

**The Future Eaters: Metaphors and Aphorisms
as Environmental Teaching Tools**

John Cairns, Jr.

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A collection of papers by
John Cairns, Jr.

met-a-phor

Pronunciation: \ 'me-tə-, for also -fər \

Function: *noun*

Etymology: Middle English *methaphor*, from Middle French or Latin; Middle French *metaphore*, from Latin *metaphora*, from Greek, from *metapherein* to transfer, from *meta-* + *pherein* to bear — more at [bear](#)

Date: 15th century

1 : a figure of speech in which a word or phrase literally denoting one kind of object or idea is used in place of another to suggest a likeness or analogy between them (as in *drowning in money*); *broadly* : figurative language — compare [simile](#)

2 : an object, activity, or idea treated as a metaphor

aph-o-rism

Pronunciation: \ 'a-fə-, ri-zəm \

Function: *noun*

Etymology: Middle French *aphorisme*, from Late Latin *aphorismus*, from Greek *aphorismos* definition, aphorism, from *aphorizein* to define, from *apo-* + *horizein* to bound — more at [horizon](#)

Date: 1528

1 : a concise statement of a principle

2 : a terse formulation of a truth or sentiment : [adage](#)

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FOREWORD

I take it as axiomatic that metaphors are essential to communicating complex topics. In 1995, I began explicit introduction of activities to focus student awareness of metaphors in communication. In 2002, I received a small grant to investigate and develop materials for the applications of metaphors in science education. Among many other findings, two really stand out: authors Miller (*The Body In Question* 1978) and Bronowski (*Science and Human Values* 1965) clearly illustrate the utility, if not the necessity, of using metaphors and alternative approaches to communications in and about science. At any level of discourse, access to adequate shared or explicit metaphors facilitates meaningful communication. So important are they that a wide body of technical literature (such as *Women, Fire and Dangerous Things: What Categories Reveal about the Mind*, Lakoff 1987 and *Metaphor and Thought*, Ortony 1993), among others) goes far in stimulating conversation and thought on their applications.

I teach high school science. Specifically, I teach high school biology, chemistry, anatomy, and physiology, and, from time to time, advanced placement biology. In the past, I have also taught physics. I teach these classes with a deliberate awareness of the symbolic, metaphorical, analogic, or aphoristic approaches to communicating with my students about the topics. In the past, I have engaged my students in extensive self study of explicit and implicit metaphors that influence their school experiences. Postman's (1995) *The End of Education: Redefining the Value of School* contains an excellent introduction to this approach in the chapter "The Word Weavers/The World Makers." So, not only have I tried to engage students in the impact of metaphors on their lives (if we see them as seedlings to be nurtured, we treat them differently than if we see them as resources to be honed into a finished product), but I also try to give them ample opportunities to become aware of their own needs and applications of metaphors in their own understanding of the scientific topics they study.

These activities have led to assignments in which students make their applications of metaphors explicit to such subjects as atomic structure, cell anatomy and physiology, DNA transcription and translation, and various other topics. I also, from time to time, point out to them the limits of metaphorical descriptions and the pitfalls of sticking to a metaphor beyond its useful applications. This work has led to my involvement in more technical research studies of the applications of metaphor, such as in the work of Reese (2003).

I write all this by way of showing that the use of metaphors is not something that I enter into casually. I have given it explicit thought in preparation of materials and activities for my students and have paid attention to their engagement of the application of and study of metaphors over the years. I am always on the lookout for additional information about metaphors and more metaphors for them to apply. This collection of writings by John Cairns are among some of the more useful ones I have encountered.

Several years ago, when I was developing materials for my students to use in studying the concepts associated with "sustainability," I came across the works of Cairns. I was immediately taken by several aspects of his work. First, of course, was the extensive and elaborate scientific background that he has. His meaningful contributions to the field of ecology and associated areas, in his own research and his sponsorship of graduate students, are without question. Anyone interested in the extent of these contributions can examine his vitae at his web site (<http://www.johncairns.net>). I wanted to be sure my students were accessing a sound scientific foundation. However, his articulate way of expressing complex and complicated interdisciplinary concepts, often with a sharp wit and pointed voice, most drew my attention to his work, and, consequently, also drew the attention of my students. Several of them completed class "final projects" in which they analyzed some of Cairns' writing – responding to and critiquing his works as they applied to the topics being studied in the sustainability sessions of our study of ecology and environmental science. One student, who had presented intelligent disagreement with some of Cairns' views while in high school, upon engaging related material her first year at the University of Virginia, wrote to say she felt that the class, and his writings, had given her a good background with which to work.

Over the years, as I continued to read Cairns' works, I began to note how he had a consistent way with words, often taking complex topics and succinctly, clearly, and, sometimes, forcefully bringing home his point – even coming across at times as very bold and an in-your-face manner in his message. These writing characteristics point out to the considerate reader that the topics on which he writes, and the message that he sends, are increasingly of urgent and important concern. One writing skill is his ability to hone a fine point with a metaphor that immediately brings home the "meat" of his message, making the content and intent clearer and memorable. The writings in this collection are exemplars of concision and clarity. Almost all, even the briefest, cite references that have been synthesized into his comments.

So, in my classes, I explicitly use metaphors to illustrate and elucidate essential meanings associated with the topics. I incorporate explicit activities to give students opportunities to study the metaphors they use

and to create/play with their own. I try to show students how the metaphors that professionals and policy makers use impact how they are treated in their schooling. I refer them to, and sometimes require that they engage, materials that present complex and complicated issues and concepts using metaphorical applications. I have found Cairns' works particularly useful at times in addressing issues in environmental science.

To bring home the point, since I want my students to be able to hit the ground running and have the tools to overcome the barriers on the path to understanding and assimilating information, transforming it into food to nourish their growing minds in this garden of learning called school, his writings present a cornucopia of meaningfully prepared nutrients to help sate their hunger. His words will help them to see the elephant in the classroom and avoid creating an alien planet while they hone the skills and develop the tools to stop, or at least slow, the future eaters.

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PREFACE

The genesis of this e-book was an invitation to act as a Special Guest contributor for the E-Conference "Climate Change and You: Putting a Face on Global Warming" (EcoRes Forum Online Conference #3, October 19-29, 2009, www.eco-res.org). Special Guests were asked to make two postings before the beginning date of the conference and to make two postings each day thereafter. From my participation in previous e-conferences, I know that short postings are most effective. I began the writings using metaphors and later moved on to aphorisms. The title of this E-book comes from an earlier publication I had based on a metaphor.

The final impetus came via an e-mail from a teacher at a local high school, with whom I had worked some years ago. He was inquiring about any books in print on the use of metaphors in teaching. Consequently, this e-book has two goals: (1) to reach as many teachers and students as possible (free for downloading should aid in this goal) and (2) to add to the e-book after its first appearance with updates).

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The Future Eaters: Metaphors and Aphorisms as Environmental Teaching Tools

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THE FUTURE EATERS

I don't think God is going to ask us how He created the earth, but He will ask us what we did with what He created. Rich Cizik

In times of change, learners inherit the Earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists. Eric Hoffer

You're not going to get success on the environmental struggle without getting people to agree to cut back their level of consumption and reorder the planet in a way that is ecologically rational. Rabbi Michael Lerner

A visitor to a village in Russia where the inhabitants were starving noticed some stacks of grain nearby. "Why," he asked, "don't you eat that grain?" The patriarch impatiently explained that the seed was being saved for next season's planting. "We do not steal from the future," he said. The 20% ecological overshoot (discussed elsewhere at this website or at the internet site of the Global Footprint Network) in 2002 took 20% more natural resources than the planet could regenerate. The United States now has an ecological overshoot of 3.6 hectares per capita. This overshoot is a measure of how humankind is "eating" its future.

Exceeding Earth's carrying capacity will almost certainly result in societal and ecological disequilibrium that will, in turn, reduce carrying capacity. However, another situation, called phantom carrying capacity, will exacerbate present carrying capacity problems. Phantom carrying capacity is the result of exploiting the benefits of oil, natural gas, and coal. These energy sources will not be regenerated in the short (i.e., a quick fix) time frames that most people expect. Alternative sources of energy could contribute to reducing ecological footprint size. For example, biofuels produced by agribusiness are typically produced by highly mechanized practices, use fertilizers that are based on petroleum, and require processing before they are useful in engines. The amount of energy used in the production of alternative sources of energy contributes to the footprint size. Some sources, such as the Athabasca tar sands, are difficult to process and require significant amounts of energy to do so.

Solar and wind energy are good alternative energy sources, but they do not have zero footprint size (e.g., they involve solar panels and windmills). Reestablishing public transportation in those countries that have permitted, even encouraged, its decline will take one or more decades. Major reductions in urban sprawl will take longer, even if adequate public transportation becomes available. Eliminating ecological overshoot is closely linked with population stabilization, but could begin immediately if humankind is truly concerned about future generations.

Only those humans alive after 1980 can be described as "future eaters" or people who consume "grain"/resources that are meant for future generations—future eaters are stealing from the future. Individual future eaters have probably always existed because numerous cultures have depleted natural resources faster than they were being regenerated (e.g., Ehrlich and Ehrlich 2004, Diamond 2005). However, economic globalization and population growth have increased humankind's ability to deplete natural resources. As usual, exponential growth ensured that the problem materialized quickly, long before social evolution had developed behaviors and practices to cope with this dangerous situation.

No justification can be given for not addressing this problem immediately!

Step 1. Calculate individual ecological footprint sizes. Many programs are available on the internet for calculating an individual's ecological footprint size and can be rapidly completed (a more detailed reference is Rees 1996). The result may be shocking, especially if the calculation is for a person who considers him/herself environmentally literate and who could not possibly be a future eater.

Step 2. Identify the major factor that determines an individual's ecological footprint size. Both the ecological footprint size and control of the footprint size will vary at different stages of an individual's life. Individuals have least control when they are very young or very old. My own life (I am 82 years old) illustrates this point.

I was born in the small factory town of Conshohocken, Pennsylvania, USA, in 1923. I grew up during the time of the Great Depression in the United States. My family's house was small, semi-detached (one wall shared with an adjacent house), and heated with coal. In those days, most houses were kept much cooler than they are today and had far fewer energy consuming appliances. I walked to school and used public transportation for longer trips. I could ride my bicycle to go fishing or to visit natural systems. The family automobile was mostly used on weekends to visit relatives (20 miles or less). Food was obtained from a nearby small grocery store and was mostly produced locally. Most summers included a vacation (two weeks) near Ocean City, New Jersey (about 80 miles distance). When I became a student at Pennsylvania State University in 1940, all my clothing fit in one suitcase and I carried a winter overcoat over my arm. Once there, all my travel was by foot. Although I had little control over it, my ecological footprint was quite small. For most of my education after World War II, I commuted by public transportation but did have a car for a significant amount of time that was adequate for short trips.

My ecological footprint size increased markedly, mostly due to energy used for travel, when I became a staff member at the Academy of Natural Sciences, Philadelphia, Pennsylvania. Professional field trips were frequent, as were trips to give seminars, present papers at professional meetings, complete service for professional societies, and the like. The twenty years between 1980 and 2000 was the peak time for traveling to present professional talks. My hope is that this travel helped reduce environmental problems; however, in view of the present ecological overshoot, I fervently wish an alternative had been available. The fact that those trips and many others were by invitation does not appreciably diminish my regret.

In the late 1990s, my wife's Alzheimer's (and, later, also Parkinson's) reached a stage where leaving her to present professional talks, even briefly, was not an option. In July, 2005, my website was set up—it has been a joy to have, and it enables me to share my thoughts with others. In March 2000, my wife and I moved into a townhouse in Warm Hearth Retirement Village. We had considerable control over our ecological footprint size, and we were not future eaters. However, in June 2001, my wife was moved to a nursing home, and, in September 2002, I moved to an assisted living center where I was close to her in the same retirement village. My wife had little or no control over her ecological footprint size, and my current control has been greatly reduced. However, I can control energy use, which has been minimal. I have an automobile, but I drive it less than 1, 200 miles per year. The communal dining room produces a small ecological footprint because of the economy of scale. In short, social norms have a significant effect upon my present ecological footprint size.

Step 3. Attempt to influence social norms so that group ecological footprint size is reduced. Influencing social norms is not an easy task, but economics (e.g., increased energy costs) has a significant influence on social norms. Europe has made commendable progress in this area and has developed many practices suitable for sustainable use of the planet. However, some recalcitrant individuals may require substantial peer pressure to even begin reducing ecological footprint size. If the resistance is substantial, perhaps only a major catastrophe will persuade people to adopt sustainable practices. Alternatively, strict laws on resource use similar to those existing during World War II may be necessary. Of course, a black market will almost certainly arise for scarce resources. As usual, powerful political leaders may manage to circumvent the rules that apply to the average citizen. The "reasoning" of non-conformists is difficult to understand. Globalization has leveled the "playing field" to a substantial degree, but adjustment to this new era will initially be slow.

Step 4. Adjust politically to the reduction of the power of nation-states and concomitant regionalization of power. Ecological overshoot may not result in the decline of powerful nation-states that, because of diseconomies of scale, lose power as resource wars continue nor will resource scarcity result in regionalization of power. Terrorism and vulnerability of societal infrastructure may ultimately favor regionalization, but the waste of resources and life might be substantial.

Cognitive Dissonance

Cognitive dissonance is anxiety that results from simultaneously holding contradictory or otherwise incompatible attitudes or beliefs. An individual may have a bumper sticker that reads "STOP GLOBAL WARMING" on a sports utility vehicle (SUV) that consumes very large amounts of gasoline or diesel fuel per mile. Since fossil fuel is a major source of carbon dioxide – a major factor in global warming – one owner justified owning a SUV by stating that ownership of such a vehicle might not be possible in the future.

