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Warren A. Johnson

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*By Warren A. Johnson**

The environmental concerns of today were generated primarily through the productive stimulus of ecology, starting with concern over increasing population and over increasing chemicals and pollutants in the environment, and culminating with the realization that our way of life was weakening the environmental base on which it depended. There is currently a new focusing of interest on areas such as economics, law, geography and religion which reflects the realization that current problems stem not from the environment but from man's behavior in the environment; that is to say, nature does very well on its own, without man's disruptive influence. The role of ecology remains fundamental, but the social sciences, hopefully, will enable us to alter man's behavior so that in the future man can emulate other organisms that have survived on the earth, contributing to the fitness of the environment as they take from it.

That we do not presently act in such a manner can be illustrated in many ways. I will focus on what I see as the core of the problem, the economic framework that we rely upon to organize our society. I will begin with a brief summary of why our economy depends on growth and some of the consequences of this dependency, and will then examine several other ecologically unsound aspects of urban industrial societies that have not received the attention that growth has. The last part of the article will attempt to show how our entire cultural system reflects and reinforces our economic institutions, reinforcing our tendency to evolve into an ever-tighter corner.

Economic Growth

The most fundamental conflict between the requirements of ecology and economics in our society centers on the present necessity of maintaining economic growth.[1] A belief in a progressively

better world, socially and materially, has been a part of western civilization since the Renaissance, and has been a pervasive part of this country since its inception. Even now it is difficult to imagine that this could end, and we instinctively think instead of new directions and altered priorities, assuming that we still have many alternatives for continued progress and growth. Unfortunately, our society, and indeed much of the world, is heavily structured toward economic growth. We have to find new jobs for young people entering the job market, and those who have jobs must keep them. In order to maintain our exports, we have to increase productivity to hold down their costs. The various levels of government depend on revenues from personal and corporate income taxes and sales taxes, and so have a direct stake in a strong, growing economy. Firms must maintain and improve their competitive position or be lost in the rush. Individual workers have house payments, children to be educated, food to buy; they cannot afford to jeopardize their jobs. Everyone is a part of this system; we probably could not survive without it at this stage. First things first—jobs and economic survival; then we can try and stop pollution. I do not accept the argument that the only reason for the rhetoric of growth is so capitalists can make a greater profit off the public and the environment. Growth is more fundamental to the American experience than that.

Nothing can grow forever, of course. Any system that requires continuous growth contains within it the seeds of its own destruction. Growth will stop at some point because of environmental resistance, and all we can hope for is that growth will ease slowly and that there will not be the crushing reversal to a much lower population level which ecologists suggest is the "natural" way that environmental balances are re-established. Growth may cease in either of two ways. First, growth may slow and stop because of the growing costs of maintaining an increasingly unstable environmental relationship, in setbacks from chemicals in the environment. in resource shortages, and in trying to prop up excessively large cities and overloaded transportation systems. Severe social stresses will accompany the grinding down of our progressive vision of existence. This may be the more hopeful vision of the future if we do not have fundamental changes in our economic system and its requirement of growth, because the second alternative involves chaos and a harsh, uncontrolled population reduction. This could stem from a breakdown in either the ecosystem or the social system,

or more probably, from both. This would be an ever-present danger in the process of stabilization mentioned above if "the center cannot hold." Things have fallen apart many times in the past; the only difference now is that such a falling apart would be far more destructive. Peasant agricultural societies can survive revolution and turmoil by living close to the land and remaining relatively independent in their sustenance. By way of contrast, we are dependent on the functioning of our complex economic system. It is the hazards inherent in this system that I wish to discuss.

The Hazards of Specialization

There is a large quantity of evidence that supports the ecological principle that diversity leads to stability (stability meaning the absence of major population fluctuations, either upward or downward). Complex natural ecosystems such as those in the tropics are much more stable than simpler arctic or island ecosystems. The simplest ecosystems of all are the modern agricultural regions where a single crop is produced; since "nature abhors a vacuum" it is not surprising that chemicals are necessary to hold back the insects, diseases and weeds that seek to colonize these artificially simple niches. A monoculture of any kind is dangerous, whether of pines in a commercial forest, corn in a field, or people in a city; but we are forced towards this specialization by economic competition and modern technology. Economic activities are concentrated in their most profitable locations and other, less competitive areas that developed in a day when transportation was less efficient are remorselessly priced out of production. This is in contrast to traditional agricultural societies in which each farmer grows a variety of crops on a small plot of land. With greater complexity, the need for chemical pesticides is reduced. In the specialized agricultural regions of this country we have increased agricultural productivity at the cost of greater ecological instability. (The word specialization can be confusing in this context. Ecologically, increasing specialization of organisms does increase diversity and therefore stability. When a specialized animal evolved to fill a previously unfilled niche, as when the giraffe evolved to eat tall plants, it added to the overall complexity. Economic specialization, however, displaces other economic units—as if the giraffe eliminated the other animals—and thus simplifies the overall system.)

