

An objective of the study of public policy and the life sciences is to deepen insight into the influence of bio-behavioral and environmental factors in the course and direction of human development. The following discussion identifies some of the trends and forces that raise serious questions regarding the future toward which human society may be tending.

Aided by science and science-based technology, modern humanity has achieved great material success. But scientific findings also suggest that in pursuit of this achievement human society may inadvertently be putting its future at risk. In remaking the earthly environment, modern society has failed to take into account the full significance of resulting changes in the circumstances of life on earth. Assumptions and behaviors that have served humanity for centuries may no longer be appropriate. The capabilities that have enabled modern humanity to attain present levels of civilization may be insufficient to overcome the risks incidental to this achievement. Accelerating advances in science and technology have enabled humans to reshape the world more rapidly than has growth in understanding of the risks as well as the benefits of these advances.

Having abandoned reciprocity with the natural world in pursuit of command over it, modern civilization has broken an ancient covenant with nature. For centuries humans lived within the parameters of nature, benefitting from its beneficence, adapting to its rhythms, and coping with its adversities. Still interfaced with the natural world, modern humanity lives in an invented environment which appears to be developing more rapidly than have human bio-adaptive capabilities. In consequence there has been a growth of stress on the human mind and body, and on traditional assumptions and behaviors.

Although humans have created the artificial environments called “civilization,” their survival is contingent upon living within the natural system from which they evolved. A critical challenge to humanity is to learn how to live in this natural-artificial hybrid environment which it has undertaken to manage.

We cannot foresee how far or for how long humans will (or perhaps can) adapt their bio-psychological endowment to the contrived environment of human invention. Yet humans must accommodate to those forces of nature which cannot be managed beyond managing ourselves.¹ Those who formulate policy should recognize that if humans pit themselves against the fundamental dynamics of cosmic nature, they are certain to lose. To the extent that natural systems and processes are adequately understood, humans may continue to “manage” nature (with nature’s cooperation). But Francis Bacon’s dictum continues to hold: “Nature to be commanded must first be obeyed.” Without a strong and governing principle of limits built into public policy, the ingenuity of humans may impel them toward their own demise. Limits hold true for all life-forms and will ultimately constrain the direction of human development. If the present widespread commitment to a sustainable future is realistic, people and policy makers must act

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upon the axiom that unfettered growth and unrestrained expansion in a finite system leads toward a condition of cul-de-sac which, if irreversible, could result in destruction.²

There is sufficient evidence of serious risk in the present trend of human society to warrant collective inquiry into its causes, its probable consequences, and possible countervailing strategies. If we fully recognized our relative risks and probabilities, as well as our beneficial possibilities, then perhaps we could redirect our collective efforts with greater assurance toward a more sustainable preferred future. It might be argued that war and civil disorder are presently the greatest threats to the human future. One need not minimize their dangers to also recognize that attrition of the Earth's biosphere and life support systems could continue unobtrusively under conditions of peace until a point at which environmental disintegration led to societal disintegration.

A Future at Risk?

Following the Second World War an unprecedented explosion of human populations, of powerful new technologies, and of advances in the sciences combined to impact the human condition and the environment in highly visible and often disturbing ways. Change has been accelerating faster than has understanding of its ramifications and consequences. Although there have been great advances in quality of life possibilities, perceptive persons have sought to alert society to the accompanying consequences of unbalanced and unsustainable growth and development. For example, in 1970 Alvin Toffler introduced the concept of *Future Shock*—disorientation due to an inability to readily adjust to radical environmental change. Earlier, in 1960, Jacques Ellul in *The Technological Society* warned of societal entrapment through technological ingenuity; and in 1974 Robert Heilbroner in *An Inquiry into the Human Prospect* asked, “Is there hope for man?” Is it possible “to meet the challenges of the future without the payment of a fearful price; the answer must be: no, there is no such hope.”³ These writers, among many more, have questioned the prospect of attaining a tolerable future if humanity continues on its present course.

As awareness of environmental deterioration has grown, explanations and remedies have been sought. Were these events inadvertent and superficial or were there underlying common causes? The conventional popular assessment, (publicized by the news media) has been to regard the environmental problem as a temporary crisis—largely of pollution caused by mismanagement or neglect, and correctable by a few new laws and better engineering. In a more comprehensive science-based perspective the environmental problem is now seen as systemic—multi-dimensional and inherent in socioeconomic trends which, uncorrected, could lead to destructive consequences neither preventable nor remedial by technical or legal means alone. Avoidance would require major social changes—including a reorientation of popular expectations, a redirection of many public policies, and a reformation of institutions impacting adversely upon the environment.

By the 1970s it was becoming clear to all who understood the evidence that the

so-called environmental crisis was a visible manifestation of a much deeper and broader problem involving nearly every facet of modern life. Unfortunately, too few people have understood the evidence, or have grasped the true scope and significance of the environment. The systemic explanation of the causes of environmental deterioration and disaster is radical in a fundamental sense—i.e., reaching for root causes. People commonly perceive their “environment” as the total of numerous separate interrelationships that have no apparent connections. In fact, these interactive relationships are ultimately, even though remotely, connected. Although humans consciously interact with the total environment only in relation to particular aspects or elements, survival as a species may depend upon their understanding that those interactions occur within the infinitely greater and more complex systemic reality. Science is progressively enlarging our awareness of this greater environmental context. Its ubiquitous complexity explains the rationale for the aphorism that “you can never do just one thing.”