Cognitive dissonance is also apparent at the national level. For example, both Zhenhua (2006), Director, State Environmental Protection Agency, China, and Narain (2006), Director, Center for Science and Environment, India, made statements that clearly espoused environmental protection, yet both India and China are increasing the use of fossil fuel. China has begun to gear its international strategy to its energy needs, and India has energy guzzling congestion at airports and on city streets (Editorial 2006). Of course, my previous travels to present talks about environmental protection are another good example of cognitive dissonance, all

too frequently shared by other speakers. Many freedoms will suffer (e.g., freedom to breed) due to ecological overshoot and exceeding the planet's carrying capacity for humans. Yet these issues are rarely discussed in depth because a free and open exchange of ideas is a threat to cognitive dissonance. This situation is particularly evident during political elections when promises are made (1) to reduce taxes, (2) to increase benefits, and (3) to continue wars (a rose by any other name, etc.). The result of this cognitive dissonance is increased financial and ecological deficits and societal disequilibrium. Without cognitive dissonance, "future eating" would be greatly diminished or even disappear.

Who Ate the Future?

All humankind is responsible for consuming (i.e., "eating") natural resources essential to the maintenance of a habitable planet. A global 20% ecological overshoot (in 2002), which has worsened for decades, is the responsibility of the entire human species.

One would expect the world's religions to have a major role in establishing humankind's moral responsibility to posterity. The United States has a large ecological deficit and an excessive ecological footprint, both as a nation and for most individual citizens. How can this situation be explained when a nation that claims to be religious is taking far more than its share of the world's resources?

The world's leaders have, with some notable exceptions, espoused exponential economic growth with dangerous diseconomies, which threaten both global and national security. However, in countries with democracies, the people voted for these leaders but are not holding them accountable for their actions. In far too many cases, American citizens did not even trouble themselves to vote. The world badly needs leaders who have policies to correct the present dangerous situation and are not afraid to tell their constituents about the difficult road ahead (short-term) or the consequences of not making a mid-course correction. The candidate who does so would probably not get elected but would be doing (long-term) a great service to society.

Warnings

Although the news media and the scientific community could have greatly improved communications with the general public about the rapidly developing environmental crises, no literate person should have missed the message. Hansen (2006), a climate scientist in the US National Aeronautics and Space Administration (NASA) has attempted to alert both the scientific community and the general public that the huge Greenland ice cap is melting far faster than scientists had estimated. Twice as much ice is going into the ocean as was going in five years ago. Just sea level rise alone is a major cause for concern, but many others exist also. However, Hansen's recommendations for reduction of greenhouse gases did not meet the approval of NASA's public affairs team (staffed by political appointees), who tried to stop him from communicating this information. Gilbert and Sullivan would have loved this scenario – a research scientist in a US government agency who is attempting to inform the general public but is being opposed by public affairs personnel in the same agency. How about "I am the very model of a public affairs officer" to the tune of "I am the very model of a modern major-general"?

James Zachos, professor of Earth Sciences at the University of California at Santa Cruz, gave a talk on greenhouse gas emissions at the meeting of the American Association for the Advancement of Sciences (AAAS), February 17, 2006 (Paul R. Ehrlich, personal communication). He noted that human activities are releasing greenhouse gases more than 30 times faster than the rate of emissions that triggered a period of extreme global warming in Earth's past. At the same AAAS meeting, David Baltimore, Nobel Prize recipient and president of the California Institute of Technology, stated, "It's no accident that we are seeing such an extensive suppression of scientific freedom. It's part of the theory of government now, and it's a theory we need to vociferously oppose" (Dean 2006). Baltimore remarked that instead of twisting science to suit its own needs, government should be the guardian of intellectual freedom.

Despite these concerns about the Bush administration's political interference with science, the US Environmental Protection Agency (USEPA) is requiring prior headquarters approval for all communications by its scientists with the media (Environmental News Service 2006). The news director for USEPA's Office of Research and Development (ORD) sent a February 9, 2006, email to all staff: "We are asked to remind all employees that EPA's standard media procedure is to refer all media queries regarding ORD to Ann Brown, ORD News Director, prior to agreeing to or conducting any interviews. ... Support for this policy also will allow reasonable time for appropriate management response." In contrast, NOAA Administrator Conrad Lautenbacher told the *Washington Post*, "I encourage scientists to conduct peer-reviewed research and provide honest results of these findings" (Environmental News Service 2006).

Almost without exception, public statements made by scientists are based on research that has passed peer review in professional journals or at professional meetings, such as the AAAS meeting just mentioned.

Thus, the information is already in the public domain and would not be improved by comments from public relations personnel with no formal scientific credentials. If permission is required for scientists to meet with the media, the public's right to acquire valid scientific evidence has been seriously impaired, if not destroyed. American tax dollars are used to maintain this political interference in the scientific process. If this unscientific procedure is continued, then an organization, such as the US National Research Council, with credentialed scientists, should be set up to evaluate the effect of public relations staff on the communication of scientific information to the general public and the media.

Some reporters claim they find science journals harder to trust and not easy to verify (Bosman 2006). The incident that prompted this comment was the fabrication of evidence on human cell cloning by Dr. Hwang Woo Suk, a South Korean scientist. The prestigious journal *Science* retracted two papers of Dr. Hwang's when they received much publicity from the news media. The scientific peer-review system typically works very well, but failures inevitably occur. In this instance, the scientific process did identify the problem, and relatively quickly. To place this particular situation in perspective, the violations of ethics in the US Congress, corporations, and the news media itself can be cited. In contrast, the scientific process worked swiftly and conclusively. More personnel with some scientific credentials would be helpful to newspapers, news magazines, wire services, and television networks. One could then reasonably expect the same level of expertise that exists in sports, fashion, and movies.

Somebody Do Something

Individual environmental catastrophes make the news almost daily. Both individual scientists (including Nobel Prize recipients) and prestigious scientific organizations are alarmed at the rate of change in global warming, environmental pollution, and the like. Many promises have been made, but the unsustainable practices that created these problems continue and even increase. These unsustainable practices harm humankind, numerous other life forms, and the prospects of any descendents. Just to satisfy my curiosity, I carried out an informal survey of a variety of people of different ages, economic status, and level of formal education. Some illustrative examples I received for justifying inaction follow.

"What can one person possibly do to correct problems of this magnitude?"

This statement ignores the cumulative impact of large numbers of small, seemingly insignificant decisions. For example, traffic jams occur almost continually in large metropolitan areas when large numbers of people drive automobiles to attend a sporting event or to drive to and from their place of employment. If a large number of people decided to adopt sustainable practices, use less energy, or stabilize the human population, very significant environmental benefits would result. However, until sustainable practices become a social norm, an adequate number of people must be willing to lead. "Leaders" in government, industry, and society would probably have a dramatic impact if, instead of telling people what to do, they actually practiced what they preached.

"I don't have time to be bothered with these things (i.e., environmental problems)."

What? Not enough time to leave a habitable planet for their descendents? Not enough time to prevent a global food shortage due to global warming, an energy crisis, and a 20% ecological overshoot? Not enough time to give millions of people now living in misery and starvation a modestly better life? SHAME!!! SHAME!!! How can any compassionate individual make such statements without feeling remorse?

"If you are on the Titanic, you might as well go first class."

The unsinkable ship mindset has faith that technology shields humankind from natural laws. An alternative mindset is to use credit to "improve" one's lifestyle instead of purchasing durable goods. Three quarters of American households carry debt. Basically, American citizens have a collective psychology that asks, "What are others doing and what can I get for myself?" (Gardner 2006). Surely, the crew of Spaceship Earth should have a more future-oriented mindset.

"How do I know other people will do their share?"

No one can know if others will do their fair share, or even a small part of it; the situation is similar to being in a leaky lifeboat with a group of strangers. If everybody bails, the lifeboat will float until rescue boats arrive. If not enough people bail, the lifeboat will sink and everybody, bailers and non-bailers, will be at far greater risk than they were before. At present, I am confident that the number of bailers is not adequate. This situation is an interesting test of what humankind calls intelligence!

Concluding Remarks

The 20% ecological overshoot is positive proof that humankind has too many future eaters. Anyone with a large ecological footprint is a future eater. Resource consumption and resource generation must be balanced now and kept in balance. In addition, if, as projected, 3 billion more people are added to the human

population by 2050, per capita resource consumption must be reduced to maintain the balance between resource generation and consumption. The biospheric life support system must get a sufficient share of global resources in order to maintain the conditions favorable to the human species. A major change in the biospheric life support system is unlikely to result in conditions as favorable to humans as the present conditions are and, most likely, will be far less favorable. May humans cease being future eaters and become future guardians!

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The Tyranny¹ of Tipping Points²

¹I hesitate to use the term *tyranny* because of its political overtones. My colleague Joyce Akerman suggested using the term *force majeure* or *overwhelming force* as an alternative. I decided to mention this alternative since politicians the world over ignore natural law or minimize its impact. The *force majeure* of natural law can, and has, destroyed societies and their economics many times. Mother Nature does not negotiate or bargain. Violation of natural law carries severe penalties for which no court of appeals exists.

²This posting is a simultaneous submission for "Climate Change and You: Putting a Face on Global Warming," EcoRes Forum Online E-Conference #3, October 19-29, 2009. Further information available at www.eco-res.org.

Complex, multivariate systems (both ecological and societal) have one or more tipping points (breaking points) beyond which the state of the system changes. Often in ecological systems, no warning is given until the system changes. These changes are essentially irreversible in time frames of interest to humans. Tipping points may be global (e.g., pH of oceans) or regional (e.g., droughts in Australia, Argentina, and Kenya). Mother Nature (or natural law) has absolute power – in short, negotiations are not possible.

Even if a region has not passed a tipping point, the lives in that area may still be affected. For example, Australia and Argentina previously exported grain (wheat) and meat, but now they do not; this situation affects prices. If the new, post-tipping point conditions are particularly bad, environmental refugees are almost certainly an outcome, and they could end up on anyone's doorstep. Even if they do not, social systems will be disrupted elsewhere, and that result will affect everyone.

A major climate conference is scheduled for December 2009 in Copenhagen, Denmark. Sovereign nations will proclaim what they will or will not do on such issues as anthropogenic greenhouse gas emissions. However, they cannot negotiate with Mother Nature. If natural laws have been violated, severe consequences will ensue, even if the delegates have agreed to substantial reductions in anthropogenic greenhouse gas emissions by 2050.

If anthropogenic carbon dioxide emissions are kept within Earth's assimilative capacity for them, the concentration in the atmosphere should not increase unless positive feedback loops become worse. Much carbon is stored in frozen permafrost, wetlands, and frozen hydrated methane on the ocean floor. Global heating will cause release of methane and carbon dioxide, thus creating a positive feedback loop. Positive feedback loops can accelerate the process of global climate change and, at worst, can negate all the negotiations between sovereign nations. Once a tipping point has been passed and the situation is irreversible, adjustment to the new circumstances is the best and, in fact, the only course of action.

The concept of tipping points is covered in the scientific literature, although the term *irreversible damage* is often used to denote the same idea.

Cast Changes on the Ecological Stage of Earth's Evolutionary Theater

The most notable feature of the history of life on Earth for the past 4 billion years has been change, which is why I used the theater metaphor for this commentary. Earth has had a comparatively stable climate for the past 10,000 years; however, it is changing mostly because of human practices.

Earth has already passed two ecological tipping points – acidification of the oceans and melting of glaciers and ice sheets – both caused by anthropogenic emissions of carbon dioxide resulting from the combustion of fossil fuels. The actions and the results are a Faustian bargain – *Homo sapiens* has accessed more energy than any other of Earth's species, but has not used it wisely. Unwise use has produced unprecedented economic growth and exponential growth of the human population, both of which have had deleterious consequences for the human species and the other life forms with which it shares the planet. Politicians and the general public have considered remedial actions, but no effective remedial actions have emerged to date. Even charismatic species, such as the polar bear, may become extinct or reduced to relic populations of little ecological significance within a single human life span.

Although I once believed in sustainable use of the planet, I no longer do. However, under circumstances far different from those characteristic of the early 21st century, I still believe sustainable use might be possible. How should humankind respond if present conditions persist until the middle of the 21st century?

If the human species is truly a part of nature – not apart from it – it should remember that species extinction is a continual process, although impressive species losses did occur during the five great extinctions, followed by dramatic rediversification over evolutionary time. Humans have greatly exceeded Earth's carrying capacity for them, and severe consequences unrelentingly have occurred for any species that exceeded its carrying capacity.

I mourn the loss of ecosystems that I enjoyed throughout the 20th century. The fossil records show that these ecosystems will probably be replaced over evolutionary time by other, quite different, but ecologically unique, ecosystems. Even so, humankind has a moral and ethical responsibility to protect the biosphere in every way possible. If humankind does indeed have a reverence for life, then acting morally and responsibly is the only possible course of action. However, if humankind fails, as E. O. Wilson states it, the result will be another roll of Darwin's dice. In short, humankind should neither hasten evolutionary processes nor impede them.

Earth as a Dynamic, Pulsing System

Even humans with an above average life span have only witnessed a minuscule fragment of life's ecological play. Most of humanity has not acquired a global perspective, and, in the United States, a Gallup Poll taken on the anniversary of Charles Darwin's birthday found fewer than 4 in 10 Americans believe in evolution (Gilgoff 2009). The numbers shrink further when Americans are asked if they believe in Darwin's theory of natural selection – Gallup puts that number at 14%, while the Pew Research Center puts it at 26% (Gilgoff 2009). Evolution is the primary unifying concept in the biological sciences and a central concept for all the sciences. Gilgoff (2009) notes that the strongest predictor of respondents' views on evolution is church attendance. Pitting religious beliefs against science is not healthy for either religion or science, and it distorts the objectivity in using scientific information to make decisions on avoiding ecological catastrophes.

Critics of Charles Darwin miss the excitement of the drama continually unfolding in the metaphor of the ecological stage in Earth's evolutionary theater. Humankind is not spectators but part of the cast, even though it acts more like a spectator than part of the evolutionary play.

