freshwater shortages, unless the reduced water supply can be replaced in a practical manner.

And freshwater shortages are occurring all over the world. Australia is presently suffering the worst drought in its history; a significant portion of its crops have failed. There has been speculation that the drought is due to global warming and may represent a permanent climate change. Such a change may result in the need to relocate up to six million people, but no one has suggested where.

Some areas that grow much of the world's food are predicted to become hotter and drier due to global warming and potentially reduced precipitation. In North America, this includes the American Midwest, Southwest, and far West. In the future, these regions may no longer be able to support high-yield agriculture because of a lack of water. In addition to less precipitation, agriculture in the Midwest and South Central region of the United States is threatened by the approaching depletion of the Ogallala Aquifer. Much of the West and Southwest, including parts of California, gets 80 percent of its water from mountain snowmelt runoff, which is already in sharp decline because of global warming.

What water is left behind is increasingly diverted to growing cities, which compete with agriculture for this vital resource. For example, most of the water in California's Imperial Valley, formerly a major producer of fruits and vegetables, has been transferred to cities in Southern California. Imperial Valley farmland is being converted to housing developments that have less need for water. Thus, what was once a major food-producing area is in now in the process of being permanently transformed.

The survival technology that could enable humans to have adequate supplies of water and maintain food production would be a practical, extremely low-cost, energy-conserving method of desalinating vast quantities of ocean water.

Stephen Paley is a physicist, and George K. Oister, who died while this article was being prepared, was an electronics engineer. They spent most of their professional careers in research, development, and technical management for multinational corporations, defense contractors, and small high-tech companies, at which they contributed to the development of several important new technologies. Richard Hull, trained as a philosopher, has participated in the development of some technologies with Paley and Oister, chiefly as an investor.

Another example of a survival technology, one that would enable population reduction, would be an injection that renders humans sterile until another counteracting shot is administered. The wide adoption of such a technology would slow population growth so that human numbers could be stabilized or even reduced below present levels.

Why Global Warming Requires Immediate Deployment of 'First-round' Survival Technologies

Normally, we like solid proof of potential outcomes before acting on major issues. But some aspects of global warming require us to compromise this principle. Global warming is a critical problem that, if it becomes pronounced enough, will put mankind's future on the planet in doubt. Given that threat, certain aspects of global warming must be addressed before 100 percent certainty of cause and effect has been established. One such aspect involves the quantity of greenhouse gases in the atmosphere and their rate of increase and the potential for global warming to become self-sustaining.

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It is accurate to describe the advance of global warming as already out of control. Recently published data for the years 2000 through 2004 show an astonishing average annual rate of increase in carbon dioxide emissions of 3.2 percent—four times the annual rate of increase of 0.8 percent during the 1990s.* The worst case of six scenarios published by the Intergovernmental Panel on Climate Change (IPCC), predicting a 6.1°C increase in temperature over pre-industrial levels, has already been exceeded.

The time during which humankind can hold global warming to tolerable limits may be short: among three thousand climate researchers who participated in a recently ended five-year international study of global warming, a common, privately held view is that the time left is shorter than ten years.** That is not to say that global warming will be full-blown within a decade, but rather that progressive and irreversible effects will by then be locked in and beyond humans' ability to moderate sufficiently.

As though rapid increase of greenhouse gases in the atmosphere and irreversible environmental damage were not threatening enough, even more disturbing is the prospect that global warming might become *self-sustaining*. As Earth's temperature rises due to additional warming, the rate at which some natural sources inject greenhouse gases into the atmosphere also increases. This, in turn, increases the Earth's temperature even further, further accelerating the rate at which natural sources of greenhouse gases enter the atmosphere. Such processes, well known to physicists are characterized as having "undamped positive feedback upon the input." They are common in nature and represent potential sources of unstable equilibria that, if pushed too far, could continue to spontaneously drive environmental changes beyond the limits humans can tolerate.

If tipping points are reached at which natural sources of greenhouse gases continue to increase and are self-sustaining, then *the biggest contributor to additional global warming will be global warming itself.* Although there is great uncertainty in global-warming models as to how fast such effects will develop, consider the following three examples of positive feedback of greenhouse gases.

The small amount of global warming that has now occurred is causing permafrost, a layer of earth frozen since the last ice age, to begin melting. (One continuous area of permafrost in Asia is larger than the areas of France and Germany combined.) Permafrost contains large quantities of the greenhouse gases methane and carbon dioxide, which are released when the permafrost melts. This contributes to global warming, which, in turn, contributes to more rapid melting of permafrost, and so forth.

A second example relates to the recent discovery that soil is a depository for carbon dioxide. The small amount of global warming that has occurred has increased the rate at which soil emits the gas. England has reduced its carbon dioxide output from manmade sources more than any other nation. Even so, by the end of 2006, the amount of additional carbon dioxide emitted by English soil due to global warming slightly exceeded the total amount saved by all emissions cuts made in England up to that time. As far as future emissions cuts are concerned, England has already made all those that are technologically easy to achieve. Globally, soil may now be supplying as much as 30 percent of the carbon dioxide that enters the atmosphere.

A third serious example currently under discussion is the possible future release of loosely bound methane from our oceans. The ice covering the Arctic Ocean, for example, will essentially disappear within thirty years. Melting ice absorbs heat without causing a temperature rise and, hence, may currently be retarding temperature increases in the Arctic Ocean. But, after the ice is gone, the ocean's temperature will begin to rise. Also contributing to the rise in ocean temperature will be replacement of the ice on the surface of the ocean by water: ice reflects 90 percent of the light falling upon it, but ocean water absorbs 90 percent of that light and changes it into heat.