Meanwhile, advocates of environmental concern indiscriminately have been labeled “environmentalists” in the news media, suggestive of a special interest not necessarily shared by the general public. Some self-styled “conservatives” see environmentalism as a threat to property rights, free enterprise, and personal freedom. Although there has been a polarization of political attitudes toward environmental legislation, not all “conservatives” are “anti-environmental,” and some “liberals” see the environment as preempting funds and attention from their favored social programs. For people who understand the comprehensive scope of the environment and its interactive dynamics, the state of the environment and its reaction to human impacts, should be a continuing focus for public policy.⁴ To the environmentally comprehending and concerned, the environment is an interest embracing all humanity and encompassing the living world.

That the world is at risk is hardly a new idea—it is as old as prophecy. Based largely on personal revelation, past prophecies were seldom fulfilled. Today, however, there are empirical, measurable means for identifying trends and projecting consequences. They are not regarded as prophecies, but rather as probabilities.

In 1992 the Union of Concerned Scientists published an open letter, *World Scientists’ Warning to Humanity*, which was an informed perspective on the implications of human failure to respond rationally to the changing environmental situation. Over 1,600 signatories from leading scientific academies or associations in 70 countries, including 104 Nobel prize-winning scientists, declared that “Human beings and the natural world are on a collision course.” The warning continued:

Human activities inflict harsh and often irreversible damage on the environment and upon critical resources. If not checked many of our current practices put at serious risk the future that we wish for human society and the planet and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about.⁵

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Warnings to humanity are not new. As early as 1864, George Perkins Marsh in *Man and Nature: or, Physical Geography Modified by Human Action* offered reasons for reflective pause in the indiscriminate course of progress. Publications relating to human impact upon nature appeared with some frequency during the succeeding century. They attracted brief attention but had little immediate effect. Notable among them were *Deserts on the March* (1935) by Paul B. Sears; *The Road to Survival* (1948) by William Vogt; and *Our Plundered Planet* (1948) by Fairfield Osborn. *Silent Spring* (1963) by Rachel Carson, has been widely credited as a spark igniting environmental concern into a social movement, but her book may have inadvertently contributed to a popular impression that chemical contamination (i.e., “pollution”) was *the* environmental problem. These books and others, in addition to numerous essays and conferences, recorded the environmental destructiveness of modern society and described its impoverishing consequences. Although widely reviewed, not until *Silent Spring* did the warnings receive serious attention.

Warnings of growing risks and threatening problems requiring attention continued. In 1969 in the magazine *Science*, John R. Platt, a biophysicist, projected an impending crisis of crises. “There is only one crisis—a crisis of transformation—it is now coming upon us as a storm of crisis proportions from every direction.”⁶ In 1969 Paul R. Ehrlich in the *Population Bomb*, and in 1967 William and Paul Paddock in *Famine, 1975*, predicted catastrophe within a decade. Their chronology was off the mark—but not necessarily the trends basic to their predictions. At least they drew public attention to trends which people and politicians had hitherto largely ignored.

The foregoing publications represent a much larger volume of admonition and prediction which probably furthered the enactment of a large volume of environmental legislation in the late 1960s and early 1970s. An error common to many of these warnings was the forecasting of an approximate date for apocalypse. The trends and consequences which they described were not invalidated by faulty timetables, but the failure of chronological prediction opened the way to discounting the warnings. In 1972, John R. Maddox, editor of the journal *Nature*, dismissed the apocalyptic literature in *The Doomsday Syndrome*. Nevertheless, an intimation of universal destruction continues to attract inquiry and conjecture. *The Encyclopedia of Apocalypticism*, a 1,500-page three-volume collection of essays, has been edited recently by an international team of religious scholars.⁷

Since 1972 a “battle of the books” has been waged between “catastrophists” and “cornucopians.”⁸ Assessments of risk have become cautious on timing but appreciation of the complexities, dynamics, and risks of interacting trends continues. In 1975 Lester R. Brown of the Worldwatch Institute wrote that “Accumulating evidence from around the world suggests that we may be on the verge of one of the great discontinuities in human history—economic, demographic and political.”⁹ Also in 1971, I speculated that “the historical continuity of American society will be broken before the end of the (20th)

Century.”¹⁰ This discontinuity may be less apparent to people now living through it than it will be in historical retrospect. In 1998, Eugene Linden in *The Future in Plain Sight: Nine Clues to the Coming Instability*, drew upon the growing body of evidence indicating trouble ahead to form fictional scenarios of possible consequences of present trends. Also in 1998, Allen Hammond’s *Which World? Scenarios for the 21st Century: Global Destinies—Regional Choices* forecast the possibilities, prospects, and risks for a transformed world. Both books saw the present and near future as a time of choice which would determine the long-term future of humanity.