Ehrlich and Ehrlich (2009, p. 64) remark: "Four decades of largely ignored population growth and related issues – especially patterns of rising consumption and their environmental effects – . . . make collapse now seem ever more likely and possibly sooner than even many pessimists think." Some prestigious organizations and people have examined the basic drawbacks of exponential population growth. They note that the most serious flaw has been too much optimism about the future. Of course, global heating has not received much attention in the past nor were endocrine disruptors even on the horizon.

Two factors make the situation worse than it was 40 years ago: (1) all global problems are interactive, making simultaneous multiple tipping points a real possibility, (2) events are moving much faster than even scientists expected. Exponential growth and positive feedback loops could easily account for changes in rate processes. Many scientists (e.g., James Hansen 2009) and some political figures (e.g., Britain's Prince Charles,

Agence France-Presse 2009) are deeply concerned about Earth's fate. Prince Charles, the heir to the British throne, has "warned that today's consumer society comes at an enormous cost to the planet and we must 'face up to the fact' that it was no longer sustainable" (Agence France-Presse 2009). Hansen (2009) remarks: "Failure to achieve the actions needed to stabilize global climate will result in great intergenerational injustice. The young and unborn in both developed and developing countries would bear full consequences of the actions of prior generations. We need to help young people draw attention to this great injustice."

The dynamic, pulsing system that is Earth has had a huge number of species on the ecological stage of the evolutionary theater. Most of them are now extinct (as many as 99%). Extinction is an ongoing process and large numbers of species go extinct between the great extinctions. In short, extinction is the norm, although some species survive for exceptional periods of time. This comment is not intended to justify driving species to an early extinction, but to note that extinctions were the norm before *Homo sapiens* appeared on the "ecological stage."

The numerous global crises should be sounding intellectual alarms almost continuously, but "business as usual" seems to be the common response. The news media obsessively pay major attention to political figures, the death of rock stars, the latest infidelities of politicians, and so on. Attention should be placed on many complex global issues: Is society immune to the ecological stress that other species bear? Does technology protect humankind from endocrine disruptors? Can humankind be confident that all climate change will be benign? Will ocean acidification be reversed by natural forces? Will the processes of evolution be suspended for *Homo sapiens*? Can the damage already done to the biospheric life support system be reversed?

Clear the Stage for Another Act

Suppose the sixth great extinction continues and *Homo sapiens* is one of the unlucky species. An unlucky species may just be reduced to a relic population (James Lovelock speculates a remaining population of about 250 million located somewhere near the Arctic Circle). Paleontology records show that, following a great extinction, the process of evolution produces a new level of biodiversity, sometimes matching the level of species biodiversity that preceded the present one. These species are the components of the new biosphere and, since they are different from their predecessors, they will not function in an identical fashion. Predicting what the next components will be like individually or how favorable they will be to humankind (e.g., atmospheric gas balance) is impossible. Furthermore, most climate change (i.e., post tipping point) is essentially irreversible (Solomon et al. 2009). How incredible that humankind would take such risks!

Reacting to These New Circumstances

From a homocentric viewpoint, horror and despair seem to be probable responses to human extinction. How can these consequences happen to a creative, intelligent species like *Homo sapiens*? It is the dominant species and suddenly seems weak and helpless. Perhaps it lacks perspective to envision 4 billion years of evolution (Ruse and Travis 2009). However, if the human species could envision the consequences, it would be more cautious and respectful of the biosphere. Wilson (as quoted in Ruse and Travis 2009, p. vii) states: "It [*On the Origin of Species* by Charles Darwin] is the masterpiece that first addressed the living world and (with *The Descent of Man* following) humanity's place within it, without reference to any religion or ideology and upon massive scientific evidence provided across successive decades. Its arguments have grown continuously in esteem as the best foundation for human self-understanding and the philosophical guide for human action. . . . The great questions – 'Who are we?' 'Where did we come from?' and 'Why are we here?' – can be answered only, if ever, in the light of scientifically based evolutionary thought."

The history of life on Earth is vast, complex, and intimidating. Still, some points deserve highlighting.

- (1) Life on Earth has existed for 4 billion years – *Homo sapiens* has only been present for 160,000-200,000 years.
- (2) Natural laws (e.g., limiting factors, carrying capacity) apply to all species – humans are not exempt.
- (3) Some species persisted for long periods of time; others did not.
- (4) After each great extinction, the process of evolution produced a great diversity of new species, most of which differed considerably from their predecessors.
- (5) The process of evolution, as is life itself, is influenced by many random (stochastic) events.
- (6) Six of the seven species of the genus *Homo* are now extinct – *Homo sapiens* is the sole surviving species of this genus. Is this situation due to conflicts within the genus or other factors?
- (7) *Homo sapiens* has enjoyed many creative accomplishments, such as music, poetry, languages, social organization, literature, technology, and so on. However, other species have many accomplishments, such as

migrating immense distances, complex social systems, extraordinary resource partitioning, adaptation to a wide variety of climate conditions, and so on.

Life Will Continue

Will *Homo sapiens* be one of the many species lost in the sixth great extinction? Lovelock (as quoted by Zaitchik 2009) believes that humans will persist even though billions will suffer and die. Lovelock (2009) believes that humankind has overstressed *Gaia* (his name for the biospheric life support system) and pushed it beyond the point of no return, which will result in a drastic reduction in Earth's carrying capacity for humans. Nevertheless, he hopes that several hundred million humans will survive and preserve a low-carbon civilization and, presumably, a society that nurtures *Gaia*.

My speculations on the future are less optimistic than Lovelock's. Resource wars seem probable, especially if climate change decreases regeneration of natural resources. Add a pandemic disease to the resource wars and millions of refugees, and the social stability needed to preserve the technological components of civilization will be endangered. Of course, if the negotiations in Copenhagen in December 2009 fail to achieve enforceable major reduction in greenhouse gas emissions and if the positive carbon feedback loops worsen, climatic and social disequilibrium seems to be a likely outcome. If this happened, a 3°-6°C increase in global mean temperature appears probable – humankind could probably not cope with this increase. In this case, small tribes of hunter/gatherers are the best outcome to hope for.

Since humankind is the primary cause of the global problems (i.e., climate change, overpopulation, ecological overshoot/excessive consumption, ocean acidification, toxic chemicals), it might have regret but should not weep or wail about its fate. Humans should be pleased, even if life goes on without them. One great satisfaction would be the survival of the human species and another opportunity to develop a harmonious relationship with *Gaia*. If *Homo sapiens* does not survive, it may be that intelligence (as humans define it) does not provide much survival value. *Homo sapiens* was not essential for most of the 4 billion years of life on Earth, and, presumably, life can continue for more billions of years without it.

What to Do Now

Establishing guilt and blame seems to be an unsatisfactory way to spend the remainder of the 21st century. Surely, something can be done to benefit the soon to evolve “cast members” on the ecological stage of the evolutionary theater. By reducing the forcing factors causing the cast change, life could be made easier for the species that will be ancestral to the next cast. “Although Darwinian evolution rejected the Linnaean view of the Great Chain of Being, in which all living organisms were ranged in a God-ordained hierarchy, for Darwin evolution was still progressive, with lower organisms giving way to higher ones. . . . Today's Darwinists prefer the metaphor of the bush, with all currently extant species equally ‘evolved.’” (Rose and Rose 2009). From this group, Mother Nature (i.e., natural selection) will determine those species that will form the next biosphere (i.e., *Gaia*). In this case, humankind should not interfere with evolutionary processes. Humans have no idea what future conditions on Earth will be like and are unlikely to choose the “fittest” species for the new conditions. If humankind wishes to preserve “civilization” as human society now defines it, then *Homo sapiens* would have to be given preferential treatment. Have humans done anything to deserve this? The question is rhetorical since Mother Nature (i.e., natural law) selects the fittest.

Conclusions

If human society effectively addresses all five global crises and restricts the global temperature increase to 2°C, civilization may be preserved if a few hundred million humans survive this level of climate change. An increase of 3°C or more will create conditions in which the survival of *Homo sapiens* is problematic. In either case, a new cast will emerge on the ecological stage of the evolutionary theater. That pronouncement should be of some comfort to those with an ecocentric viewpoint, but almost certainly not comforting to those with a homocentric point of view.

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Phantom Land and Ghost Slaves: Humankind's Addiction to Fossil Energy

Abstract : Humankind uses vast amounts of fossil energy accumulated millions of years ago. The rate of use is many orders of magnitude greater than the replacement rate. Peak oil is the most immediate problem, and replacing this rate of energy use with biofuels is problematic. Coal is an alternative but produces more severe environment problems than petroleum and is less suitable for some forms of transportation such as airplanes. Nuclear energy does not reduce greenhouse gases, but does generate troublesome waste disposal problems (e.g., one-million year storage for some components). Solar and wind power are proven alternatives, but are not likely to generate sufficient energy to replace the petroleum no longer available. The prudent course of action, then, is reduced energy consumption per capita. As the Marks et al. (2006) report illustrates, high energy and material goods consumption is not highly correlated with happiness (i.e., satisfaction). Even if high consumption were related to happiness, continued extremely high energy consumption would probably not be justified. The approximately 100-200 years of the petroleum era are a brief, aberrant period of human history, and breaking this addiction will be painful, but not fatal.

Key words : Peak oil, Petroleum era, Reduced energy consumption, Carrying capacity, Environmental refugees, Energy return on investment.

Conquer thyself, till thou hast done this, thou art but a slave.

Sir Richard Francis Burton

It is evident that the fortunes of the world's human population, for better or for worse, are inextricably interrelated with the use that is made of energy resources.

M. King Hubbert

There is no substitute for energy. The whole edifice of modern society is built upon it ... It is not "just another commodity" but the precondition of all commodities, a basic factor equal with air, water, and earth.

E. F. Schumacher

Power tends to corrupt and absolute power corrupts absolutely.

(Lord Acton was referring to political power, but might equally well apply to energy use since the latter has led humans to believe they are immune to natural law.)

Lord Acton

An attempt by any outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interests of the United States of America.

**US President Jimmy Carter
in a 1980 address to US Congress**

Thus there may be no solution to the problem of oil depletion, if by "solution" we mean a strategy that will enable us to continue living as we are.

Richard Heinberg

As Catton (1982) notes, humans increase Earth's carrying capacity for themselves by "diverting some fraction of the earth's life-supporting capacity from supporting other kinds of life to supporting one kind." For example, during the Agricultural Revolution about 10,000 years ago, humans began taking over land occupied by other species to produce food for human consumption. In many areas, this acquisition resulted in extinction of other life forms. In some cases (e.g., Australian Aborigines), humans learned the necessity of stabilizing their own population levels through extended lactation, use of contraceptive herbs, or infanticide in order to co-exist successfully with other species. Regrettably, at present, sharing resources, including energy and other natural resources, with other life forms is not the norm.

Fossil Fuels

Approximately three decades ago, I heard a jest (possibly from H. T. Odum) that humans had a purpose on Earth - to get rid of all fossil fuels. When the easily obtained fossil fuels were gone, humans could depart. At present, this prophecy is no longer a jest - Earth's fossil fuels, oil and coal, which accumulated for hundreds of millions of years, are now being burnt in a few centuries. Moreover, released carbon dioxide is causing global heating. Coal burning also releases mercury and other pollutants. Tainter (1988) views human society as an energy processing system that tends to collapse when its strategy for energy use is subject to the law of diminishing return. Recent studies (e.g., Homer-Dixon, 2006) have indicated that the energy return on investment (EROI) has diminished in the United States from 25 to 1 in the early 1970s to 15 to 1 at present. Black (2006) notes that the global network of agricultural research centers warns that famines lie ahead unless new crop strains adapted to a warmer future are developed. The Consultative Group on International Agricultural Research notes that yields of existing varieties will fail. New forecasts indicate that global heating will shrink South Asia's wheat area by half.

Coping with these crises will not succeed unless a consensus on standard of proof is reached in the law and in science. One case on global heating before the US Supreme Court (Dean, 2006) is not reassuring, at least in the early stages of this case. Typically, scientists do not accept a finding unless, statistically, the odds are less than 1 in 20 that it occurred by chance (Dean, 2006). This standard is higher than the typical standard of proof in civil trials (preponderance of evidence) and lower than the standard for criminal trials (beyond a reasonable doubt) (Dean, 2006). As Dean (2006) notes, the justices may also consider that, when scientists confront a problem, they collect all the information they can about it and then draw conclusions; however, lawyers use a different strategy. They know the desired outcome at the outset, so they gather arguments to support it. Scientists face peer review and cannot omit publications uncovered in their research that do not fit their hypothesis. This case before the US Supreme Court is crucial since mainstream science agrees that the planet's climate is changing and human activities (e.g., greenhouse gases) are major components of this change. At present, voluntary reduction of greenhouse gases is not working for most individuals or corporations, so effective legislation and enforcement are essential. Reduction is a matter of utmost urgency since humankind may be approaching a global tipping point on both global heating and energy availability.

Phantom Carrying Capacity

Borgstrom (1972) devotes an entire chapter of his book to the concept of "ghost acreage." This concept explains why countries, such as The Netherlands, appear to be living well with a large population on relatively little land. The explanation is that the space they occupy supplies only 1/14th of their needs. The remainder comes from outside the country. Arguably, two even more important problems also exist:

- (1) The scientific process is not designed to study global-level phenomena. The reductionist scientific method of isolating an important variable and studying it under carefully controlled conditions simply is not suitable for complex, multivariate global-level studies.
- (2) Humankind is carrying out a massive global experiment on global heating with no control planet to document the differences between treatment (*i.e.*, human-produced greenhouse gases) and no treatment.

As a consequence, prudence dictates reduction in the release of human-produced greenhouse gases from the use of fossil fuels, which would also conserve unused fuel for future use. Excessive use of fossil fuels has already endangered crop production through drought, floods, and other types of climate change.