In both agriculture and industry, however, there is another,

possibly more dangerous hazard inherent in regional economic specialization; the absolute reliance it places on the transportation system. If the transportation system ceased to function, what would a city be able to provide for itself? Normally, food, water and fuels are brought in from all over the country, and even from other countries in some cases (such as oil). Pipelines, powerlines, railroads and highways are vulnerable to disruption.

Nuclear war or some other equivalent disaster would not be necessary to cause a breakdown in several or all of these forms of transportation. Disruption could come as a result of a severe depression. Our affluent society might be unwilling to endure the hardships of the 1930's without resort to violence, which was near the surface even then. A breakdown in the international monetary system or an international trade war could trigger such a depression. A small minority of bitter, irrational (or rational) individuals who understood the functioning of urban industrial society could cause untold havoc by interrupting transportation and communications. The hazards of such a response will increase in the future as increasingly stringent governmental controls become necessary to maintain our society under increased environmental resistance to continued economic growth.

This danger was expressed powerfully in 1937 by Robinson Jeffers in "The Purse Seine:"

> We have geared the machines and locked all together into interdependence; we have built the great cities; now
> There is no escape. We have gathered vast populations incapable of free survival, insulated
> From the strong earth, each person in himself helpless, on all dependent. . . . The inevitable mass disasters
> Will not come in our time nor in our children's, but we and our children
> Must watch the net draw narrower; government take all powers—or revolution, and the new government
> Take more than all, add to kept bodies kept souls—or anarchy, the mass disasters.

Great increases in productivity have also been accomplished through specialization of labor over the last two hundred years, but this inevitably increases the danger of degeneration following even a minor interruption. A peasant in India, living on a far lower material standard, at least has the broad knowledge necessary for the functions on which his life normally depends. Not by the

farthest stretch of the imagination could an American say the same thing, given the staggering complexity of our manufacturing processes and our transportation and communication systems. The loss of a relatively small number of key personnel could leave us stumbling frantically to reestablish communications with outside areas, trying to restart an oil refinery or an electrical generator, or trying to reestablish an electrical grid. The longer machines are stopped the harder they normally are to restart.

Indeed, once solidly stopped, our machine civilization may never be gotten underway again. Harrison Brown, a noted geophysicist at the California Institute of Technology, dealt with this problem in THE CHALLENGE OF MAN'S FUTURE:

> Our ancestors had available large resources of high-grade ores and fuels that could be processed by the most primitive technology—crystals of copper and pieces of coal that lay on the surface of the earth, easily mined iron, and petroleum in generous pools reached by shallow drilling. Now we must dig caverns and follow seams ever further underground, drill oil wells thousands of feet deep, many of them under the bed of the ocean, and find ways of extracting elements from the leanest of ores—procedures that are possible only because of our highly complex modern techniques, and practical only to an intricately mechanized culture which could not have been developed without the high-grade resources that are so rapidly vanishing.
>
> As our dependence shifts to such resources as low-grade ores, rock, seawater, and the sun, the conversion of energy into useful work will require ever more intricate technical activity, which would be impossible in the absence of a variety of complex machines and their products—all of which are the result of our intricate industrial civilization, and which would be impossible without it. Thus, if a machine civilization were to stop functioning as the result of some catastrophe, it is difficult to see how man would again be able to start along the path of industrialization with the resources that would then be available to him.[2]

To suggest that an underdeveloped country may have greater stability than a developed country is not to say that a child born in India is more apt to live a long life than a child born here; this is clearly not the case. But as far as the survival of a way of life is concerned, continuity is much more probable in the underdeveloped countries than in the developed.