Although there is now wide recognition of self-imposed risks to humanity, there still remains disagreement on the seriousness of environmental risks and their importance in relation to other issues. Opinions differ over whether humanity is confronted by a number of discrete environmental problems which may be resolved by separate action directed to each of them—“growing pains,” largely incidental to the mainstream of a growing economy—or whether these environmental risks and the damages incurred are manifestations of a fundamental change of state in the world reflecting a major “man-made” discontinuity in the history of mankind. Recourse to science cannot mediate these differences—its findings are more often probabilistic than conclusive. Science has not yet been able to predict with assurance the larger dynamics of the Earth’s biogeochemical systems. Controversy over global climate change demonstrates our present forecasting predicament. Science identifies trends and projects probabilities. But it seldom offers unequivocal predictions.

Crisis or Climacteric?

In an address in 1978 at Stanford University Eric Ashby put the issue in the following way:

I do not underestimate the perils threatening industrial society, though I think that some of the people who warn us about environmental crisis have got their perspectives wrong. Indeed, I think they are wrong to call it a crisis at all. A crisis is a situation that will pass; it can be resolved by temporary hardship, temporary adjustment, technological and political expedients. What we are experiencing is not a crisis, it is a climacteric. For the rest of man’s history on earth, so far as one can foretell, he will have to live with problems of population, of resources, of pollution. And the seminal problem remains unsolved: Can man adapt himself to *anticipate* environmental constraints? Or will he (like other animal societies) adapt himself only in *response* to the constraints after they have begun to hurt?¹¹

Adaptation to a climacteric does not imply the prospect of a clear, constant, or coherent course to the future. The world will need to learn its way into a new paradigm. Mankind is an adaptable species, but adaptation may take many forms depending upon circumstances, human learning, and perceptions. Adaptation offers a road to survival, but may lead to an impoverished or degraded quality of life

as well as to higher and sustainable levels of existence.¹² Anticipatory adaptation to unmanageable changes in the geosphere-biosphere (e.g., global climate change) depends heavily upon timely assessment of environmental trends and action toward preferred or, at least, achievable outcomes.

A profile of the late 20th century reveals contrasting trends. It has been a positive period of steady advances in science and technology coexisting with negative impacts by humanity upon its environment. It has been an age of revolutions—conceptual, religious, political, industrial, and institutional. Yet certain basic assumptions have remained dominant. Among these has been belief in the destiny of humans to grow in numbers, in material economy, and in power to dominate, exploit, and reshape the planetary biosphere—and perhaps even to colonize other worlds. A human habitat without limits has been widely and persistently assumed, despite demonstrable evidence that this vision is an illusion.

Behavioral Problems

Are we then *The Unprepared Society* (1968) in relation to the consequences of improvident responses to unsettling socio-environmental trends—as described by Donald Michael 30 years ago? Outcry against the projections of the 1972 Meadows report, *The Limits to Growth*, and of President Carter’s 1980 *Global 2000 Report* indicated that an outspoken sector of Americans rejected precautionary forecasts and agreed, at least tacitly, with the late Julian Simon that society has been inundated by “a surplus of false bad news.”¹³ It seems probable that a plurality of people want to believe that “the best is yet to be.”

So far as one may generalize, modern society collectively has not comprehended that its course of development has brought it to a basic change-of-state. Success in improving the human condition within the environment has obscured the risks incurred in its achievement. For example, advances in medicine, engineering, sanitation, and agriculture have facilitated an explosive growth of human populations, stressing all elements of the biosphere. Risks that might have been avoided have often been ignored until unwanted consequences become evident (radioactive wastes and biocides). Modern political economies have been administered with minimal understanding of, or regard for, the greater environmental context within which they are encompassed. Damage to the natural environment has been regarded as the price of progress. But this price, (often unnecessary) has bought no protection for mankind’s future.

The modern view of progress has been distorted psychologically in a way that has obscured its cumulative adverse impacts on humanity. Human behavior, while driven by forces both internal (cerebral) and external (environmental), is moved by perception. How people interpret what they perceive is largely determined by their own experience within their culture, and is a legacy of generations past, transmitting interpretations of reality which may persist as after-images even though the reality has in fact changed. The man-nature dichotomy, the conquest of nature ideology, material expansion, and perpetual growth have long been

dominant themes of modernity. They continue to be mantra of social behavior, albeit increasingly at odds with science-based holistic systemic perceptions of reality.

Only within recent decades has the paradigm of a world environment as an interactive multiplex feedback system with diverse and contingent limits begun to be comprehended among informed people. General Systems Theory advanced this concept and by the 1970s, systems interpretations of the world environment began to attract notice.¹⁴ In 1972 the Club of Rome initiated a series of reports on the “problematique”—“the predicament of mankind”—which assumed a multi-systemic world environment.¹⁵ Moreover the “system” is synergistic in that changes affecting one aspect of the system may cause changes in other parts of the system.¹⁶ It is truly impossible to do just one thing. Yet few people appear to understand that the ultimate environment *is* an interactive system and more, because it exists within a dynamic cosmos without which our living world is inconceivable. The systems synergistics concept implies an ultimate unity of knowledge, elaborated recently in writings by E.O. Wilson (e.g., *Consilience: The Unity of Knowledge*, 1998). Yet our published knowledge of the world remains largely specialized and segregated. This may be unavoidable if research is to advance detailed knowledge. But there is also need to appreciate the connective, integrative, interactive aspects of holistic knowledge which we seem poorly equipped to comprehend, but ignore at our peril.