Energy Use

The average Canadian uses an amount of energy equivalent to what 200 men would expend while working 24-hour days continuously (Campbell, 2000). These hypothetical "individuals" are "energy slaves." What will humankind do as availability diminishes after peak oil has been passed (e.g., Bériault, 2005)? The food humans eat results from a huge amount of energy from production, to processing, to delivery, to cooking, to dishwashing (e.g., food travels an average of 2080 km from farm to plate) (Heinberg, 2005). Because of inexpensive oil, one farmer can feed 100 people. However, this advantage will substantially diminish when the peak oil threshold has been passed and the end of readily available cheap oil has passed.

The Transition to Low Per Capita Energy

Some illustrative components follow:

- (1) Earth's carrying capacity for humans will markedly diminish. Since the ecological overshoot is already 24%, population stabilization is mandatory, as is reduction of population size to suit the new carrying capacity.

Adjusting society to meet the needs of natural systems will not be easy, despite the fact that they constitute the biospheric life support system.

(2) Travel, especially by aeroplanes, will be greatly reduced due to decreased availability of petroleum and increased costs to reduce greenhouse gas emissions. Humankind will mourn the loss of a significant number of ghost slaves, but the era of cheap energy is approaching its end.

(3) Stop being delusional! Humankind simply can not continue to use the amounts of energy that all too many consider normal. Biofuels must be grown on real land, not phantom land, so humans must be prepared to use fewer ghost slaves. Coal is a dirty source of energy and nuclear power produces long-term radioactive wastes.

(4) Attacks on science, when robust scientific evidence conflicts with political ideology, are endangering billions of lives by delaying for many years the effective control of greenhouse gas emissions. Harvard Professor Daniel P. Schrag (2006) claims that US Senator James Inhofe, then Chair of the Senate Committee on Environment and Public Works, issued an erroneous press release that claims that Schrag agreed with him that the Kyoto Protocol would have almost no impact on the climate.

Vidal (2006) describes 2006 as the year humankind woke up to the adverse effects of global heating. However, the dangers of perpetual economic growth on a finite planet and the adverse effect (e.g., global heating) of the technologies that power it are not well appreciated. Heilbroner and Thurow (1987) define economic growth as an increase in the production and consumption of goods and services; it is a function of population size and per capita consumption. The human population continues to grow and consume resources at an ever increasing rate. These and other factors accelerate the depletion of finite fossil fuel reserves, especially oil. Czech (2001) remarked "The United States is a bellwether nation with respect to democratic politics, economic development, and environmental policy. At the beginning of 2007, much of this ethical and moral leadership has been lost. The United States has approximately 5% of the planet's population and contributes nearly 30% of anthropogenic greenhouse gases".

In an era when resources (e.g., oil and food stuffs) have probably peaked and may soon suffer declines in production, the kind of excessive consumerism flaunted by the ultra-rich is becoming both archaic and immoral. In short, an individual may be able to afford large quantities of material goods and energy, but the planet cannot afford such purchases. However, in the United States, many consumers are going deeply into debt to increase their material possessions. In many cases, large storage spaces are rented by the year to store the overflow (i.e., beyond the capacity of their dwelling[s]). Very probably, these possessions will not be used by the original owners after storage. Fewer possessions per capita would reduce and might even eliminate the 24% ecological overshoot. An economic system that produces a 24% ecological overshoot is clearly not sustainable. Yet, exponential economic growth is still worshipped globally, and most people and their leaders are either unaware of the ecological overshoot or uncertain about it.

The Elephant in the Room

The present "joke" is that population is like an elephant in the room. Everyone sees the elephant, but no one is willing to talk about it. The World Population Growth Chart (<http://www.atmos.umd.edu/~owen/CHPI/IMAGES/pop.html>) projects that an additional 1 billion people will be added to the planet between 1998 and 2009 (i.e., 11 years). Heinberg (2005, p. 31) estimates that world population will drop from 7 billion in the early 21st century to less than 4 billion in 2200 due to a decrease in oil availability. However, even as the population rises, Australia, an exporter of meat and grain, has a dramatically decreased supply of mutton and grain as a result of a drought that has lasted 5 years already (Mercer, 2006). The drought could break in 2007 or 2008, but might not break until 2050. China is also experiencing a reduction in grain supply due to global heating (Buckley and Aizhu, 2006). Climate change and water shortages exacerbate these problems. Lou Yong, a deputy director of China's National Climate Centre, stated: "The most direct impact of climate change will be on China's grain production."

However, at present, the human population continues to grow (Motavalli, 2006). In Niger, Salamatow said "I am exhausted" as she struggled through labor with child number 13. She is a 37-year old widow. In some countries, such as Russia, the "birth dearth" (births less than deaths) is definitely real, but it is far from universal. For example, the United States (a leading consumer of energy and resources), which has a fertility level just above replacement, has just reached the 300-million population mark, primarily due to legal and illegal immigration. The United Nations projects a world population of 9.1 billion (as the middle of three possible scenarios) in 2050 (Motavalli, 2006). Given all the bad news about droughts and the food supply, loss of arable land due to desertification, and sea level rise, clearly present unsustainable practices cannot continue (e.g., Markowitz and Rosner, 2002). The much publicized fertility decline has not halted global human population growth and ignores the fact that the human population has more than doubled between 1950 and 2000. In fact, many countries (e.g., Saudi Arabia) have a very young citizenry (i.e., nearly half under age 15).

This youth increases population growth momentum since a huge percentage of the population is at or soon will enter the breeding age.

Segelken (2004) quotes agricultural ecologist David Pimentel: "Every trend – from decreasing per capita availability of food and cropland to population growth - shows the predicament becoming even more dire." Pimentel also notes that the present level of malnutrition among nearly half the world's population of 6.3 billion is unprecedented in human history. Despite this evidence, corn to ethanol production continues. Pimentel (2007) reports that 18% of the US corn crop and the same fraction of the corn crop land produced less than 1% of the total automotive fuel used in the United States. If 100% of the corn crop were dedicated to ethanol production, it would only satisfy about 5% of US energy needs. Since humankind is already using Earth's resources 24% faster than that of their regeneration (ecological overshoot), a major catastrophe would be inevitable if current rates of resource consumption continue, even if population growth ceased. However, it has not ceased, so an even greater catastrophe lies in the near future unless major changes in human behavior are made immediately.

Humankind's exponential growth should be accompanied by comparable growth in all the factors now associated with civilization - schools, health care facilities, etc. The remedy to this situation is not readily apparent since the planet is finite. In addition, present resources are distributed very unevenly. The richest 2% of the world's adults own more than half the world's wealth (Glantz, 2006). The wealth gap has increased dramatically in recent years, which is likely to produce social instability, just when stability is needed to cope with the concomitant crisis in population, energy, food production, and climate change.

Even in a relatively new country, the United States, the original inhabitants were deprived of the buffalo so they would move to reservations established by the US government. However, the relationship of the human to the animal community that supplied its food, clothing, and housing (e.g., teepees) had been the central, pivotal concern of the rigorously maintained social order (Campbell, 1972, p. 89). As a consequence, the loss of the buffalo meant the loss of the binding symbol. In the 21st century, the loss of energy (e.g., phantom land and ghost slaves) will almost certainly have a more dramatic impact because the effects will be global. As Campbell (1972, p. 89) notes, the first and most important effect of a living mythological symbol is to waken and give guidance to the energies of life. The symbol requires functioning in a certain way, which will be conducive to participation in the life and purposes of a functioning social group. Campbell further notes that, when the symbols provided by the social group no longer work and the symbols that do work are no longer of the group, the individual cracks away, becomes dissociated and disoriented, and is confronted with what can only be named the pathology of the symbol. Humankind is embedded in natural systems but is assaulting nature (e.g., greenhouse gases) as if its dependence on natural systems were not true. Humans have made energy a central unifying symbol and are acquiring and using energy in ways that affect nature adversely.

Moral and Ethical Leadership

In many cultures, especially in the United States, many people believe in a conflict between science and religion. As Campbell (1972, p. 90) notes "the famous conflict of science and religion has actually nothing to do with religion, but is simply of two sciences: that of 4000 BC and that of AD 2000." The driving sources of human society (the computer, cheap energy, the automobile, television, airlines, nation states, space exploration, fast food, global heating and globalization) are drastically different from the forces that drove the early societies in which religions developed. Given this perspective, the perception of a conflict between science and religion is not surprising.

What does this perceived conflict have to do with the present situation? The solution often given for the problems of overpopulation, diminished energy, global heating, resource wars, ethnic conflict, and religious confrontations is that some deity will solve the problems. However, the people who state this solution are usually not among the approximately 3 billion humans who are malnourished. Presumably, the same deity provided brains and intelligence, so one wonders why those humans feel no responsibility to use their brains and intelligence to solve the many problems. One also wonders why the intelligence is not used to live harmoniously with other life forms that collectively constitute humankind's biospheric life support system.

Three of the myths humankind lives by in the 21st century are: (1) a technological solution exists to every problem humans have caused, (2) the rising tide of economic growth will "raise all boats," (3) the status quo will endure forever - exponential population growth can continue indefinitely on a finite planet, the automobile culture will endure, pollutants harmful to the environment will not affect humans. If the first myth is true, why are peak oil, environmental pollution, AIDS, and global heating major problems? If the second myth is true, why is disparity in the distribution of wealth increasing so dramatically? The third myth is really a denial of reality, which can be very powerful.

Much cognitive dissonance is present in humankind's response to present problems. The Calvert Group, Ltd., an investment rating service, endorses 52 of the largest 100 US companies based on market capitalization, but flags the other 48 for transgressions against social responsibility (Piller et al., 2007). For example, the Gates Foundation assets total more than the gross domestic products of 70% of the world's nations. The Gates Foundation awards grants in support of public education in the United States and for social welfare programs in the US Pacific Northwest. In contrast, the Gates Foundation has major holdings in:

- companies ranked among the worst US and Canadian polluters, including Conoco Phillips, Dow Chemical Company, and Tyco International, Ltd.
- many of the world's other major polluters, including companies that own an oil refinery and one that owns a paper mill; both of these types of companies can sicken children at the same time that the Foundation is trying to save their parents from AIDS
- pharmaceutical companies that price drugs beyond the reach of AIDS patients.

Paul Hawken, who directs the Natural Capital Institute, notes that, while foundations fund groups trying to benefit posterity, their investments steal from the future. This type of "blind-eye" investing rewards bad behavior. However, anyone who has tried to achieve ethical investment (even by one's personal standards), using overall good or bad performance of the majority of corporate operations, has found this task incredibly difficult. Clearly, foundations, corporations, political leaders, and the general public must develop a more holistic perspective on environmental ethics and morals, particularly with the energy crisis and all of its manifestations.

On Monday, January 6, 2007, with wars in Iraq and Afghanistan and an air attack on a suspected terrorist site in Somalia, worsening global heating, and an unsettling national debt, the US Congress suspended its activities so that some members could fly to the US State of Arizona to watch the football game between Ohio State University (ranked #1) and the University of Florida (ranked #2), thus increasing the global supply of greenhouse gases. Not to be outdone, Prime Minister Tony Blair (UK) stated: "I would frankly be reluctant to give up my holiday abroad" (Etchingham, 2007). However, he does recycle and uses energy efficient light bulbs. Do these two conservative activities offset vacations in the US and Caribbean? Blair has labeled as "impractical" any personal sacrifices to cut greenhouse gas emissions (Watt, 2007). In contrast, the Prince of Wales declared that he will cut back on domestic and international flying. Blair made an unpersuasive effort to offset British fury over his personal flight policy by using carbon emissions offsets, but at least some newspaper columnists are not persuaded (e.g., Grice, 2007). Street-Porter (2007) feels Blair should set an example and holiday in Britain. Monbiot (2007) calls attention to US President George Bush's six years of obfuscation and denial of climate change, which was followed by a memo to the Intergovernmental Panel on Climate Change that advocated "modifying solar radiance" rather than advocating cutting greenhouse gas emissions.

Energy and Nation-States

Fossil fuels have provided humankind with incredible amounts of energy. However, this extra energy enables nation-states to flourish and extend, economically and militarily, their power far beyond their borders. The United States has fought wars, and is still doing so, in Iraq and Afghanistan. Initially, much of the US part of each war involved aircraft carriers far from the field of battle. However, the period of abundant, cheap energy ends with peak oil or soon thereafter. Presumably, then, the power of nation-states will diminish.

At present, with a major global crisis in heating and other types of climate change, humankind needs a universal ethic for survival. Failure to develop such an ethic will make the probable outcome one of severe stress upon humans, possibly extinction. Since the biota of the planet has survived five great extinctions, it is probable it will survive a sixth. However, a major reduction of human potential is a violation of humankind's sacred obligation to posterity. Humankind has a second ethical responsibility also to other life forms, not only because they constitute the planetary life support system but primarily because desecration of other life forms is a sacrilege. However, if one listens to what most societies and their leaders profess, endangering or actually harming economic growth is of greater concern than the survival of polar bears and other megafauna, including non-human mammals. A global ethic for all life forms is essential for sustainable use of the planet and development of a harmonious relationship between humans and other life forms.

With approximately half the world's population living in urban areas and the other half living primarily in humanized landscapes, development of an eco-ethic will be difficult, especially since phantom land and ghost slaves will decrease each year. Internet based organizations should be most helpful in this situation. Also, loss of both phantom land and ghost slaves should diminish humankind's deleterious environmental impact, which is primarily, but not entirely, technology based. Technology can also adversely affect humans by producing greenhouse gases. As John Holdren (2007), President of the American Association for the Advancement of Science, remarked, in conjunction with the 2007 Annual Meeting, on the problem of energy:

Well-being has environmental, sociopolitical, and cultural dimensions as well as economic ones, and the goal of sustainable well-being entails improving all of these dimensions in ways and to end points that are consistent with maintaining the improvement indefinitely. This challenge includes not only improving substantially the standard of living in developing countries, but also converting to a sustainable basis the currently unsustainable practices supporting the standard of living in industrialized ones.

