Ecologic Dilemmas

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In the millennia of the earth's history, man has had only a brief life-span. In that short time he has been an endangered species, a beneficiary of nature's largesse, and a predator. Within the limits of a rigid ecologic ethic it is difficult for him, as a reasoning animal, to steer a middle course between the Scylla and Charybdis hazards of these opposing forces.

The destructive character of natural phenomena provides, or should provide, us with some sense of the relative significance of our own impacts. This should lead at least to some equilibrium in decision-making. It is rare that man does anything, even with malevolent intent, that would match the devastating environmental effects of a Guatemalan earthquake or a volcanic eruption of Mt. Baker. One may be staggered by the recent U.S. Geological Survey's pronouncement that a major eruption of Mauna Loa Volcano on the island of Hawaii is predicted to occur sometime before July 1978. Such an eruption, if it produces sufficiently high volumes of lava over a long period of time, could destroy parts of the city of Hilo, the economic and transportation center of the island. In addition, such an eruption produces atmospheric effects throughout the world for long periods of time. Locally, the USGS provides guidance to agencies that plan means to divert lava away from potentially harmful paths. The success of such measures remains to be demonstrated.

Without belaboring the less than beneficent behavior of nature, it should be remembered that one of the pressing environmental problems is that of sediment. Geologic processes, again active over the millennia, account for far more total tonnage of sediment than all of man's activities put together. In his small way, however, man has the responsibility of controlling his actions so as to keep himself alive with minimum damage to the environment and with the preservation of those rare amenities with which nature has temporarily endowed him.

Within this framework, how have we fared in recent years in terms of ecology? No one would be courageous enough to make such an assessment over the entire spectrum of ecologic interest, even though the more militant have volunteered to plan, monitor, and control the universe. The regulation of the water, the air, and the land, more modest in scope, is a sufficient challenge to require and to deserve the maximum use of our energies. Within these categories, I choose only a few examples illustrative of progress, of problem, and of ignorance.

Water and Wastes

The National Commission on Water Quality (NCWQ), created by the Congress several years ago, now supplies us with a reasonably succinct estimate of where we are. In March of this year, it stated that "We are encouraged that, in many areas of the country, the water is not only improving, but improving faster than some had expected." The universal caveat is included, however, in its summary of status (and is equally applicable to the air and the land): "We also find that there is still a major lack of adequate information. We simply do not know enough."

Areas of ignorance abound in virtually all of the fields with which we are concerned. Decision-making is an exercise in which two extremes compete. In some cases, insistence on scientific underpinning, no matter how meager, prevails. In others, pressure for action, without understanding, is by no means uncommon. A middle ground between the perfectionist and the opportunist is not easy to maintain in the present climate of desire for speed in regulatory action.

Postaudits of the consequences of environmental decisions are difficult to come by. The creation of the NCWQ and the parallel assignment to the National Academy of Sciences are unusual public policy actions. Their findings will, predictably, ensure battles within Congress when ecologists launch a drive to preserve the status quo of Public Law 92-500. A congressional act, once ratified, takes on a semibiblical character. When the NCWQ, after several years of elaborate inquiry, suggests alterations in the implementation strategy, it is bound to create a storm. The fact that the program really requires a stability and continuity of funding, which it does not have, may be lost in the insistence that a public law should never be adjusted to reality. The search for necessary flexibility, so as to assure more effective implementation, has likewise been an objective of the NCWQ, and is bound to be attacked.

Industry, although always suspect, voices a similar desire for legislative adjustment. Many of its exponents feel that many of the environmental standards and time schedules for accomplishment are unrealistic. They insist that, unless these requirements are sensibly modified, construction of new facilities may be brought virtually to a halt.

The public official, with an edict from Congress to move forward with due speed, but encumbered by legislative deadlines, finds himself most unhappy in diligently pursuing essential environmental improvements while attempting to reconcile them with other national goals and priorities. The economic and social consequences of public policy are still fuzzy and need to be inventoried and assessed almost continuously.