Why have responses to repeated and authenticated warnings of the consequences of exponential growth of the human economy been largely ignored, denied, or rejected? The reasons appear rooted in two interconnecting realms of comprehension. One may be an underdeveloped mental capacity to envision our situation on the time-space trajectory of the real world. There are today, however, vigorous organized efforts to forecast and evaluate possible futures, but they have been confined largely to so-called epistemic (like-minded) communities with little visible impact on public opinion or policy.¹⁷ To the extent that this is a deficiency, it limits our ability to perceive the interconnectedness and to evaluate consequences of trends. The connected other realm is cultural—a composite of social convention, tradition, faith, institutional inertia—and perceived self-interest. These possible root causes may be examined separately—but in the human persona they integrate to form a coherent outlook on life. The vision may be erroneous yet satisfying to a human urge for coherence and consistence with a personal view of self interest.¹⁸

The most basic and important questions regarding human behavior have yet to be answered empirically by the sciences of the brain and nervous system, complemented by sociobiology. Our assumptions today are largely based upon inference. Yet inference, drawing on human history and observed behavior, may lead to pertinent questions and hopefully to reliable hypotheses toward averting hazards to the future. Returning to our question: Have the evolved capabilities of the human mind and culture failed thus far to sufficiently equip humanity to comprehend and evaluate the consequences—good or bad—of its accelerating far-

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reaching impact upon its environment and thereby upon itself? Jay W. Forrester, systems scientist at MIT, thought so, and in a 1971 article published in *Technology Review* he wrote:

It is my basic theme that the human mind is not adapted to interpreting how social systems behave. Our social systems belong to the class called multi-loop nonlinear feedback systems. In the long history of evolution it has not been necessary for man to understand these systems until very recent historical times. Evolutionary processes have not given us the mental skill needed to properly interpret the dynamic behavior of the systems of which we have now become a part.¹⁹

Forrester's hypothesis suggests three comments. First, his observation regarding the behavior of social systems applies equally to our comprehension of "natural systems." Indeed, human social systems collectively may be regarded as a very special natural system characterizing the human species. There are other social systems in nature, notably among primates and certain insects, with a survival success record far longer than that of humanity.

Second, although biological evolution may not have initially given us the capabilities needed for valid perception and appropriate response to the multiple systems which affect our future, it does not follow that the human mind lacks an innate capacity to learn to respond rationally to the interactive dynamics of the environment. Yet it appears that human inventive ingenuity has been outrunning the underdeveloped anticipatory disposition of the human mind. History demonstrates that human societies have a capacity to learn, but it is not merely the process of learning that is necessary. Wrong lessons may be learned. The survival value of our learning is to apprehend the realities of this world and to act in consistence with its parameters. Its larger purpose would be discovery of the road to survival. It seems doubtful if many people today if they thought about it at all—would regard this as a practical or useful activity. Personal mortality is conceded—the possible collapse of human society is a subject for writers of science fiction—hardly a present issue. But humanity cannot survive apart from the biosphere within which *Homo sapiens* evolved; the artificial environment of the spaceship is a false facsimile of the planetary environment. If the *World Scientists Warning* is valid and the timing of environmental change is uncertain (the future may arrive sooner than expected), the risks that human society is incurring ought not be dismissed as unfounded alarms.

Third, Forrester appears to have believed that innate human mentality *can* be extended and enhanced by learning the processes of systems dynamics simulated by the computer, thereby enhancing the perceptive and reasoning processes of the mind. Humans *may* learn from computers how to identify and diminish risks, and to direct behaviors toward desired outcomes that are consistent with the way the world works. This is an optimistic expectation.

Computers may simulate intelligence, but they have not attained an autonomous creative intelligence (admittedly an ambiguous concept). We may

never develop a computer with rational capabilities independent of engineer or programmer. A problem must at least be partially formulated in the human mind before its substance, significance, and possible solutions can be delineated by the computer's heuristic capabilities. Thus the utility of the computer as a simulator and problem-solver is ultimately dependent upon innate properties of human mentality. And computerized responses to inputs of information cannot be more reliable than the adequacy and validity of that information. The findings of artificial intelligence may not be sufficiently persuasive to overcome incompatible paradigms or mind-sets long-embedded in human culture, and reinforced by perceptions of personal self-interest.