Cities entail a much greater drain on resources, particularly

energy, than do smaller, more dispersed settlements. Energy is needed to bring in and distribute materials, food and water, to collect and remove waste, to transport its population within the sprawling city, and, in the future, to recycle wastes. Yet from an economic standpoint, larger cities are significantly more productive than smaller cities,[3] at least while resources are so easily available.

Energy is likely to be a critical resource in the future. The use of oil and natural gas is increasing rapidly, utilizing primarily domestic sources which may be depleted soon after the year 2000.[4] Near Eastern oil will last somewhat longer, until around 2030, but Europe and Japan are already dependent on it and the U.S. soon will be. Concern for the continued availability of this oil will be a major source of world political instability. In the future we are going to have to rely on either breeder reactors (which are dangerous and generate radioactive wastes), or lower grade fossil fuels such as coal and oil shales (both of which are environmentally damaging) or achieve thermonuclear fusion power (which will be extremely difficult, perhaps impossible, technologically). There are many other sources of energy available, but none have the capability of supplying the vast quantities our society requires. The easiest way to emphasize our dependence on present energy sources is to point out that without them we would be dependent on solar energy, which is what powers India and other agricultural societies. The energy cost of recycling materials such as aluminum, glass and copper may neutralize much of the benefits gained in materials conservation. Because of urban sprawl and regional industrial specialization, the energy costs of collection and transportation of materials to be recycled becomes significant, even without considering the energy requirements of reprocessing.

Composting of solid wastes generated in urban areas has been proposed as the ecologically ideal method of disposing of waste while replenishing the organic content of soil and reducing the need for chemical fertilizers. The quantity of composted waste, however, would be so great that the energy requirements for transportation to agricultural areas and distribution onto the fields would negate many of the gains. In contrast to bulky compost, chemical fertilizers are highly concentrated and often are produced near the agricultural areas where they are needed. In traditional agricultural societies, where the farmer can step out of his front door to return waste to the land, composting is logical; in an urban industrial society, chemical fertilizers are, in a limited sense, logical.

It is urbanization that is the basis of this conflict between the demands for the conservation of energy and the demands for conservation of valuable materials.

A recent report expresses the ecologist's concern with the transportation of materials from the land to the city and to the ocean.

> The scale of this operation is far greater than anything previously known on the face of the earth. It is a gigantic one-way flow of elements, essential to life, from the earth and the air into the sea. This human phenomenon is in stark contrast with natural communities of plants and animals which have been living in balance with their surroundings for thousands of years. There, substances essential for life are taken from the air and from the soil and are used with the sun's energy by plants to manufacture organic materials which, in turn, provide food for herbivores and carnivores in a food chain. At each stage of the process materials are returned to the soil, where they decay and liberate materials for the plants to reuse. Ecologists call this a balanced ecosystem. Some nutrient material may be washed out of the soil by rain, but it is replaced by natural weathering of the rocks. The only input of energy is from the sun. This kind of system is viable for thousands of years, and the key to its success is the recycling of elements within the system.[5]

The report goes on to point out that resources of phosphorous, an essential component of chemical fertilizers, could be depleted in 60 years, at which time the world's population may be 11 billion; the number that could be fed without chemical fertilizers would be 2 billion. The phosphorous would be at the bottom of the ocean or immobilized as insoluble salts in the soil. Although the availability of phosphorous resources could probably be extended by various conservation measures, phosphorous shortages remain a serious problem.

The suggestion is often made that we should build new cities instead of further increasing the size of our present cities. This would make ecological sense if new cities were indeed built, dispersed broadly across the country and based economically on the surrounding area. They should not be the satellite towns of larger cities that we see at present, which are attractive but less satisfactory from the energy standpoint since they require more movement of people and materials than they would if they were a part of the central city. A proposal for a truly new city, however, would find some severe and perhaps insurmountable economic obstacles in the provision of jobs. An existing metropolitan area can provide

a new job-producing enterprise with transportation facilities, communications, labor, consultants, materials for construction and manufacturing, and a market in the surrounding city for the goods or services being produced. A new town could not offer any of these advantages. England has tried to revive declining areas to some extent but has found it to be very expensive. At times it has been necessary for the government to build entire plants and supply firms with incentives to operate them. Unless our government were willing to subsidize ecologically sound industrial locations with substantial amounts of money and at the same time restrict the growth of other urban locations we will see little change in the process of megalopolis formation now under way.