Drinking Water

One of the curiosities that has recently aroused people's interest is the minimum attention that has been paid to the water we drink. Its impact on man far transcends any by way of the rivers and lakes used for recreation, beauty, fish, and wildlife. These amenities are of great spiritual and cultural value but do not vitiate the fact that, without water, man cannot exist. A recognition of this axiom found no place in any of the legislative acts passed within the last 10 years until the enactment of Public Law 93-523 in December 1974. It is known as the "Safe Drinking Water Act"—a belated recognition that, today, some 180 million people are dependent on this commodity, which is supplied by some 40,000 organized systems of distribution.

In less that three-quarters of a century, the number of distribution systems has been multiplied about tenfold from less than 4000 in the year 1900. Public

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Law 93-523 has already sparked a major public concern with what we drink, resulting in the expected plethora of imaginary and real crises. These range from the actual disabilities of maintenance and operation in many small communities to the emergent debates and regulations regarding the supposed potential carcinogenic effects of chlorination and fluoridation.

Chlorination has been used for more than three-quarters of a century to protect the drinking water of more than a hundred million people in the United States. Its use has been a major contributor, during this period, to the increase in the life expectancy of man at birth from less than 50 to more than 70 years. Infant mortality, similarly heavily affected by the quality of drinking water, has declined from more than 75 to some 18 per 1000 births. The decline in typhoid fever has been spectacular, again with water quality as a significant contributor. At the turn of the century its toll was between 75 to 100 per 100,000 population. Today, the loss is less than 0.1 per 100,000.

The debate on fluoridation of water continues unabated, even though some 80 million people have been using such a treated water for a number of years. The results have been considered by many responsible people to be of high public health value. Nonetheless, controversy regarding the objectionable effects of fluoridation has reached a new peak in recent months. This provides an excellent demonstration of the persistent clash between well-intentioned groups that base opposing claims on presumably valid interpretations of scientific data.

In the case of fluoridation, the National Cancer Institute of the Department of Health, Education, and Welfare has actually found "reduced mortality from cancers of the brain and nervous system in communities with high levels of natural fluoride." The Institute's conclusions were contained in the preliminary draft of an exhaustive study of cancer statistics in the United States over a 20-year period (1950 to 1970). "This study," the draft states, "provides no support for recent claims that fluoridation of water supplies in the U.S. has increased the risk of cancer." It added that "no significant excess mortality from cancer could be detected up to 15 years after fluoridation in areas where 95 percent of the population had been abruptly and continuously exposed." A report, issued by a private agency, the National Health Federation, and published in the *Congressional Record* of 21 July 1975, linked cancer mortality patterns in certain U.S. counties to artificial fluoridation of water.

According to the National Cancer Institute, the Health Federation report based many of its conclusions on a comparison of counties containing the ten largest fluoridated cities to counties containing the ten largest nonfluoridated cities. However, no attempts were made in the report to take into account demographic variables that are known to affect cancer mortality, the Institute said.

The Institute's conclusion: "We found no (cancer mortality) trends attributable to the consumption of water that is artifically or naturally fluoridated."

Aerosols and Pesticides

Probably no situation has caused more battle, among investigators and the public, than the question of whether aerosols in wide use and pesticides in almost universal application have overriding deleterious effects on man, plants, and animal life. In this debate, as in almost all ecologic decision-making, complete knowledge is rarely available, but demands for prompt prohibition are usually in abundant supply. Those who advocate slow motion in the weighing of positive assets versus negative impacts are at war with those who would like to avoid any disastrous impact, no matter how slight or no matter how long deferred in detectable manifestation. Decisions are particularly difficult and sensitive, especially where present uses have significant public health or agricultural benefits.

An important case in point is the use of pesticides for such public health purposes as the control of malaria and yellow fever. The results have been spectacular, saving millions of lives throughout the world. The search for nonchemical, natural biologic, or rapidly degradable complexes has not been distinguished so far by any startling success. The World Health Organization has pursued this inquiry with some 1400 compounds which have demonstrated neither efficiency nor rapid disappearance in a natural environment. The search continues because alternatives and strategies, while often valuable, are not always applicable. The control of vectors and pests by environmental sanitation and by physical modification of the terrain has been successful, but is severely limited in total scope. The same situation prevails with respect to biological and genetic controls and to modifications of present conventional materials.