Policy choice for the future is complicated by cognitive dissonance over questions involving relationships between population, resources, and environment. There has arisen a choice dichotomy between the perceived advantages of a continuous growth economy and, alternatively, sustainability of the environment. There appears to be a popular belief in the reality of environmental problems, but also in the necessity for economic growth and a consequent commitment to inevitable increases in human population and material consumption, infrastructure development, job-creation, and global commerce. There is emotional resistance to the concept of limits even though reasonable people might concede that growth cannot continue forever.²⁰

Problems commonly described as “environmental” are therefore often “human behavioral.” For example, our assumptions and assessments regarding environmental disasters commonly misconstrue their causes, externalizing them in nature rather than internalizing them in misguided intentions and unrealistic expectations. Humans reveal a seemingly infinite capacity for evading recognition of their own errors—seeing themselves as victims of nature instead of collaborators in their own misfortunes through lack of foresight regarding the predictable behavior of nature. The question remains whether the intransigence of perception is so persistent, reason so firmly bounded, and perceived self-interest so compelling, as to preclude informed and realistic choice toward preservation of the quality of life and the environment.

Many common environmental disasters are “normal accidents.” They are largely predetermined by inadvertence, misconception, inattention to the demands of high risk technologies, and to perverse defiance of nature, such as building habitations on coastal barrier islands, in river flood plains, on semi-active volcanos, or on geologically unstable terrain.²¹ Thus the causes of “human disasters” are too often behavioral. Self-destructive behavior is also exemplified in tolerated indifference to environmental degradation caused by exploitive farming, grazing, mining, deforestation, and development, and by the release of synthetic chemicals into the environment which may threaten reproductive fertility, intelligence, health, and, at worst, possibly survival.²² Creative destruction by natural forces

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becomes human disaster when humans have made themselves vulnerable to predictable natural events. Foresight and prudence will not avert all environmental misfortunes, but implemented in policy they might avert or diminish those predictable catastrophes metaphorically described as Nature's Revenge.

Driving Forces

External forces of the environment and the internalized forces of mind and culture drive humanity along a trajectory into the future. That future is being shaped by interactions among those forces which, depending on their relative strengths, and directions may lead to very different ends. Their aggregate effects, however, may not be easily foreseeable. We are only now beginning to see them as inherent in a multilinear-multiloop feedback system. And we are only beginning to understand how the human mind perceives this "reality." The course of human society is being driven by forces which, inseparable from our world, from one another, from ourselves, and within ourselves, influence our future in the following ways:

Planetary Change. The most formidable external forces affecting the future are changes in the basic physical systems supporting life on Earth. The Gaia hypothesis describes the geosphere-biosphere (the living Earth) as a self-generating, self-renewing system.²³ In the 20th century, however, humanity has become a force of planetary proportions for change within this system, with consequences only recently becoming subjects of scientific inquiry and policy concern. Conjectures for the future vary widely, but the weight of scientific opinion appears to regard measurable changes in the planetary system as cumulating, interacting, possibly irreversible, and impacting decisively on humanity's future. All of the threatened aspects of environmental change identified in the *World Scientists Warning to Humanity* are affected by anticipated changes in the global climate affecting the atmosphere, oceans, fresh water, soil, forests, and living species. Unlike the following driving forces, this concurrence of planetary forces can be influenced but not controlled by human behavior. Their properties—chemical, physical, and biological—are beyond management except where "permitted" by the laws inherent in a particular natural system.

Population. Today there is one human force that is driving the expansive course of the material economy and stressing all parameters of the natural environment. It may be the most significant factor in the prospect of societal self-destruction. This is the unprecedented and presently irreversible explosive growth, dispersal, and concentration of human populations. There are few real environmental, economic, and social problems that would not ultimately be significantly eased if world populations were stabilized below present and projected levels. The interactions of population, resources, environment, and the economy are complex and controversial. Generalizations risk error; and yet the adverse ecological and sociological consequences of unrestrained population growth seem undeniable—albeit nevertheless widely denied. If society overshoots the limits of sustainability, retrenching to a stable state would likely be painful and disruptive.²⁴ Whether

democracy and individualism as we know them could survive a reverse transition is, at least, questionable.

Numbers count in numerous ways. But continuing human preemption of physical space, habitat, and natural resources seems certain to destroy the living world within which humanity evolved. It is plausible that human populations are today too large to sustain indefinitely their present demands upon the planet. Yet their numbers are projected to grow into the coming century and their demands upon the Earth to increase.

Reproductive practices that served humanity during past centuries have now become counter-productive for humanity as a whole, and are the major force driving the environmental future over which humans, in principle, have control. At some point the adverse effects of overpopulation seem certain to stop, stabilize, or reverse population dynamics. It remains to be demonstrated whether or how the so-called demographic transition to stabilization will relieve the social and environmental pressures attributed to over-population. A sudden collapse of population levels would have, at least, a short-term disruptive effect on human society. The oft-rejected concept of optimal population may have future relevance.

The question of optimality has a practical relevance to the inordinate concentration of population in urban centers, variously called megalopoli or conurbations. The socio-ecological implications of these concentrations of unprecedented size are not yet certain. Some students of behavioral abnormalities have identified a condition of “pathological togetherness” resulting from stress-inducing overpopulation in confining areas. Symptoms range from interpersonal indifference and rudeness to serious socio-psychological disfunction and violent crime.²⁵ The “urban problem” has been exacerbated as cities become havens for increasing numbers of the world’s poor, low-skilled, and dispossessed, often with not easily accommodated ethnic differences.