Without government support or regulation a firm must locate in economically sound areas, primarily urban. If a firm located instead in an ecologically sound area, it would probably be rewarded for its public concern with bankruptcy, in much the same way that a firm which currently voluntarily spends money for pollution control would weaken its competitive position.

Barry Commoner has emphasized the key role that new technologies have played in the deterioration of the environment.[6] Our economic system virtually forces the rapid development and the adoption of new technology. The first firm to put a new technology into use is the one most likely to capitalize on its profitableness. Other firms must try to get the new technology into use as soon as possible so that the technology leader does not outdistance the rest and control the market. Many firms have gone out of business because they did not have the capital or the initiative to go into new processes or products fast enough. No other social system has ever rewarded the innovator so handsomely and so penalized the technological conservative. To restrain this process while a government agency studies the consequences of new technology would be difficult, given the economic stakes involved.

The termination of work on the SST must be considered as a very significant action. This is the first time that a glamorous new technology has been halted. Fortunately the noise of the aircraft and its cost far exceeded any social benefits gained by small reductions in trans-Atlantic flight time. The real problem with halting the SST is economic. The resulting unemployment in Seattle may make similar future successes difficult for environmentalists. Economic growth is dependent on technology to develop new products and generate new investments.

Only the government can control the introduction of new technology. This would add another activity to the government's rapidly expanding role in American life. This would be justifiable, considering the necessity of maintaining the system on which we are all dependent. But we should also keep in mind Jeffers' fear that government might take all powers. Price and wage controls have been instituted by a Republican president who thought them unthinkable only a short time before. Limitations on labor's right to strike also seem probable. As our economy continues to evolve, more and more government intervention will be necessary, much of it stemming from increasing economic pressures and environmental resistances. It is the nature of our system and the present stage of its evolution that necessitates government controls. The controls themselves should not be seen as alien to the American way.

The Man-Land System

Cultures are internally organized and coherent systems. Any element of a culture, such as a religion, ideology or art, usually reflects and reinforces the structure of the cultural system as a whole. I suggest that economics provides the core of our cultural system, the basic structural framework on which the rest relies. Other aspects of our culture, however, are consistent with our economic values, or have been made so; we hear little about traditional American values of frugality and forthrightness in a consumer society. The entire cultural system reflects the expansiveness and dynamism of the economic system and reinforces the tendency toward social and ecological instability. (Stability is another concept that has different implications to economists and ecologists. Stability, to an economist, usually means full employment, price stability and inevitably, economic growth, i.e. instability. To an ecologist stability means the absence of growth or decline.)

One way to illustrate this internal consistency in American society is to examine the physical environment in which our society evolved, and the influences of some of the basic elements of our culture, such as religion and ideology.

The Physical Environment

To imagine the attraction that this virgin, fertile continent had for Europeans, it must be remembered that Europe had been over-

populated, at existing levels of technology, for hundreds of years, and that in a dominantly agricultural society ownership of land was the major source of wealth and status. America was a vast new land without the oppressive social controls that had been necessary in Europe. The new world was so large and so abundantly endowed with resources that for several hundred years the myth of superabundance, of unending land and resources, seemed valid. In contrast to Europe, where the maintenance of one's land was necessary for the future of one's family, this country did not encourage the expenditure of much effort to maintain land since there was always more land farther west. The best of the resources were taken first, including the soils, the forests and the wildlife, and the land was then abandoned. It has been argued that this was the best way to build the country quickly, using the best resources in the pioneering effort. The problem is that we are still doing it today. The upper and middle classes abandon our central cities instead of maintaining and enriching them. The lack of concern with which we are consuming non-renewable resources further suggests that the myth of superabundance is still with us.

Religion

Much has been made recently of the role of the Biblical dictum in Genesis that man should subdue the earth and have dominion over every living thing. Man is made in the image of God; nature is below us and for our use and pleasure, and is merely comprised of natural resources for which we have no special obligations other than to ourselves. This attitude toward nature differs greatly from that of oriental religions in which God is generally understood as a life force, as some form of spirit that is found in all living things alike.