And, one might add, stabilizing the human population so that it does not exceed Earth's carrying capacity. Very little progress is being made in any of the important categories just mentioned. Greenhouse gas emissions are increasing - dramatically in some cases, such as China and the United States. The world population continues to increase at the rate of 91 million per year. All too often the daily news has some unpleasant new surprise. For example, the long-term stability of the massive Antarctic ice sheets, which have the potential to raise sea levels substantially, has been called into question with the discovery of fast-moving rivers of water sliding beneath their base (Connor, 2007). Other findings show substantial subglacial lakes under ice that is moving a couple of meters per day. Most of the plans to address global heating and other types of climate change have end dates such as 2020 and 2050. It is probable that within that time frame, one or more critical ecological and societal thresholds will be passed. For many disequilibrium situations caused by exceeding a threshold, remedial action may not be possible within time frames of interest to human society.

Despite the clear connection between combustion of fuels and anthropogenic carbon dioxide, Americans (and other automobile cultures) continue to search for ways to replace petroleum, despite the warning to US lawmakers not to rely on biofuels for energy security (Seba, 2007). Of course, these executives also recommended opening up more offshore areas to drilling. The era of cheap, abundant fuel is over but few people accept this fact.

Small Group Species vs Large Group Species

Abundant, cheap energy has made it possible for *Homo sapiens* to evolve from a small to a large group species in an extremely short period in evolutionary time. However, this abundant, cheap energy has also made it possible for humankind to seriously damage the biospheric life support system. If this damage continues at the present rate, the result will probably be a precipitous decline in human numbers, especially if resource wars involve nuclear and/or biological/chemical weaponry. Sagan's (2006) posthumous book predicted part of this scenario - he warned of the danger that a leader under the sway of religious fundamentalism might not try too hard to avoid a nuclear Armageddon, reasoning that it was God's plan. The urgency with which actions are taken to reduce anthropogenic greenhouse gases will determine how severe the consequences will be for humankind and the extent of the necessary remedial actions.

At present, atmospheric carbon is markedly increasing (over 3 billion metric tons emitted in 2007; <http://www.worldometers.info>). Statements from political leaders of two of the biggest contributors, the United States and China, do not indicate that an emissions tax on carbon is likely soon. Of course, in the United States, California and some other states are taking substantial remedial measures on their own. However, a global problem will not be solved unless all nations, especially the largest contributors, join in effectively reducing anthropogenic greenhouse emissions. Global cooperation will be difficult to achieve since some countries, such as Bangladesh, are more at risk than others (Huggler, 2007). In addition, a truly staggering quantity of unreported carbon dioxide is emitted around the world by the top ten companies on the London Stock Exchange (Black, 2007). Presumably, this situation occurs elsewhere in the world. Finally, the ice caps may not be saved (Adam, 2007), and such melting would raise sea levels by 4 to 6 meters (Adam, 2007).

Epic Changes

Pimentel (1998) states:

Approximately 90% of the energy in crop production is oil and natural gas. About one-third of the energy is to reduce the labor input from 500 hours per acre to 4 hours per acre in grain production. About two-thirds of the energy is for production, of which about one-third of this is for fertilizers alone.

Youngquist (1999) remarks:

A future without oil is difficult to visualize in detail, but some aspects of the post-petroleum paradigm can be anticipated with some degree of certainty.

All possible economic energy sources will have to be used, but replacing oil in its great energy use versatility probably will not be completely possible. Replacing the role of both oil and gas in agricultural production will be the most critical problem and may not be entirely solvable.

With a still growing human population, finite agricultural land, and reserves of petroleum (a primary source of income) diminishing, a major social crisis in the first half of this century is highly probable. As Fleay (1995) noted many years ago: "A very large proportion of the world's population depends for food from high agricultural yields achieved by use of fossil fuels." Epic change will result from: (1) the end of the cheap, abundant fossil era, (2) a global freshwater crisis that will have a major impact on agriculture, (3) and severe deleterious effects of global heating and other types of climate change on agricultural productivity.

Bartlett (1994, p. 28) wrote about the general complacency about the future:

There will always be popular and persuasive technological optimists who believe that population increases are good, and who believe the human mind has unlimited capacity to find technological solutions to all problems of crowding, environmental destruction, and resource shortages. These technological optimists are not usually biological or physical scientists. Politicians and business people tend to be eager disciples of the technological optimists.

Well over a decade later, not much has changed, although there appears to be a modest trend to abandon these thought processes and recognize the findings of science. At present, depending on unproven technology is not enough to meet the epic changes humankind faces.

Humankind has faced starvation and disease before, but never on the scale likely to occur in the 21st century because the global population is far larger than it was even a century ago. The petroleum age is nearly over. There are alternatives, but as Youngquist (1999) notes: "The inability of fuels to be easily interchangeable in their end uses is a major problem." Youngquist (1999) also makes a major additional point:

It is important to note that the end product of many alternative energy sources such as nuclear, hydro-electric power, wind, solar, geothermal, and tides is electricity, which is not a replacement for oil or natural gas in their important roles of raw material for a host of products ranging from paints and plastics, to medicines, and inks. But probably the most vital of all uses is to make the chemicals which are the basis for modern agriculture. Electricity is no substitute.

Ethical/Moral Issues

What should humankind do when the nations of the Middle East have diminished funds to buy food because their main source of income - petroleum - is less available? Even at US\$200 per barrel, adequate purchasing power for foodstuffs will not last forever. They are mostly beyond sustainable long-term carrying capacity. Anarchy, even while oil remains, would impede delivery to other parts of the world as the war in Iraq has already done. Armed conflict is not a good, or even adequate, way to resolve these issues!

The current (March, 2007), estimated population of Saudi Arabia is 27,019,731 million, of which 5,576,076 are not citizens. The freshwater supply is negligible, so food is imported and purchased primarily with funds from the sale of petroleum. In 2006, Kuwait's population was estimated at 2,014,100 million and the area had a negligible agricultural base. In 2006, Iran had an estimated population of 68,688,433 and a significant amount of water and arable land. All these countries will be affected eventually by a decreasing oil supply, even if the price per barrel rises four fold or more. Millions of individuals will be added to the high number of environmental refugees. Iraq, population estimate for 2006 of 26,783,383, has already produced millions of resource depletion refugees, and their numbers will almost certainly increase dramatically until the civil war ends and social stability is achieved. Present indications are that both British and American military forces will not be able to end the civil war, but neither the precise departure dates nor the effects the departure will have is clear.

The ethical/moral question of how to cope with more millions of refugees has not been adequately addressed. A large part of the problem is the result of mismanagement of energy use from phantom land. This has produced global heating and other types of climate change, as well as a rapid population growth based on

depletion of a finite resource - petroleum. The problem must be addressed before the human/environmental crisis worsens.

Path Forward

Eric Hoffer stated: "In times of change, learners inherit the Earth, while the learned find themselves beautifully equipped to deal with a world that no longer exists" (from Future Quotes - http://www.wisdomquotes.com/cat_future.html). The scientific evidence on global heating increases almost daily. All too much evidence indicates the rate of environmental damage is greater than expected. However, humankind cannot adapt to the new conditions by ignoring them, nor can effective remedial measures be taken unless a realistic appraisal of the problems is undertaken. Political leaders were reluctant to accept the evidence of global heating and, at present, refuse to implement the strong remedial measures that would probably diminish the high rate of change, fearing it would damage the economy. However, protecting the economy at the expense of the biospheric life support system is not a sound strategy. Sagan (2006, pp. 53-54) has a lucid statement of the problem:

But what is interesting is that in a number of respects the universe is very fine-tuned, so that if things were a little different, if the laws of nature were a little different, if the constants that determine these laws of nature were a little different, then the universe might be so different as to be incompatible with life.

Sagan (2006, p. 35) notes: "Now there is another tendency from the psychological or social sphere projected upon the natural world. And that is the idea of privilege. These prophetic statements describe why humans put the economy ahead of natural systems. We feel privileged and nothing bad can happen to us." The evidence of global heating and other types of climate change are causing humankind to reluctantly abandon these ideas. Will they be abandoned in time to take effective remedial action?

Phase 1 - Reducing Anthropogenic Greenhouse Gas Emissions

Many people in the United States have faith that a supreme being will step in and save them from the consequences of unsustainable practices. Others believe unproven technology will save humankind. What both groups have in common is the conviction that the status quo in energy use can be maintained without changing unsustainable lifestyles and practices. Phase 1 will begin when these delusions are abandoned and energy efficient policies and programs are embraced. Phase 1 will end when sustainable energy policies and practices are in place globally (i.e., greenhouse gas emissions maintained at a level that will not result in climate change).

A concomitant component of Phase 1 is the stabilization of the human population within the planet's long-term carrying capacity. The actual number will depend on the quality of life chosen. Most people would not choose disease and starvation as the prime limiting factors, but those will be the default factors in the absence of strong, effective population control measures.

Phase 2 - Fine-tuning Greenhouse Gas Emissions to Match Global Assimilative Capacity

Ecosystems are dynamic and, therefore, their greenhouse gas assimilative capacity varies. The assimilative capacity will vary both seasonally and regionally. This situation will require development of predictive models and biological/chemical/physical monitoring systems to validate their efficacy and make corrections when necessary. At first, this vision appears to be utopian, but is essential to sustainable use of the planet. In a period of climate disequilibrium, much work will be necessary for the experimental sciences, and enough appropriately experienced personnel may not be available. The National Research Council (1977) devotes an entire book to the problem of environmental manpower, which was difficult to resolve even before global heating and peak oil had been recognized as major problems.

Conclusions

Humankind is rapidly creating an alien planet that will probably be quite different from the hospitable planet that has nurtured humans for approximately 160,000 years. Already, global events are sufficiently unprecedented to make scientifically sound predictions of future conditions difficult. Worse yet, humankind appears unwilling to abandon the unsustainable practices that are causing an already precarious situation to worsen. Adapting to markedly altered conditions will require a continuous flow of scientific information as well as dramatic changes in individual and social behavior. Stabilizing the human population so that it is within Earth's carrying capacity and reducing greenhouse gas emissions so they are within Earth's assimilative capacity will

require a higher degree of environmental literacy than is now present, as well as a willingness of individuals to sacrifice some of their perceived "needs" for the common good. The balance of life on Earth is the greatest ethical/moral issue today. Humankind has a responsibility to other life forms as well as members of its own species. May humankind be up to the challenge!

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THE GLOBAL TOWER OF BABEL

Only in the last quarter of my life have we come to know what it means to be custodians of the future of Earth—to know that unless we care, unless we check the rapacious exploitations of our Earth and protect it, we are endangering the future of our children and our children's children. We did not know this before, except in little pieces, people knew that they had to take care of their own...but it was not until we saw the picture of the Earth, from the moon, that we realized how small and helpless this planet is—something that we must hold in our arms and care for.

Margaret Mead, March 21, 1977

I am confident that many humans would endorse Margaret Mead's message above, but most would not know precisely how to take action on this prophetic statement that will affect both the present generation and posterity. In addition, how can individuals and dedicated organizations become active and effective custodians of Earth when:

- (1) the global ecological footprint exceeds the regenerative powers of Earth,
- (2) humankind has many languages, cultures, ideologies, and an enormous range of per capita income,
- (3) the major global paradigm is economic growth, even at the expense of natural capital,
- (4) far more money is spent on destructive forces (e.g. military forces and equipment) than on environmental restoration and protection;
- (5) spokespeople of special interest groups denigrate and distort science when it appears to threaten their activities,
- (6) a major portion of the news industry is directly or indirectly controlled by special interest groups,
- (7) many obstacles exist when attempting to visualize the world from multiple integrated perspectives,
- (8) no single discipline can transcend the barriers to integrate knowledge throughout the planet, and
- (9) environmental literacy is inadequate for achieving sustainable use of the planet?

I immediately thought of the Tower of Babel story in which the whole world had one language and a common speech. Humans found a plain on which they built a city with a tower that reached to the heavens and were not scattered over the face of the whole earth. The Lord said, "If as one people speaking the same language, they have begun to do this, then nothing they plan to do will be impossible for them. Come let us go down and confuse their language so they will not understand each other." So the Lord scattered them all over Earth, and they stopped building the city. (There are multiple versions of this story—from Genesis 11:1-9, available on-line in many languages at <http://www.omniglot.com/babel/>; details are available at <http://www.idolphin.org/babel.htm/>.)

Of course, the key to long-term economic and social stability is sustainable use of the planet. Arguably, the key to resolving this issue is China, which is not only a very populous country with a rapidly growing consumer economy but comparatively little natural capital. How China addresses its consumption and production might represent a clear danger to humankind or, alternatively, an unprecedented opportunity to become a model nation for sustainable use of the planet (Flavin 2005).

Natural law has been "solving" bio-capacity problems for roughly 4 billion years. Nature's ways, however, are hard on both individuals and species. Even so, evolutionary processes have survived five major extinctions and will probably survive the sixth now underway. *Homo sapiens* may not be one of the surviving species, but, even if it is, a major loss of human life may occur. A common ground for simplifying this fragmentation (including language, culture, etc.) would be a global consensus on eco-ethics and sustainability ethics, both of which:

- (1) focus intently upon the ethical relationship between humankind and natural systems (Cairns 2003),
- (2) deplore the folly of humankind's unsustainable course of action, which is exhausting the planet's nonrenewable resources, such as fossil fuels,
- (3) deplore the over-harvesting of renewable resources, such as oceanic fisheries and old growth forests,
- (4) agree that global environmental quality is being degraded by automobile emissions, pesticides, nuclear wastes, greenhouse gases, and chlorofluorocarbons, which produce environmental consequences such as biotic impoverishment, global warming, and acid rain, and

(5) are deeply concerned about the exponentially growing human population, increased per capita affluence, and the increasing disparity in per capita distribution of the planet's resources.