Cities have historically concentrated populations and, given the available technologies and notably through interpersonal communication, were centers for the advancement of civilizations. Today unprecedented changes in communications technologies have diminished the importance of geographic location for numerous intellectual, economic, and professional activities. New modes in transportation similarly facilitate decentralization. Whether social demographics and the consequences of crowding will diminish the magnetism of large cities is a question yet to be answered. Advancements in television and the internet may diminish the importance of large cities as cultural centers. Decentralizing trends are proceeding in government administration.

Defensible answers to the “urban question” may well be forced before the end of the 21st century. Meanwhile, such indirect evidence as we now have regarding the effects of crowding within species does not encourage expectations of continuing benefits from growth. Stabilizing populations at significantly reduced numbers would greatly improve the human prospect. But this objective seems far from acceptable in today’s world. There would be pain in the transition—the benefits in the long-range future. The plausible expectation is that humanity will be

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*“Understanding
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unwilling or unable to attempt this transition until it is imposed by forces exceeding human volition or control. The possibility of disastrous consequences for humanity should not be discounted.

Energy. To the extent that humans influence their future, choice in the sources of energy is fundamental. Through science-based technology modern society has drawn upon a growing number of energy sources in ever growing quantities and for growing purposes. Some of these—nuclear and (e.g., liquefied natural gas) chemical have high-risk potential and others, especially fossil fuels, have disruptive ecological and economic effects. Modern society has become absolutely dependent upon a steady flow of engineered energy. This success has had the paradoxical effect of enabling an enormous increase in the global economy and in population. It has also increased the vulnerability of society through the destructive potential of high risk forms of energy and from possible deprivation of critical energy flows. But an unlimited supply of safe, virtually costless energy would pose a formidable challenge to human judgment, restraint and morality.

Technology. Energy forces have been “harnessed” through technologies increasingly based on scientific knowledge. Technology infuses almost every aspect of modern life and, as with energy, has mixed effects. Although it has immensely advanced the quality of human life and enlarged capabilities and especially tools of learning, technology applied can have both constructive and destructive consequences. Thoughtful analyses have addressed the paradox that as humans extend technology, technologies tend to control human behavior.²⁶ “Technocracy” has become a term descriptive of the controlling force of human invention in modern society. Bio-technologies for behavioral control may become acceptable options in the future, modifying current attitudes toward criminal justice and civil rights. Their effects may be malign as well benign.

Information. What people believe or disbelieve can make a determining difference in future-shaping choices and decisions. Modern society has been definitively, although erratically, shaped by scientific knowledge and through communication technologies. Yet there is an anomaly in popular beliefs about the world and the future—a dichotomy between religious and scientific explanations about the workings of the world, and conflicting beliefs about how things ought to be. Science does not address nor have reliable answers to many questions affecting the future—and there is a popular inclination to be skeptical of scientific findings which conflict with what people want to believe. Moreover there is risk in the ever more abundant rapid flow of information causing people to suspend all belief—having no basis for assessing the validity of contradictory messages.²⁷

Convention. Custom shapes convention in many aspects of human belief and behavior—notably in values, economics, ethics, politics, and religion. In his letter on Knowledge and Faith (1841) Cardinal John Henry Newman observed that: “Many a man will live and die upon a dogma; no man will be a martyr for a conclusion.”²⁸ Scientific findings have limited persuasion when not internalized by faith in the scientific approach to knowledge. Conventional belief and behavior are commonly resistant to science-based findings perceived as contrary to “common

sense.” Institutionalized convention, especially in government, provides social stability, but often retards needed change. But conventions may become facades, vulnerable to shattering in unforeseen attitudinal change, especially in response to post-catastrophe trauma.

Innate Tendencies. Human responses to all of the aforementioned forces are mediated by apparent predispositions in human nature. Although the world has known saints, the 20th century offers little ground for faith in the corrigibility of human tendencies toward aggression and violence. To the question of the malleability of mankind’s future the insight of a poet may sometimes be as revealing of beliefs as the uncertain conclusions of empirical inquiry. Robinson Jeffers wrote that:

It is good for man to try all changes, progress and corruption, powers, peace and anguish, not to go down the dinosaur’s way until all his capacities have been explored: and it is good for him to know that his needs and nature are no more changed in fact in 10,000 years than the beaks of eagles.²⁹

Basic needs and nature may perhaps remain unchanged, but may be informed and disciplined. The human future may depend upon social learning—the transposition of knowledge into culture and behavior. How this may be accomplished is being addressed by anthropologists, psychologists, and sociobiologists, and educators, although the route to an adequate answer is inherently metadisciplinary.