Yet if we look at Medieval Europe, when the role of the church was as central as that of economics is today, we see a relationship with the land which was relatively stable and enduring. In many cases the fertility of the land was actually improved. The important role of Christian attitudes to nature was in the stimulus it offered to science. Nature, without spirits of its own, without holiness, was thus considered amenable to scientific study, initially to learn of God's will on earth, but ultimately to transcend natural limitations. This was the "conquering of nature" that post-Renaissance western civilization has been so proud of. It also gave the west the military

and economic power to wreak havoc on other world cultures, from the tribal cultures of America and Africa to the more developed cultures of India and China. Even now we force other cultures to emulate us if they wish to survive, especially after western technology has set off the population explosion. In this process the Bible has been displaced by WEALTH OF NATIONS and DAS KAPITAL, although many Christian values remain that do not conflict with the new order, including our anthropocentric attitudes toward nature.

It has been suggested that the United States is actually an underdeveloped country, underdeveloped in the non-economic aspects of life—religion, traditions, kinship and community—and that only in economics we are overdeveloped. Our values certainly do not permit us to look as deeply into nature and religion as into mathematics and science, and not as richly as prescientific peoples almost universally did.

Ideology

The settlement of America did not really get underway until the industrial revolution, and particularly until the railroad, permitted the effective exploitation of this vast continent. The timing was significant. Thomas Jefferson, one of the great individuals of the Enlightenment, rejected the authority of monarchy and church in favor of reason, freedom and democracy. Adam Smith's contemporaneous economics would let each individual act in his own best interests, drawn by the invisible hand of the market to act in the best interests of society as well. Jeffersonian democracy also would let citizens decide what was in their own best interest, and would greatly limit the power of the government. In both theories, the individual had precedence. Jefferson's belief that the best government is the least government was a valuable asset to a country bent on extracting the wealth of the land as fast as possible. Freedom, instead of entailing the responsibility that Enlightenment philosophers confidently expected once the repressive hand of the church and state were removed, has instead entailed self-interest and greed. The lonely and threatening quest for gain and status is not a part of the society that Jefferson visualized. To a growing number of people, young and old, the loss of a supporting community and faith is beginning to seem a heavy price to pay for the increased material standards achieved as individuals are left to seek security in wealth or achievement.

Even as the environmental base of this way of life deteriorates it seems that faith in individualism remains our most powerful belief. Faith in technology and economic progress are weakening but even the counter-culture, which rejects virtually everything else of the establishment, still seems to have great faith in "doing your own thing."[7]

Population

The abrupt and major decline in the birth rates in the United States during the late sixties suggests that overpopulation may not be the most critical problem in this country in the future. We might prefer to have a smaller population, but at least our numbers are not skyrocketing the way they are in the underdeveloped countries and the way our GNP and energy consumption are. This drop in birth rates, which has occurred in most industrialized countries, is perhaps not too surprising considering the limits children place on parental resources of time, energy and money. For the underdeveloped countries, however, the picture looks terrifying. Traditional agricultural societies, which characteristically value large families, seem to be hopelessly caught in the trap that was baited, perhaps with good intentions, with western public health technology.

Nature, of course, has no qualms about death; it is as essential as life in the cycles of existence. As we steel ourselves to cope with the seemingly inevitable famines of the future, we may begin to see that our wish to have life and not death was simple-minded. If we are successful in conquering the degenerative diseases that now end most lives in this country, it will not only mean that there will be larger population but also a smaller percentage of children in our population, and more aged. Garrett Hardin undoubtedly caused consternation in his readers when he wrote:

> In a less than perfect world, the allocation of rights based on territory must be defended if a ruinous breeding race is to be avoided. It is unlikely that civilization and dignity can survive everywhere; but better in a few places than in none. Fortunate minorities must act as the trustees of a civilization that is threatened by uniformed good intentions.[8]

Thoreau once said while visiting a city that "the presence of so many people must make human life seem very cheap." The possibility of human life losing its supreme value makes one wonder what other cherished values will be threatened in the future.

The World Closing In

Any cultural system that incorporates dynamism and growth in all of its cultural components is inevitably going to find the world closing in on it, especially to the degree that it is successful. Increased environmental resistance must result if we continue to go against the ecological grain of the environment in order to avoid going against the economic and political grain of our society. This closing in, which we have already experienced to a degree, is going to be very difficult to cope with. It will be very discouraging compared to the easier past of an industrial society expanding on the bouyancy of new technologies, high grade resources and low population levels.