Both concepts are essential to the quest for sustainable use of the planet. At present, it is difficult to visualize reaching a consensus or a common ground. Yet a consilience (literally, "leaping together") must be achieved for successful implementation of sustainability, and these ethical constructs are only two of many cultures/languages in the contemporary Tower of Babel. Regrettably, one can find more than one example of language and cultural barriers to a consensus in the news each day.

One major factor in the failure to make an effort to reduce cultural and language barriers is the lack of a long-term perspective, which is essential to any effort requiring a reduction of cultural barriers. Hulbert (2005) reports that investors in the stock market are not interested in the long term. They focus instead on what a stock is likely to do over the next quarter—or just the next week. Equally distressing is that these investors do not project very far, even when they attempt to consider factors that will affect a company's long-term profitability. Since they should have a strong self-interest in the long-term results of investing their personal money and do not, one would conclude they would have even less interest in events far distant in time and space. Yet, stewardship of Earth's natural resources is essential to the quest for sustainable use of the planet, and fair and equitable resource distribution is essential among those now living.

Another major obstacle to a harmonious relationship between people in different cultures speaking different languages is the high probability of an increased frequency and intensity of resource wars. As Brown (2005) notes, competition for vital resources, such as land and water, will increase as they become scarce. Of course, these resource wars will occur among ethnic and religious groups, as well as between the poor and the wealthy in the same culture. For example, the global expansion of the human population cut the grainland area per capita in half, from 0.23 hectares in 1950 to 0.11 hectares in 2000.

Finally, the supply of fossil fuels per capita is decreasing due both to population growth and increased per capita affluence. In addition, at the Prudhoe Bay oil field in Alaska, which still pumps more oil than any other site in the United States, output has fallen nearly 85% from its peak in 1987 and is expected to continue dropping (Blum 2005).

The global Tower of Babel is such a formidable obstacle to achieving sustainable use of the planet that the barriers must be markedly diminished. However, a harmonious relationship with unique local and regional ecosystems requires that cultural diversity be maintained. In a diverse biological world, global standardization is not a viable approach. Diverse languages will be less of a problem if a global consensus can develop on eco-ethics and sustainability ethics, which requires that they be compatible. Neither biological nor social evolution has prepared humankind for this sort of resource partitioning, but, if achieved, it would be a triumph for the ethical approach, which is, in any circumstances, better than the alternative. There is hope. Humankind is, more than any other species, a product of cultural evolution (Ehrlich and Levin 2005). Continual cultural evolution may permit achieving sustainable use of the planet.

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HUMAN ALTERATION OF EVOLUTIONARY PROCESSES

ABSTRACT

Soviet climatologist Budyko has remarked: “temperature and rainfall are the two major variables of life on Earth.” Human society is changing both of these phenomena markedly, along with many other key variables that affect evolutionary processes. A major risk is that the tempo (or rate of human-induced environmental change) may proceed more rapidly than the ability of scientists to understand, predict, or make any long-term changes that might reduce the severity of the consequences. Increasing evidence indicates that the general public and its leaders (i.e., policy makers and politicians) fail to grasp the full implications of a planet in which the types and rate of environmental change differ substantively from the climate records of the past 5 million years.

INTRODUCTION

Almost every human activity has some effect upon natural systems. When the human population was small and spread thinly over the planet, as it was for most of the 160,000 years the human species has inhabited the planet, adverse effects were localized and comparatively small. In short, the resilience of natural systems was not exceeded and, as a consequence, the impact on evolutionary processes was much less than it is today. Currently, however, effects are global and intense; illustrative examples follow.

- (1) Human population increased fourfold in the 20th century (Speth, 2004). The doubling time occurred within the life span of a single individual—a new phenomenon.
- (2) Affluence has increased even more because the global economic output has increased approximately twenty fold.
- (3) Humankind has become a major evolutionary selective force.
- (4) Perpetual economic growth is, arguably, the major paradigm for human society.
- (5) Species impoverishment (i.e., loss of biodiversity) and the consequent loss of valuable genetic information due to invasive species and habitat destruction and alteration, together with an increase in ubiquitous persistent toxic substances, has alarmed the scientific community for decades.
- (6) Over-harvesting, especially of marine fisheries, has made sustainable use of natural resources problematic.
- (7) Climate change has already become a major factor that is impairing ecosystems globally.

LOVE OF NATURE AND CATASTROPHES

Two major factors may diminish or stop damage to the 30+ million other life forms with which humankind shares the planet: (a) a love for and an ethical responsibility for the well being of other life forms and (b) fear of the consequences if humankind continues unsustainable practices (Cairns, 2004a,b).

Concern about natural systems and the environment became widespread during the latter part of the 20th century, which resulted in the first Earth Day in 1970 and the 1972 United Nations Conference on the Human Environment (The Stockholm Conference). The latter resulted in the United Nation’s Environmental Programme. However, the failure to implement any of these protective measures resulted in continued environmental degradation, although some notable successes were achieved. Even environmental catastrophes in the late 20th and early 21st centuries have resulted in a focus on symptoms rather than causes. Some ecological catastrophes (e.g., thinning and disappearance of the Arctic ice shelf) receive little or no attention from the “popular” news media. Other ecological events receive significantly more attention, such as the sea level rise at the Pacific Ocean island country of Tuvalu (Brown, 2001-2002) and the displacement of the Inuits (Native Americans in Alaska) covered by US Senator John McCain’s global warming hearings in the US Senate. Of course, the most dramatic catastrophe was the tsunami in late 2004, which caused massive loss of human life. Persuasive evidence indicates that the loss of protection from massive wave action increased tsunami damage substantially. This lack of protection would not have happened if the mangrove forests and coral reefs had not been damaged previously by human actions (e.g., Silverstein, 2005; Sharma, 2005). Ecological catastrophes are most likely to occur in areas or nations with significant ecological deficits (i.e., natural capital has been lost at a rate greater than the replacement rate) and will almost certainly have a major effect upon evolutionary processes, which, in turn, will have both long- and short-term effects upon human society. Finally, global warming and other human induced ecological changes that will affect evolutionary processes will result in severe consequences to human society.

One example is the suddenly warming climate, which is likely to be a serious threat to political stability (Schwartz and Randall, 2003). The “Pentagon Report” (Schwartz and Randall, 2003) describes an extreme scenario whose effects might be less than described or even worse because of interactions between subcomponents of the global systems. Effects on evolutionary processes are probable, regardless of the way the scenario unfolds.

EVIDENCE FOR HUMAN ALTERATION OF EVOLUTIONARY PROCESSES

An excellent summary of the alteration of evolutionary processes is available through the US National Academy of Sciences (Myers and Knoll, 2000), which provides abundantly referenced evidence that alterations have occurred and are likely to continue if present trends persist. Significant alteration of evolutionary processes will have major effects, mostly unfavorable, upon the dynamics of human society and humankind’s quest for sustainable use of the planet. Dixon and Adams (2003) speculate on what a post-human society might entail (these two authors consulted thirteen advisors with impressive credentials on evolutionary processes). Habitat fragmentation, now a global phenomenon, is another alteration that could cause a major disruption of evolutionary processes (e.g., Templeton et al., 2000).

Attesting to evolutionary alterations with massive documentation seems superfluous. Who can contemplate the massive recent alterations humans have made in the biosphere and conclude that these alterations have no effect upon evolutionary processes? Those persons would have to deny such evidence as the development of resistance to antibiotics in some disease organisms and the continual need to develop new pesticides to control pests. Why do policy makers not regard this paucity of readily available information as major evidence of the detrimental effects to human society of altering evolutionary processes?

DENIAL, ANTI-SCIENCE, AND SPECIAL INTEREST LOBBYING

One controversial explanation of the ineffectiveness of the environmental movement in the United States is that no prominent national leader has stated publicly and forcefully the detrimental consequences of present environmental trends. Leadership may fear alarming the general public or being labeled an extreme environmentalist (e.g., Shellenberger and Nordhaus, 2005). Although many laud the efforts of pioneers in the environmental field, some (Shellenberger and Nordhaus, 2005) believe that modern environmentalism is no longer capable of coping with the serious ecological crises of the world. For example, efforts to reduce global warming over at least two decades have not resulted in unsustainable practices being replaced by sustainable practices.

In contrast, Ehrlich and Ehrlich (2005) assert that, despite their belief that *The New York Times* Science Section has led the journalistic profession in reporting the consensus of the scientific community on the issues of climate change, the seriousness of the overall environmental situation has never been adequately covered by the media. Even though *The New York Times* has printed articles (Editorial, 20 January, 2005) on the human impact on the planet, no explicit statement about the seriousness of the impact has been forthcoming.

The well-known American religious leader Martin Luther King, Jr. stated: “A time comes when silence is betrayal.... Nor does the human spirit move without great difficulty against the apathy of conformist thought, within one’s own bosom and in the surrounding world” (Quote of the Week from *Sojourners* online newsletter, Wednesday, 19 January, 2005). How can the silence continue when the processes, including evolutionary, of Earth’s biological life support system are being seriously disrupted by human activities? Earth’s life support system has favored the human species for approximately 160,000 years, but the 30+ million species with which humans share the planet are not concerned with the fate of *Homo sapiens*. The other species are not committed to maintaining the life support system on the behalf of humans, even though conditions they produce now are beneficial to humans.

Speth (2004) believes that three factors are responsible for humankind’s failure to respond to global threats: (a) the collective power of the forces that produced this situation will not be adequately changed by half-measures, (b) the far-reaching complex responses required make redirecting the global agenda inherently difficult, and (c) global politics impede the development of a suitable global agenda. However, Speth believes the transition to sustainability can be made.

Gelbspan (2004), a recipient of the Pulitzer Prize, focuses on the consequences of global warming, which he feels is causing the planet to fall apart piece by piece in the face of persistent and pathological denial. Since Gelbspan is a journalist, his charge that the media has failed to make the connection between climate change and other events, such as altered rainfall patterns, is very persuasive. Gelbspan also feels another major failure of the media is ignoring the ferocious battles between the fossil fuel industry lobby and credentialed scientists who have made the study of global warming a major part of their professional careers. He uses as an example (pp. xii, xiii) the assault on the character and scientific integrity of Dr. Benjamin Santer, a world-class climate

modeler at the US Lawrence Livermore National Laboratory. Associated Press Special Correspondent Hanley (2005) remarks that the US delegation to a global conference on disasters wanted to purge a UN action plan of its references to climate change as a potential cause of future natural calamities. Clayton (2005) describes the fate of George Zeliger, a *whistle blower* (a person who makes a public disclosure of corruption or wrongdoing). Orr (2004) has written a very disturbing analysis of the effect of politics (especially when disguised as patriotism) on the environment.

The relevance of these incidences to human alteration of evolutionary processes is that the scientific process must be allowed to flourish and must not be suppressed when it appears to conflict with political or economic ideologies or matters of faith. The scientific process, including peer review, has been very successful in discrediting faulty hypotheses, but it does so by rigorous testing of them and their supporting data.

Wiener (2005) describes a situation in which 20 of the largest chemical companies in the US have developed a campaign to discredit two historians who studied the attempts of industries to conceal links between their products and cancer. This situation is unusual in that the companies have subpoenaed and deposed (in courts of law) the five academicians who recommended that the University of California Press publish the book *Deceit and Denial: The Deadly Politics of Industrial Pollution* by David Markowitz and David Rosner. Intimidating qualified reviewers strikes at the heart of the scientific process. In another somewhat similar situation, the British Government's chief scientific advisor, Chief Scientist Sir David King, has claimed there have been attempts to discredit him because of his attempts to call attention to the threat of global warming (Conner, 2005).

In the United States, arguably one of the scientific leaders in the world, the assault on science has three major components: (a) discredit scientists whose views differ from the dominant political or economic ideology and religious faith, (b) attempt to intimidate scientists and other academicians by litigation, which is both time consuming and expensive, (c) attempt to discredit scientific theories by implying they are merely educated guesses rather than carefully constructed frameworks for understanding a substantial body of evidence (e.g., Editorial, January 23, *The New York Times*, 2005). Theories supported by mainstream science are the most useful scientific theories. Attacks on the theory of evolution in the United States are increasing and persistent and are especially significant when they are against the texts used in the school system. If science is discredited in the educational system, understanding the effects of humans upon evolutionary processes will be markedly hampered. Fortunately, many scientifically advanced countries accept evolutionary theory, and both teaching and research can proceed in a systematic way in keeping with the processes of science.

Many Christians view evolution as God's means of creation, and the theory of evolution is taught in Catholic schools and many other Christian schools. Christian fundamentalists and creationists are a very politically active sub-set of all Christians, but their energy and fervor in promoting their beliefs have made teaching evolution a major issue in the United States. Sustainable use of the planet requires that humankind have a better understanding of evolutionary processes. Achieving this goal requires that the processes of science not be disrupted, especially in the education of future scientists.

CONCLUSIONS

The quest for sustainable use of the planet by *Homo sapiens* requires a mutualistic relationship between human society and natural systems. Disrupting evolutionary processes that facilitate this relationship will almost certainly have adverse, possibly fatal, effects upon human society. Another way to envision the quest for sustainability is avoiding a post-human world (Cairns, 2005). Lest this seem too fanciful, it is well to remember that *Homo sapiens* has only inhabited Earth for approximately 160,000 years out of an estimated 4.5 billion years that the planet has probably existed. In addition, the greatest anthropogenic damage has occurred in the last 200 years.

If ecological tipping points are reached or exceeded, disequilibrium will result. Regrettably, the only certain way to find an ecological tipping point is to reach it or exceed it, because no laboratory experiments are suitable for such large temporal and spatial spans. McCarthy (2005) discusses a report that estimates the climate change tipping point at 2° centigrade above the average world temperature prevailing in 1750 (before the Industrial Revolution). Since that time, human production of greenhouse gases, such as carbon dioxide, has markedly influenced the retention of the sun's heat in the atmosphere.