Assessing and evaluating the driving forces of change in our society would rationally seem a high priority for the shapers of public policy. But although society might benefit, discerning examination regarding the effect of alternative policies on the future (a goal of futurologists) has been risky to pursue in professional politics.³⁰ The Congress of the United States has repeatedly declined to consider legislation for an institutional capability to assess trends in population, resources, and environment. The National Environmental Policy Act, Title II, places this responsibility on the Council for Environmental Quality, but neither congresses nor presidents have supported its implementation. Conservative opinion rejects it as a step toward centralized social planning. Commercial interests fear constraining regulations and adverse effects on “consumer confidence.” The cold reception of the cautionary *Carter Global 2000 Report* contrasts with the warmth of public response to Ronald Reagan’s reassurance that “It’s morning in America.” Findings and recommendations of “blue ribbon” national commissions that address issues of basic public importance have been ignored and their very existence forgotten by presidents, congresses, the information media, and the public.³¹

A case may be argued that the principal handicap to rational and sustainable policy choice lies in the character of contemporary society which from some view points may be described as “chaotic.” In our expanding and complexifying world system, conflicting forces drive toward inadequately examined and frequently incompatible probabilities. Chaos theory has been invoked as a suggestive heuristic

toward discovery of which among convoluting forces are more likely to dominate the future. More influential is the belief that science-based rationality alone is insufficient to ascertain or guide the course of social development—and that collective individual choices responding to “policy-neutral” market-like forces will lead to the best of all possible worlds. Emotional and intuitive aspects of human values and behaviors are resistant to empirical inquiry—but society could benefit if their origins and consequences were better understood and evaluated.

Choice or Necessity?

At our present state of knowledge it still seems rational—with some reservations—to believe that social choice is possible. In the concluding lines to his book *Chance and Necessity* (1972) biologist Jacques Monod wrote:

The ancient covenant is in pieces; man knows at last that he is alone in the universe’s unfeeling immensity out of which he emerged only by chance. His destiny is nowhere spelled out, nor is his duty. The kingdom above or the darkness below: it is for him to choose.³²

But we do not know the extent to which meaningful choice is really possible. Human society may be driven by innate forces which in effect determine human destiny. Choice may be an illusion. The fate of *Homo sapiens* may be destined by evolutionary “necessity,” overriding all hypothetical rational choice. But until forced by evidence to this conclusion, it seems reasonable to assume that humans possess or may acquire the capacities to make the choices necessary to a sustainable future.

Rational choice, however, implies recognition of requirements for ecological and psychological integrity within the complicated, multi-linear dynamic social system through which modern society impacts upon nature. In a rational world this recognition would imply a major conceptual reorientation regarding human relationships to the Earth. Numerous collateral changes in expectations, behaviors, and institutions would be involved in turning the course of our giant worldwide political economy comparable, on an immense scale, to turning the course of a giant ocean liner—a Titanic task.³³ Before this could happen there must be broad international recognition regarding the danger ahead. A paradigmatic change of this magnitude requires social learning, about which we yet have much to learn. And this learning requires public leadership and time.³⁴ But timeliness is also required. Turning begun too late may be unable to avoid disaster.

Change of direction is not without costs, some of which may not be payable under our present socio-political-economic order. Democracy as we know it today tends to be primarily responsive to here and now and organized particularistic interests. Deterred by “sunk” investments in unreliable expectations, the political economy may be unable or unwilling to bear new costs which corrective and redirective action would require. Faith that freedom is best protected by competition among interests may be misplaced if applied to issues critical to the

future of all humanity, and in which human society must concur and cooperate if it is to cope. The veritable world is more than a political economy, and neither governance through competition nor the opaque forces of the market place will modify nor nullify the dynamics and limitations of nature.

Redirections implied by the *World Scientists' Warning to Humanity* may be beyond the readiness of present world society to implement. Scientists are better able to warn against what should *not* be done than to advise on how to avoid destructive decisions. Self-destructive improvidence by humanity does not necessarily imply biological extinction—more likely is the decline of human potential and loss of higher qualities of life achieved over centuries of time. Alternative futures comparable to those depicted by Aldous Huxley in *Brave New World* (1932) and by George Stewart in *Earth Abides* (1949) are more plausible than is disappearance of the human species. Humanity may destroy its higher achievements, and degrade and impoverish its environment, but an environment remains—much poorer than the one in which humanity arose, seemingly to dominate. Impairment of the conditions—ecological, moral, and material—that made human achievements possible could diminish or destroy the prospect of their continuance or recovery. History demonstrates that human achievements can be lost. The greatest loss to the human species could be loss of confidence in its own rationality, and weakening of its will to cultural survival.³⁵

Evidence that the modern world has put its future at risk is persuasive of the need to critically examine the direction toward which future-shaping actions appear to be tending. If the coordinated efforts of science and social research, aided by government and the shapers of public opinion, were focused realistically on the effects of critical trends, a credible assessment of our present policies and practices might be forthcoming. We may then have more reliable evidence for encouraging constructive trends while correcting those leading toward unwanted consequences. Some efforts in this direction are being made, but have not yet reached the level of a major social purpose.

The prospect of such an integrative social effort is utopian; but utopian goals are not invariably impossible—the unprecedented material achievements of the 20th century would have been utopian in the 19th century. If those achievements are sustainable beyond the 20th century a more difficult set of goals must be pursued. They may be more difficult because their formulation and achievement depend for realization on underdeveloped resources of the human mind. Humans have thus far not been notably successful in verifiable explanations of themselves to themselves. Understanding why we behave like human beings is surely the ultimate challenge to human intelligence.³⁶ But we should recognize that this understanding could carry with it unforeseen consequences. Our findings might complicate our preferred self-images and expectations.