At the bottom of the ocean is a solid form of the greenhouse gas methane, in the form of hydrates which are very temperature sensitive. If the temperature of ocean-bottom water increases sufficiently, methane will be released and enter the atmosphere. Molecule for molecule, methane is twenty times as efficient as carbon dioxide in promoting greenhouse warming. And there is a lot of it—ten trillion tons, much more than all of the oil and coal on Earth. The last time ocean-bottom methane was released (some fifty million years ago), most

*Steve Connor, "Global Growth in Carbon Emissions Is 'Out of Control,'" *The Independent/UK*, November 11, 2006. Accessed on December 2, 2007, at http://www.commondreams.com.

**Private communications from three Intergovernmental Panel on Climage Change (IPCC) climate researchers.

organisms had a very hard time maintaining their existence; higher forms tended to die out.

These and other examples suggest that both manmade and natural sources of greenhouse gases must be addressed *immediately*. It doesn't matter what percentage of carbon dioxide comes from human-made versus natural sources; we know enough about the carbon cycle to know the ending (human extinction, along with that of much of the biosphere) if we allow atmospheric carbon dioxide to continue increasing at its present rate. Worse yet, this rate appears to be accelerating.

In principle, two approaches are available to us. One would be the use of various techniques to reduce the output of some natural sources—difficult because most natural sources are distributed over large areas. The other approach would be to employ a practical survival technology that would remove and sequester greenhouse gases after they enter the atmosphere, irrespective of whether they come from manmade or natural sources.

In our opinion, the capture and long-term sequestration of greenhouse gases from the atmosphere is the most important emergency measure that can be taken to cope with such fundamental problems as environmental destruction, global warming, population increase, conventional methods of energy generation and use, replacement of planted areas by concrete and asphalt, and so on. But it is an emergency measure analogous to placing a human patient on a heart-lung machine to keep him or her alive long enough to fix fundamental problems. As such, we cannot rely upon capture and sequestration of atmospheric carbon, or other purely compensating techniques, by using them to avoid dealing with basic causes while we continue life as usual.

Many of the necessary changes and technologies, however, will require more time than we have left to contain global warming. A conceptual solution is to immediately deploy certain "first-round technologies" to buy us more time—for example, employing technology for large-scale capture and long-term sequestration of greenhouse gases from the atmosphere. The additional time the rapid deployment of first-round technologies may buy must be used to develop and deploy other necessary technologies and to make other changes that because their nature cannot be accomplished quickly.

Because there is no time left for further research and development of first-round technologies, their implementation must be achieved by (1) employing technologies that already exist (or slight modifications of them) and are capable of being rapidly deployed; and (2) synthesizing optimized systems created from such existing technologies.

A Look Ahead

In the second part of this essay in the next issue of Free Inquiry, we will deal with the various impediments to the creation and commercialization of first-round survival technologies.

Some impediments will come as no surprise:

• Large and multinational companies suppress technologies harmful to them, such as in the case of oil interests restricting the market for solar cell arrays.***

• Companies in areas requiring survival technologies can earn a profit without their products conforming to the many requirements of a survival technology—a major reason for our current environmental crisis. Profit motive alone does not guarantee that fundamental technologies in the field of energy will be survival technologies, and the companies that develop them often do not have the knowledge, internal mandate, or organizational structure to develop them as such.

• The economic benefits of some technologies are partitioned among different groups so that these benefits cannot be consolidated on a single balance sheet. Solar cells, for example, would have looked much more economically attractive decades ago if the economic benefits associated with their lack of pollution could have appeared on the balance sheets of the organizations that purchased them.

But other significant impediments may be less familiar. There are specific skills, different from those of basic research and germane to creating first-round survival technologies, that are almost extinct. Changes have occurred in multinationals, defense contractors, and government labs that make it almost impossible for these alternative development skills to be utilized within these organizations to create survival technologies.

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The culture of freedom and flexibility prevalent in many small, high technology companies has enabled some of them to create such technologies. Some technologies, in fact, are pivotal in the battle to contain global warming, but access to capital with which to commercialize them is, for all practical purposes, nonexistent.

Researchers at some university centers and government-sponsored labs have incorrectly claimed that certain badly needed technologies are not yet ready for commercialization and that they won't be for at least five years. The effect is to keep research funds flowing to these organizations for an additional five years.

Not every survival technology can be driven by the profit motive, and, if such technologies are to be deployed, it will take government intervention that, so far, has yet to occur.

Finally, there is a fundamental obstacle that we have labeled the "knowledge barrier." It often accompanies the above-listed impediments and arises when decision-makers who have little or no firsthand knowledge of technology—be they economic, financial, industrial or political decision-makers—attempt to make decisions concerning technology. Fundamental limitations arise when such decision-makers try to utilize, in a "secondhand" fashion, the knowledge of science and technology experts. These limitations result in decisions that are usually far from optimum. If this flawed decision-making process continues, it will significantly reduce the likelihood of creating, recognizing, and deploying the technologies required for mankind's survival at the very time that we may have only one last chance to achieve and deploy them. FI

***See the history of Solarex, its possibly illegal takeover by oil interests, and the subsequent restriction of sales of its solar cell arrays.