The most that can be said of the present state of the art is that "the majority of the human vector-borne diseases cannot be controlled or prevented by vaccines or chemotherapy. They must be controlled, therefore, by reduction of vector sources and of contacts between vector and man" (*1*). In this contest between man and nature, it is to be hoped that we will recognize as essential "an intimate knowledge of the significance of the ecology and behavior of the target species and the epidemiology of the disease" (*2*). With such a contest must come an appreciation and respect for environmental values that may be placed in jeopardy and be depreciated.

An even greater and more elusive controversy rages over the wide use of aerosols and, more particularly, of Concorde airplane emissions. Their impact on the upper atmosphere is not well understood and hence the potential effects lend themselves to passionate declarations, court actions, and dynamic marches—all demonstrative of major concern and equally major deficiencies of knowledge.

A reasonable assessment of the situation, for our present purposes, appears in a recent editorial from *Chemistry in Britain* (*2*). I quote liberally from it as follows:

> F. S. Rowland proposed in 1974 that, although fluorocarbons were inert in the lower atmosphere, they eventually rise into the stratosphere where they are dissociated by ultra-violet radiation releasing chlorine. Chlorine catalyses a chain reaction which results in depleting the ozone layer. This, he maintains, would result in an increase of ultraviolet radiation reaching the earth and consequently create an increase in skin cancer and have disastrous effects on the world's climate. His original calculations—which have now proved to be inaccurate—were based on small scale studies of fluorocarbons in the atmosphere performed by James Lovelock from Reading University, who has since emphasized that there are other sources of chlorine containing compounds loose in the atmosphere. Although the calculated rate of ozone depletion is less than at first feared, would the effects be as horrific as Dr. Rowland predicts?
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> The amount of ultra-violet reaching the Earth depends on many factors: latitude, altitude, and the length of the day. Theoretically skin cancer increases with a higher ultra-violet level and therefore at high altitudes also, e.g. above sea level. In fact, this has not proved to be the case, as studies by the American Cancer Society have shown. In equatorial regions the increase in ultra-violet intensity does not herald an increase in cancer skin deaths. Veerabhadran Ramanathan has studied the Earth's irradiation balance and has calculated that it would have a "greenhouse effect." Fluorocarbons would absorb heat radiated from the Earth's surface and trap a substantial portion. The polar ice caps would melt if the fluorocarbon concentration increased from 0.1 ppm to 1 or 2 ppm. The thinning of the ozone layer has also been attributed to nitrogen oxide and sulphur oxide

from supersonic airliners' emissions, and to oxide produced from nitrogen based fertilizers.

This whole controversy is likely to continue unabated for several months at least. In the U.S., particularly, the Federal government is considering a ban on aerosols employing fluorocarbon propellants, until 1980 to ensure that further research is carried out. The U.S. National Academy of Science is due to publish an assessment of the likely danger to ozone. Du Pont, the major fluorocarbon manufacturer, is running an extensive campaign to present their views and along with 18 other producers is sponsoring a major research programme. In the U.K. the DoE [Department of the Environment] is preparing a report with the support of the UKAEA [United Kingdom Atomic Energy Authority] and the Met. [Metropolitan] Office in Bracknell. The British Aerosols Manufacturers Association, while confident that there is no danger, is looking at alternatives but stress that it would be several years before these could be utilized.

Quality of Life

A few comments are desirable on that most popular of slogans, the protection of the quality of life. Some cynics suggest that the phrase is the banner of the elite in their intent to protect their world against the depredations of others. The pronouncements of governors of some states, the zoning regulations of towns and cities, and the decisions of some courts give some evidence that people like the amenities they have and would protect them against outsiders who might wish to intrude on them. The "Keep Out" sign has become more noticeable and inevitably has created a polarization between those who have and those who have not. In democratic societies, such contests have surfaced; their solutions present fascinating, earthy illustrations of ecologic attitudes and conflicts.