Research in the multi-disciplinary social-behavioral sciences calls to mind the parable of the blind men and the elephant. To attempt to ascertain the trajectory of human history is more than an elephantine task. Yet I believe that there is an intellectual and, more importantly, a moral imperative for more students of human

*“How to act
is a matter
of policy,
legitimated
through politics
and
implemented
through
governance.”*

society to accept this undertaking. There is more agreement in science and academia regarding the risks confronting society than there is on those which are avoidable and those that are not. To sort out the risks and identify priorities for public choice and policy would require a collaboration among all sciences and the humanities. Disciplinary specialization would continue in importance, but could have greater value when it contributed to this larger agenda. Consilience among the disciplines would require personal leadership, social learning, and reciprocity among investigators.

In her presidential address to the 1997 Annual Meeting of the American Association for the Advancement of Science, Jane Lubchenco summarized the issue in these concluding paragraphs:

It is time for the scientific community to take responsibility for the contributions required to address the environmental and social problems before us, problems that, with the best intentions in the world, we have nonetheless helped to create. It is time for a reexamination of the agendas and definitions of the “grand problems” in various scientific disciplines.

We can no longer afford to have the environment be accorded marginal status on our agendas. The environment is not a marginal issue, it is *the* issue of the future, and the future is here now.³⁷

Discovery of what must be done to move from a course that possibly threatens global destruction to one of global sustainability must surely be a compelling task for sciences relating to human behavior. What to do may be inferred from the integrated findings of the sciences. How to act is a matter of policy, legitimated through politics and implemented through governance. A profound global shock may be required to move leaders in government and the economy to weigh the costs of major socio-economic change against the possibility of environmental degradation or irremediable disaster. But they will not be moved until there is unmistakable public recognition of the need for change—popular concern sufficient to jeopardize their political careers should they not take a lead in action. If modern society is on a collision course with nature (as mounting evidence suggests) a major change in prevailing assumptions and behaviors will be necessary. A Chinese proverb warns “If you do not change direction you will end up where you are headed.”

If choice rather than necessity is an option available to humanity, what courses of action might be taken toward realizing the probability that the direction of development will lead to outcomes that are preferred and sustainable? In summary, there are four connected lines of action.

The first is an analysis and evaluation of major social-environmental trends. The federal government has from time-to-time sponsored studies of particular trends since the report in 1933 of President Hoover’s Research Committee on Recent Social Trends.³⁸ Reports of national commissions (e.g., on population, material resources, and public lands) have had minimal effect, and the Congress

has consistently declined to consider a continuing program for the analysis of interacting trends in population, resources, and environment. Non-governmental reports such as those published by Lester Brown's Worldwatch Institute provide public information, but there is need for inquiry built into the processes of national policymaking if action is to follow.

A second line of action, more difficult, is the universalizing of an ethic of environmental stewardship and sustainability. Calls for this ethic may be found in numerous high-level international declarations and in Title I of the United States National Environmental Policy Act.³⁹ Adoption of this ethic has been growing but the greater part of humanity appears locked into assumptions and values which, in practice, prejudice humanity's future. Universalizing an ethic for sustainability is a task which government alone cannot accomplish—but may assist. All sectors of society must somehow be involved. There is evidence that this ethical transformation is occurring. Whether it is moving far enough or fast enough is less certain.

A third line of action, essential to an ethical conversion, is persuasion through communication. People are unlikely to commit to propositions that they do not understand—or which contradict conventional beliefs and behaviors. They may also reject propositions that they perceive as contrary to their personal interests and objectives. The art of persuasion has been highly developed by advertisers, politicians, and evangelists. But I am uncertain whether we have learned how to persuade people to accept disagreeable truths without deception. There is practical wisdom in the observation of Jack Point in Gilbert and Sullivan's *Yeoman of the Guard* that “. . . he who'd make his fellow creatures wise should always gild the philosophic pill!”

A fourth line of action follows from the necessity for informed and responsible leadership in communication. In democratic societies this role falls especially to leaders in the formulation and explication of public policy. Donald Kagan in his book *Pericles of Athens and the Birth of Democracy*, states the necessity persuasively.

A democratic leader, to be great, must be a teacher. For whatever the nobility of his vision and the excellence of his goals, they cannot be achieved in a free society unless the people truly share and are inspired to accomplish them . . .

Any successful society must be an educational institution. However great its commitment to individual freedom and diversity, it needs a code of civic virtue and a general devotion to the common enterprises without which it cannot flourish or survive.⁴⁰

Will a critical mass of society accept the leadership required to move humanity toward a sustainable and sanative future? The state of the world today may justify hope, but does not encourage optimism. Hope for a preferable future will be of little avail unless joined to action. The resources needed to sustain mankind's tenancy on Earth are present and available. How they will be used will determine the future insofar as that future may be shaped by human minds and hands.

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