Speth (2003) believes that globalization is one of the profound phenomena in the present era that has affected the environmental, economic, and social aspects of the nations of the world. Because globalization involves so many political and economic systems, mid-course corrections of these powerful trends will be exceedingly difficult, but not impossible, to alter. To achieve this goal, a mutualistic co-evolution of human society and natural systems is necessary (Cairns, in press). If humankind fails in this undertaking, evolutionary processes will continue, although many other species will probably be driven to extinction. Failure would also

suggest that intelligence, as humans define it, did not provide the long-term survival value it was thought to have. I believe if intelligence is used to select sustainable practices, it will have proven to have long-term survival value.

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COMPASSION, CATASTROPHE, AND CHANGE

The world is plunging into an energy crisis unlike any before, while geopolitical alliances are shifting quickly and to a degree not seen since the end of the Soviet era, and perhaps not seen since the end of World War II.

Richard Heinberg (2006)

Background

Modern society is based on energy, and its recent evolution has been rapid because of cheap, convenient, readily available energy. Energy availability enabled the small-group species of *Homo sapiens* to change from a few million, spread thinly over the planet, to over 6 billion individuals, mostly in large human artifacts or cities and their suburbs. The energy in an ecosystem available to its biota is one of the most important determiners of carrying capacity. Anthropological evidence shows that humans have been capable of living in a harmonious relationship with natural systems for most of the 160,000 years the species has been on the planet. This relationship does not mean that humans caused no damage; however, the damage has been small and isolated so that ecosystems could recover from it.

However, as Catton (1980) remarks, humans diverted a substantial portion of Earth's life support capacity from supporting other life forms to supporting humans. Moreover, humans have continued to usurp energy since the Agricultural Revolution (which occurred about 10,000 years ago) so that only a few truly wild systems remain and most of the planet shows some effects of anthropogenic activities. In addition, tools (e.g., bows and arrows, knives) enabled humans to extend their domination over nature, but the tools also changed humans. In an automobile culture, such as the one in the United States, the "tool" actually separates humans from natural systems.

Domestication of wild plants and animals that supported the Agricultural Revolution also gave humans access to energy that was previously less available to them. For example, horses turned grass into transportation or work energy – cattle turned grass into food. However, climate change can result in a reduction in the energy available via these routes.

The process that has enabled humans to produce a 24% ecological overshoot is called *drawdown*. This process can use either nonrenewable resources, such as fossil fuels, or renewable resources, such as old growth forest or top soil, for which regeneration rates are slow. However, this strategy is not sustainable.

Humankind faces an unprecedented opportunity for both success and failure on a global scale. As Heinberg (2005), Diamond (2005), and Tainter (1988) note, many human societies have expanded their power and complexity to remarkable levels only to decline and revert to simpler forms of social organization. Humankind has used every means available to displace other life forms from the areas they once occupied, divert their resources to human use, and deplete natural capital that has taken many years to accumulate. Now the cheap, easily available, convenient energy that made this scenario possible is declining (Heinberg 2005). Alternative fossil sources of energy are available (e.g., coal), but come at a higher environmental cost. Wind and solar power are appealing, but are not yet widely available. Clearly, profligate energy use is rapidly becoming a relic of the past.

Humans have not shown much compassion for other life forms during the process of dominating the planet. Will compassion for other life forms increase or decrease when the era of cheap energy is over? Some foodstuffs (e.g., corn) can be converted to fuel (e.g., ethanol). Will compassion for other members of the human species place food ahead of fuel while some humans are starving or malnourished? Some catastrophes now seem probable. How will compassion for the suffering be expressed in terms of resource allocation? In short, in an era of rapid change, will the manifestations of compassion from humans be appropriate?

Resource Consumption

Concern is mounting about global warming, peak oil, environmental pollution, species impoverishment, and other trends resulting mostly from human activities. The concerns and trends continue because implementation of strategies that would improve prospects for sustainable use of the planet is minimal. Tipping points cannot be precisely predicted until they have occurred, so scientific uncertainty is being cited extensively as a justification for inaction, just as it was cited for the harmful effects of cigarettes decades earlier. However, disequilibrium of the planet's life support system will almost certainly not be reversible. Unless major changes

are made soon in humankind's relationship with the biospheric life support system, catastrophes will occur and hope for leaving a habitable planet for posterity will diminish.

Beginning around 1980, evidence showed that the use of resources by the global economy has outgrown the capacity of natural systems to regenerate them. Almost daily examples of the conflict between demand and supply are in the news media. Worse yet, resources that have taken hundreds of thousands, even millions, of years to accumulate are being consumed in a few centuries. One lesson of history is that the primary indicators of societal decline were ecological, not economic. The ecological overshoot was about 20% in 2002 and appears to be increasing about 1% per year. This situation is not sustainable.

Ecosystem Restoration

Lowering resource consumption to equal the regenerative capacity of natural systems will require monumental management changes of resource extraction and use. Restoring damaged ecosystems will require even more sacrifice, but the health of the economy and the supply of natural capital and the ecosystem services it supplies are closely coupled. Moreover, restoring damaged ecosystems to their pre-damaged condition in an era of ecological disequilibrium will be extremely difficult (Cairns 2006). In fact, anthropogenic climate change and loss of species may make restoration to predisturbance ecological conditions an impossible task. Perhaps humankind should let nature take its course and see what happens. The major risk of this approach is that the new ecosystems will probably not be as beneficial to humans as the ones that were damaged. Worse yet, new ecosystems could be a threat to human society.

Brown (2006) recommends an annual earth restoration budget of US\$93 billion. This sum is tiny in view of the amount of restoration needed. At the very least, such a budget would indicate where and under what conditions ecological restoration might meet stated goals. However low the probability is of success, ecological restoration must be attempted, unless failure is virtually certain. Essential to any plan is the determination of which damaged ecosystems are irreversibly damaged, which should recover without restoration efforts, and those for which ecological restoration efforts will make a major difference.

An ecological triage decision would differ from the human medical one in an important respect: ecosystems too damaged to restore to pre-disturbance condition or to recover naturally to that state could be replaced with constructed ecosystems (e.g., Atkinson and Cairns 1993) and created ecosystems (e.g., Atkinson et al. 1993). These naturalistic systems are designed to function under new conditions, and both help accumulate natural capital and provide ecosystem services. These constructed ecosystems will require subsidies and more intensive management, but should increase Earth's carrying capacity appreciably.

Since humankind has typically ignored threats to the biospheric life support system, damaged ecosystems may also be ignored. This scenario is not a good idea since these damaged systems will be colonized by species resistant to human control (called pests). Many pests will emigrate to parts of the surrounding area and probably out-compete and displace many indigenous species, which is not conducive to achieving sustainable use of the planet. If humans have diminished natural capital and the ecosystem services it provides, both must be replaced to whatever degree possible.

These ecological restoration activities are usually accomplished best in a local setting so that citizens can both be part of the effort and protect the improved ecosystem from future damage. This approach is also helpful in developing and demonstrating compassion for other life forms. What a pity that ecological catastrophes are necessary to catalyze these ecologically benign activities.

Compassion for Other Humans

Exponential increases in both human population size and level of affluence have resulted in a global water shortage. Since 1,000 cubic meters (approximately 1,000 tons) of water are necessary to produce a ton of grain, water shortages and food shortages are closely coupled. Populous countries, such as China and India, already have large water deficits, as do Algeria, Egypt, Iran, Mexico, and Pakistan. Their citizens are fellow crew members of Spaceship Earth; surely, political differences can be resolved so that humans can help each other. If human populations are not stabilized, any efforts will be wasted. However, unsustainable practices caused the problem and compassionate help should not allow these practices to continue. Should the United States be given more cheap oil with the hope that the US Congress will develop a comprehensive, sustainable energy policy or the that drivers of automobiles will use energy efficient vehicles?

Since the beginning of my professional career in 1948, action has been postponed because "technology will save us," reason will prevail and the environmentally damaging practices will cease, politicians will fulfill their promises to protect the environment, and polluting industries will become environmentally sensitive. Instead of improving environmentally, the planet is in a precarious situation that may be irreversible. None of my hopes have been realized; many have been shattered. However, is inaction best? No; however, neither are

statements such as “I respect the interdependent web of life if it is not accompanied by major environmental deeds.” Even so, what can be done must be done to protect and restore the environment.

Nation-States in Disequilibrium

Schell (2003) notes that global warming cannot be stopped by B-52 bombers (but they contribute to it) or by nuclear proliferation (pp. 353-354). He notes that peace, social justice, and defense of the environment are a cooperative triad pitted against war, economic exploitation, and environmental degradation. Schell also adds that rejecting war is not enough; humankind must now secure survival by suppressing the menace of annihilation. Second, Schell believes in delimiting sovereignty — when power is cooperative, in the domestic sphere at least, it does not have to be indivisible but can be divided among branches of government and localities (or even eco-regions). Schell states that, if such divisions cannot occur in the international sphere, hope for sustainable use of the planet is doomed. The European Union is a good example of what might be accomplished with hybrid arrangements unimaginable if nation-states base their policies on war. Third, the old unity of state, people, and territory would be dissolved (p. 374).

Gottlieb (1993) feels that the basic components of sovereignty (the state and the nation) might possibly be separated. Given the turbulent relationship between ethnic groups, religions, and other special interest groups worldwide, this separation is unlikely, although it has existed, temporarily, in some sovereign nations. The problem is that humans remain a small-group species and are unable to cope with complex, multivariate political structures. Perhaps human resource distribution issues might be resolved more fairly and equitably if political boundaries were replaced by ecological boundaries and the primary political goal was preservation of carrying capacity based on natural capital and the ecosystem services it provides. The people responsible for the diseconomies and catastrophes would then suffer when their ecological life support system is damaged.

Developing Naturalistic Social Norms

In the 21st century, a rapid evolution of social norms is essential. For cultures such as the United States, in which social norms have been based on a cheap, convenient, readily available source of energy (i.e., petroleum), the rate and degree of change needed will be almost overwhelming. The American automobile culture has let public transportation languish, and urban sprawl has been possible because of the independence automobiles provide. Coal is a possible energy alternative, but it diminishes air quality as well as producing greenhouse gases. Ethanol is an alternative to petroleum products, but may have unattractive input/output energy ratios. Moreover, corn and other foodstuffs are serious contenders as sources of ethanol. Since most of the planet's arable land is already in use, an “eat or drive” situation could easily develop, especially if climate change (e.g., rainfall patterns, temperatures) diminishes present agricultural productivity. If climate change occurs more rapidly than predicted, as it is in some parts of the world, the consequences will probably be catastrophic. If foodstuffs, such as corn, are diverted to alcohol production for automobiles, the increased demand could force prices well beyond the means of poor and middle-class people. If climate change diminishes the production of corn and other foodstuffs that can be converted to alcohol, prices could soar even more. At present, over a billion people are not adequately nourished, and the additional 3 billion more people who are projected to be added in the 21st century will exacerbate this troubling situation.

If compassion for the poor exists, something should be done to improve their condition. Since most of the population growth is expected in third-world countries, population stabilization at a level compatible with regional carrying capacity is an obvious solution, which means intruding on individual freedom to have large numbers of children. This intrusion would be distasteful to many people. On the other hand, in natural systems, species that exceed the regional carrying capacity simply lose large numbers of individuals to death, starvation, and disease. If humankind is unable to develop social norms that protect the biospheric life support system, should disease, starvation, and death be permitted to limit human population size as they do for other species? In the Pacific arena of World War II, the very heavy casualties resulting from capturing Iwo Jima were considered justified because they saved the lives of so many B-29 bomber crews whose damaged aircrafts would otherwise have been lost at sea. Should the same reasoning be used to protect the biospheric life support system that is essential to a habitable planet for posterity? Should this reasoning be used when the long-term carrying capacity of the planet has been exceeded?

Biospheric Life Support Systems

One colleague correctly pointed out that there is yet no robust evidence that the biospheric life support system is in disequilibrium; however, no robust evidence indicates that its health and integrity have not been impaired. The consequences of the biospheric life support system ceasing to maintain conditions so favorable to humankind are so appalling that precautionary measures to avoid stressing the biospheric life support system

beyond its tipping point are prudent. Paleontological evidence indicates that evolutionary processes eventually restored biological diversity in the past, but not the species that became extinct. Post-disequilibrium conditions may not be as favorable to humans as those at present. From a homocentric viewpoint, precautionary measures are justified even though the precise tipping point of the present biospheric life support system is not known. This tipping point can be determined by continuing present unsustainable practices; however, when the biospheric life support system is in disequilibrium, how will this new knowledge benefit humankind? Evolutionary processes will almost certainly persist (until the sun dies), but individual species, such as *Homo sapiens*, may well suffer major loss of life or even become extinct. Compassion for the other life forms that constitute the present biospheric life support system is a matter of enlightened self interest, as well as an indication of compassion for posterity.

The Limits of Compassion

The daily news is a constant reminder that catastrophes occur continuously, even though, fortunately, most are regional rather than global. Responding to each in a meaningful way would produce an emotional overload in most people. In fact, many people studiously avoid the bad news and only welcome the good news. Of course, denial of or avoidance of problems usually results in delaying the solution of the problem. However, so does taking on too many problems at once so that none gets the attention needed for solution.

With an exponentially increasing human population, increasing ecological overshoot, global warming, and other types of climate change; peak oil; and inadequate supplies of fresh water, exceeding a number of ecological and societal tipping points in the 21st century would not be astonishing. Since the exact location of these tipping points will not be known until they have been passed, each catastrophe will be a surprise. Of course, if an urgent, major global effort were made to first arrest and then reverse these unsustainable trends (remembering ecological overshoot), these thoughts could be dismissed as idle speculation. However, no credible signs indicate that this trend is happening at the global level. Worse yet, so little has been done that even inadequate measures may look good to the general public and, thus, delay effective remedial action. Some illustrative questions related to these issues follow.