Where do we stand now? Sir Geoffry Vickers suggests that we do not wish to think about it.[9] It may be argued that this is putting the predicament far too bleakly, disregarding the resiliency and adaptiveness that we have and the possibilities offered by our system. This is probably true. At this point, however, it is essential to be aware that it is optimism that characterizes our orientation after the favorable historic currents of the last several centuries. Robert Heilbroner focuses on the dangers of this optimism:

> Before these ominous developments of history, we react with the natural attitudes of our optimistic conditioning. If there are 'forces' in history, we prefer not to think of them; and if we must think about them, we assume that they will be, as they always have been, on our side.[10]

It has been said that the abrupt drop in the birth rates and the rapid change in attitudes toward abortion is a demonstration of our ability to change when conditions require it. I agree; it is an amazing change. But there is a significant difference between the changes necessary to slow population growth and the changes necessary to alter the historical movement of our society. Family size is primarily an individual decision. People are now free to limit the size of their family based on their perception of the population problem and their own wishes. In contrast, halting the progressive increase in the modification of our environment is restricted by structural problems inherent in our cities, our society, and our world. Many people probably would be willing to limit their standard of living, as they have been willing to limit the size of their family. But these same people could not get along without a job if the economy stopped growing. They could not get along without a car

because of the way our cities are laid out, nor could they feed, clothe and shelter themselves without factories, industrial agriculture and chemicals, nor could they return to the land and make a living. A nation as a whole cannot disregard the demands of international economic competition or the reality of nuclear weapons. Rarely is a social system so flexible that certain components can be modified without resistance from the rest of the system.

In "The Hollow Men" T. S. Eliot wrote:

> This is the way the world ends
> Not with a bang but a whimper.

In a sense, these are the two alternatives we have to consider, given the way things are. The bang would be the end suggested by ecological parallels with nature, with the population collapsing when the environmental base is overtaxed and when social structures cannot hold together under the increased pressure.[11] The whimper would be the leveling off of the S-shaped population and GNP growth curves at some unknown carrying capacity, an end to the dominant qualities of western civilization, a closing in of the open ended system. Personally, I find both alternatives equally unsatisfactory.

The critical question is whether there are other fundamentally different alternatives. Aware of our perennial optimism, I think we must still say yes. But we must give up our vanities, and accept that our ultimate aims must be for simple joys and accomplishments, and above all for stability, and we must not delude ourselves by believing that we can bring salvation to the rest of the world. If anything, we should look to the relatively stable systems of the world that we so thoughtlessly rejected and rudely disrupted and see what we can learn from them in a more humble quest for a lasting place on this earth.

FOOTNOTES

* Associate Professor of Geography, San Diego State College.

[1] *See,* W. A. Johnson, and J. Hardesty, eds., ECONOMIC GROWTH VS. THE ENVIRONMENT (Wadsworth Publishing Co., 1971).

[2] H. Brown, THE CHALLENGE OF MAN'S FUTURE (Viking, Compass Edition, 1956) 222–223.

[3] W. Alonzo, *The Economics of Urban Size,* PAPERS OF THE REGIONAL SCIENCE ASSOCIATION, Vol. XXVI (1971) 67–83.

[4] M. K. Hubbert, *Energy Resources,* National Academy of Sciences—National Research Council, RESOURCES AND MAN (San Francisco: Freeman, 1969) 183, 190.

[5] MAN IN THE LIVING ENVIRONMENT, The Institute of Ecology Report of the Workshop of Global Ecological Problems (University of Wisconsin Press, forthcoming) 20.

[6] B. Commoner, *The Causes of Pollution,* ENVIRONMENT (April, 1971) 2–19; B. Commoner, THE CLOSING CIRCLE (Alfred Knopf, 1971).

[7] P. E. Slater, THE PURSUIT OF LONELINESS (Boston: Beacon Press, 1970).

[8] G. Hardin, *The Survival of Nations and Civilizations,* SCIENCE 172: 1297 (June 25, 1971).

[9] G. Vickers, *The End of the Free Fall,* in VALUE SYSTEMS AND SOCIAL PROCESS (Penguin Books, 1971) 68.

[10] R. L. Heilbroner, THE FUTURE AS HISTORY (New York: Harper & Row, 1959) 57. This lucid discussion of the problems that beset liberal civilization was written prior to the era of ecological awareness that has added new dimensions to our understanding of this dilemma.

[11] Meadows, D., *et al.,* THE LIMITS TO GROWTH (Washington, D.C.: Potomac Associates, 1972).