It is a far cry from the comforts and indulgences of the Western world to the living conditions of the one-and-a-half-billion people on the rest of the globe. They are destined, for a long time to come, to live half starved, half sheltered, and besieged by all the ancient ills which once beset us all. Their quality of life is still characterized symbolically by Mohandas Karamchand Gandhi, the gentle prophet of the world's most extraordinary liberation movement. A half-century ago he walked throughout India with his portable toilet, a graphic reminder of the importance he attached to sound sanitation. In every village, he helped to locate new wells or to improve old ones.

In spite of much progress since then, the plight of hundreds of millions of people in the Middle and Far East remains difficult and sad. The universal attainment of their desired quality of life would encompass a job, food, shelter, and survival beyond the age of 40 years.

The relevance of these contrasts is simply to remind us that there is no average country and no average region within a single country. No average quality of life is available to guide us, and we are driven to select priorities for each situation without the benefit of the 20 or 30 parameters of quality of life recently enumerated by workers in the United States.

Total Management of the Environment

The examples of environmental problems so far listed might well be multiplied tenfold. No mention has been made of the ecologic impacts of energy production, radiation, housing, noise, chemicals, regional management, transportation, airports, oceans, and food supply. Such an exercise would do no more than reinforce the conclusion that ordering the world is difficult. A list of functions necessary for man to exist with minimum ecologic disturbance would be long. It would make abundantly clear that urban New York, Los Angeles, or Chicago could not be viable or livable. In fact they are, even if they are not attractive to everybody.

The challenge is how to manage the environment so as to do a better job than in the past—incidentally, a past which was pretty good! What would be the minimum required ingredients? Here I take refuge in my own observations (*3*).

It is abundantly evident that the world is complex and beset by the vicissitudes of a malignant nature and by the sometime degradations exercised by man. The combination of realities imposes upon the biosphere a series of threats. Their amelioration demands a high degree of sophisticated behavior by man and a selection of priorities of functions guaranteed to improve his quality of life, while preserving to the utmost what nature may profusely make available to him. This is a large order. It demands an illumination of choices, a consequent assessment of priorities, and a vast cultural acclimation to a changing set of values.

Can government provide such a mechanism for continuing, balanced, decision-making? Few governments have provided such a planning and management structure. Most have given lip service to a conceptual total management of the environment (using the term in its broadest sense). Even the few who provide, at central government level, a mechanism designed for total overview, find it necessarily buffeted by the winds of doctrine within its own region and external thereto. Something less than total perspective and theoretical priority naturally result. . . .

What confronts everyone, therefore, is the objective of viewing society's problems as a whole and making a start on listing the most significant and pressing ones. In doing so, there is probably no escape, and there should not be, from arriving at some order of priority. These initial exercises will prove profitable, if not definitive, in disclosing global variation and time parameters.

When one moves to considerations of implementation of solutions, and the necessary attendant decision-making, the hard realities of politics, economics, and social philosophy inevitably intrude. Clarification by scientists and technologists, with all of their analytical tools, becomes an input necessity. At this stage, the unpleasant truth emerges that vast areas of ignorance persist. Their continuing assessment is required, even with the uncomfortable pronouncement "I do not know."

The following refreshing remarks by Lord Ashby (*4*) serve to reassure us that all is not yet lost in our hopes for the future.

The notion that the "balance of nature" is delicately poised and easily upset is nonsense. Nature is extraordinarily tough and resistant, interlaced with checks and balances, with an astonishing capacity for recovering from disturbances in equilibrium.

The formula for survival is not power; it is symbiosis.

Geopolitics, social psychology, social anthropology, political science (despite its name): these are still regarded as second-class citizens in the hierarchy of the sciences. But if my thesis is correct these are the disciplines which will help us to understand, and to influence even if we cannot control, the destiny of Industrial Man.

References

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2. Anonymous, *Chem. Br.* **12**, 1 (1976).
3. A. Wolman, *J. Am. Water Works Assoc.* **68**, 132 (1976). This quotation is reprinted from the *Journal* of the *American Water Works Association*, vol. 68, by permission of the Association. Copyrighted 1976 by the American Water Works Association, Inc., 6666 West Quincy Avenue, Denver, Colorado 80235.
4. E. Ashby, *Encounter* (March 1976), p. 16.