1. Will compassion for the biospheric life support system be adequate to ensure its health and integrity so that conditions favor *Homo sapiens*?
2. Can humans adapt to rapidly changing social and ecological conditions so that species survival is likely?
3. Will humankind have sufficient compassion for posterity to withhold aid to populations that persist in having social norms that are unsustainable?
4. Will resource wars, both military and economic, be the primary determinant of allocation of finite resources on a finite planet?
5. Will resources be used sustainably?

In natural systems, finite resource problems are “solved” in ways repugnant to most humans — mass deaths, starvation, disease, etc. Since humankind credits itself with intelligence, creativity, and compassion, one might reasonably expect more from this species than a 24% ecological overshoot, exponential population growth, excessive anthropogenic greenhouse gases, and resource wars. The basic question is not how to meet human “needs” and expectations, but how to live sustainably so that the biospheric life support system continues to maintain conditions that are so favorable to humans. Otherwise, humans will become a transient species like those that preceded it over billions of years.

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SURPRISE, SURPRISE—HEAT MELTS ICE

Get your facts first; then you can distort them all you please.

Unknown

Globally, temperatures are rising; glaciers are melting and shrinking; scientists are predicting increased numbers of damaging hurricanes (Zollo 2005); rainfall patterns are changing; and sea levels are rising. All these events will affect the reliability of global food production. In addition, higher seas are swamping native villages in far north Alaska, and the melting of the permafrost around Fairbanks is causing some roads and other structures to buckle (Egan 2005). Climate change is also affecting bird migration, a significant source of tourist dollars for some Alaskan villages. Portage Glacier can no longer be seen from the visitors' center.

Some politicians, corporate executives, and many citizens act surprised at these changing events and emphasize the uncertainty in scientific hypotheses and information. However, Swedish scientist Svante Arrhenius predicted, in the 1890s, that the Industrial Revolution would result in global warming, and evidence supporting his theory has been accumulating for well over a century. Uncertainty will always exist in science since theories are probabilistic determinations based on verifiable evidence. Citizens invest in the stock market and vote for political candidates based on the expectation that the stock market will benefit them and politicians will fulfill their campaign promises. Obviously, considerable uncertainty exists in both these expectations, but citizens still act.

Michaels (2005), a research epidemiologist, calls attention to similarities between his research and that of those who study climate change (including global warming). Michaels cannot intentionally expose people to carcinogens and must collect data through observation only; so must climate change investigators. He notes that uncertainties are inevitable, but neither public health nor environmental protection will be effective if absolute proof is required before acting. Otherwise, action will be indefinitely postponed, which, Michaels notes, is often exactly what industry wants. As a consequence, part of industry has mastered the art of manufacturing uncertainty and demanding absolute proof.

Worse than this situation are recent disclosures that unqualified government employees are altering scientific reports. For example, the former US White House staff member (Philip Cooney) who revised government-generated scientific reports on global warming resigned his position following these disclosures and promptly acquired a position with Exxon Mobil. He was a lobbyist with no scientific credentials (Revkin 2005).

Yet another approach is used when the facts do not fit the ideology—the administration just rewrites the facts (Opinion 2005, Goodman 2005, Cart 2005). If none of the preceding strategies work as well as expected, the tactic of delay is used. For example, McNeil and Barrionuevo (2005) report that the US Department of Agriculture finally confirmed, after seven months delay, that a cow had died last year with Mad Cow disease. The result was never publicly disclosed, even though interest in this disease has been intense both nationally and internationally; many countries have banned shipments of US beef because they consider testing techniques lax.

The American Civil Liberties Union charged that the US President Bush's administration is placing science under siege by overzealously tightening restrictions on information, individuals, and technology in the name of homeland security (Associated Press 2005). Another strategy is to resist any discussions on an issue perceived as unfavorable to the government's cause. For example, Heilprin (2005) reports that the Bush administration is working on a draft report on climate and energy about the need to resist naming global warming as an urgent problem that requires aggressive action. Still another approach is to annex the news and public affairs of the US Public Broadcasting System to the larger state propaganda machine (Rich 2005).

A widely read news outlet, *USA Today*, has proclaimed that the global warming debate is over (Vergano 2005). Vergano notes that the ground has shifted on global warming since, with little fanfare, divergent groups are joining hands to deal with a problem they believe people can no longer ignore. However, there is still a long way to go. The administration of US President Bush is still trying to downplay global warming as a major problem for humankind. Many large corporations still spend huge amounts of money minimizing the importance of global warming. A large number of people are unwilling to change their life styles to diminish anthropogenic greenhouse gases, and literacy on global warming is still appallingly low. All these tactics are reflected in the reluctance of the US Congress to take a strong position on global warming. The fact that this reluctance results

in deep disappointment in Europe and other areas of the world seems not to matter (e.g., Woolf and Brown 2005).

Even the Kyoto agreement, if implemented, is regarded by mainstream science as an inadequate solution, although it is widely viewed as an important first step. Global warming is now a battle between science and ideology, although a favorite delaying tactic is to call for more research. As noted previously, it is the nature of science to always have different levels of uncertainty. Gathering more scientific evidence on global warming is highly desirable, but no amount will displace ideology. Compassion for those already suffering from global warming in Europe (e.g., LaFranchi 2005), Pacific Islanders forced to leave their native lands, and the Inuits in the US State of Alaska is not very evident. Even compassion for future children, grandchildren, and their descendants is not apparent. Bustillo (2005) quotes Peter Hoppe, head of the "geo risks" division at Munich Re, the world's largest insurer of insurance companies, that his biggest worry is what global warming is already costing the \$3-trillion insurance industry. The present situation is difficult because the techniques for estimating disaster risks are based on historical trends, which may no longer be reliable. Other professionals, such as Pielke (Bustillo 2005), note that the reinsurance industry has a powerful vested interest in charging the highest rates possible. A former insurance executive, Andrew Elugolecki, stated that, unless insurers could adjust their premiums to match the uncertainties they see, they might eventually stop offering some types of coverage, such as oceanfront properties (Bustillo 2005). Historic data will probably be less useful in estimating the risks of global warming than such things as fire and theft.

McCarthy (2005) wonders if the United States can prevent wealthy countries from agreeing on what to do about climate change; he concludes that the omens do not look good. Other questions concern areas such as Africa and its poverty. Many professionals note that everything that makes Africa hard to inhabit today will be made harder by global warming. Even though the United States may not endorse a Kyoto Protocol style agreement, global warming proponents may shift the approach in a new direction. The tide may be turning, but it may be turning too slowly to prevent a series of catastrophes.

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LIFEBOAT ETHICS — TO SINK, OR NOT TO SINK: THAT IS THE QUESTION*

No generation has viewed the problem of the survival of the human species as seriously as we have.
Garrett Hardin (1974)

For the foreseeable future survival demands that we govern our actions by the ethics of a lifeboat. Posterity will be ill served if we do not.
Garrett Hardin (1974)

Hardin (1974) used a lifeboat metaphor to simplify the issues involved in living on a finite planet with finite resources. The human species hopes to remain on Earth for many generations (i.e., sustainable use without abuse of the planet), and the use of metaphors will help humankind understand and cope with vast temporal and spatial scales and complex multivariate data. Further, Hardin (1974) believed that rights and responsibilities must be congruent. He asserted (Hardin 1976): “lifeboat ethics is merely a special application of the logic of the commons.” He also provided some ways to avoid sinking the planetary lifeboat (Hardin 1985). Hardin’s numerous publications identified the major issues humankind must resolve in the 21st century — or suffer grievously. Hardin’s lifeboat metaphor is ideal for illustrating the consequences of individuals leaving (emigrate from) a sinking or badly overcrowded lifeboat to board (immigrate to) a lifeboat with more desirable conditions.

The metaphor is weak in that the lifeboats (islands and continents) cannot rise when the sea level rises. As Revkin (2004) notes, Greenland has an ice cap that is two miles thick; Revkin calls it a “freshwater Gulf of Mexico” that is frozen atop the world’s largest island. Equally important is that the influx of freshwater from this melting ice cap might block currents in the North Atlantic that help moderate the weather of the North Atlantic (Revkin 2004). The lifeboat metaphor does not convey the high probability that rising water will reduce food production while crowding people on a small land surface. Changing weather would also impair agricultural productivity, probably pushing it into instability. As Hardin (1974) noted, lifeboats should not be filled to capacity so that each will maintain a safety factor.

Sachs (2004) maintains the necessity for both understanding and resolving human catastrophe security threats arising from extreme poverty. The poor are on sinking or unsafe (i.e., not sustainable) lifeboats, which they will almost certainly be tempted to leave, even at great personal risk, if their circumstances are not improved. *The Camp of the Saints* (Raspail 1973) is an apocalyptic, but believable, vision of future events if the disproportionate allocation of planetary resources worsens or if damage to natural systems reduces Earth’s carrying capacity.

The quest for sustainable use of the planet is an attempt to avoid a post-human world. Many circumstances are contrary to achieving this goal; two of the most important follow. (1) An ecological “overshoot” has been caused by the human economy. Stated more directly, humankind is not living within the regenerative capacity of the biosphere (Wackernagel et al. 2002)—humankind is exceeding the long-term carrying capacity of the planet. (2) Access to the global commons is not regulated (Cairns 2003-2004). Hardin (1968) has eloquently described the tragic consequences of free access to the commons by people or organizations with little or no conscience.

Prestigious scientific groups (Union of Concerned Scientists 1992, Royal Society of London and the United States National Academy of Sciences 1992) and world-class scholars (e.g., Wilson 1993) have issued

*With apologies to William Shakespeare

warnings about the dangerous deterioration of environmental conditions. Myers (1996) has included national security as an environmental issue, and his book is not an isolated example of the connection between biospheric conditions and political conditions. Since culture has markedly shaped human evolution (e.g., Wilson 1998), humankind may be its own worst enemy. Arguably, the leaked Pentagon report that warns of climate wars (Environmental News Service, 23 February 2004, originally published by the British newspaper *The Observer*) is a dramatic force since the Pentagon is not viewed as an environmental organization.

Oddly, the Pentagon report has received little attention in the American news media even though the probability is high that global warming is almost certainly a greater threat to American security than terrorist attacks. Myers (1996) discusses why humankind chooses to ignore the environmental implications of its actions. He wisely avoids explicit policy statements (since the need for a policy on greenhouse gases and population stabilization, to mention two matters of urgency, have been evident for years), even though no remedial policies have been developed. Since world leaders respond primarily to emergencies, one or more environmental catastrophes will probably have to occur to initiate action on policies. Hanley (2004) provides an excellent summary of the views on global warming of prominent scientists and highly respected scientific organizations. As he notes, even skeptics agree that it is time to act, although research on global warming should continue.

Even the well publicized September 11 terrorist action (i.e., three hijacked planes crashed into the World Trade Center twin towers and the Pentagon in 2001) has not yet produced an effective policy to prevent such future incidents. Arguably, this inaction is due to policy makers who are addressing the symptoms rather than the underlying causes, partly because special interests protecting existing policies and practices are too formidable and their lobbyists are too entrenched. In addition, an environmental illiteracy problem exists which, when corrected, should elicit policy development from all sectors of human society. Myers (1996) does discuss failed policies on natural resources and profligate unsustainable use of these resources. What is not understood is that even moderate damage to the planet's biospheric life support system will severely impair global security and major damage might result in the final exit of *Homo sapiens*.

These thoughts are depressing, but humankind has the ability to change these circumstances by changing behavior patterns so that it neither exceeds carrying capacity nor irreversibly damages the biospheric life support system. These resolves will require leadership that can persuade and inspire the average citizen to make such changes. However, the United States, which has the world's largest ecological footprint, has carried out more than 150 impairments of environmental safeguards between January 2003 and March 2004 (National Resources Defense Council 2004). To assume that these impairments would have no interactive or cumulative effects would be madness. Globally, the probability of cascading tipping points is daunting. China has a rapidly growing economy, making it a major influence on the world grain market. The United States trade deficit with China is huge, so that much of the American grain surplus will probably go there. Since about 1,000 tons of water is needed to produce 1 ton of grain, the world shortage of freshwater will have an impact on grain production, as will desertification. Furthermore, in the United States, grain production is highly mechanized, so increases in energy prices will have a major effect on costs. Finally, global warming and other types of climate change may well have adverse effects upon grain production.

Orr (2004) describes the current crisis as political, although not in the traditional sense. He notes that American-style democracy is in tatters when trying to change unsustainable practices, since most American citizens (the majority) do not want dirty air and water; however, there is formidable opposition to changing practices that pollute and damage the environment. Ironically, as Mooney (2004) notes, there is an Orwellian aspect to any attempt to undercut scientists. Politicians who advocate "sound science" in support of their political agenda do not dare, at least at present, to call mainstream science poor, deficient, or fraudulent because they have no robust evidence to support this assertion. "Junk science" is best dealt with in professional journals by the scientific process involving credentialed scientists. A call for "sound science" is an attempt by politicians to denigrate scientific research that deviates from the dominant political ideology. The Union of Concerned Scientists (18 February 2004) released a report criticizing the Bush administration for distorting and denigrating scientific publications that differ from the administration's ideological agenda. Bartlett (2004) notes that there will be no satisfactory long-range solutions to problems of energy and the still increasing carbon dioxide emissions until population growth and sustainable energy policies have been developed. Since human society depends heavily on energy, this serious problem could destabilize human society if it is not addressed in the near future.

Orr (2004) discusses how the democratic public, on such crucial topics as climate change, hazardous chemicals, and environmental degradation, has had little or no influence on public policy in the United States. If democracy is to be established in non-democratic countries, the United States should serve as a model for sustainable use of natural resources. Orr (2004) attributes this situation to two key factors: (1) a marked

decline in public accountability and (2) a well funded campaign to denigrate alternate points of view. Both of these are acts of denial and are not limited to politics, advertising, or economics, but include politicizing of both scientific research and education. Berry (1977) discusses the perversion of the goals that led to the establishment of land-grant universities in the United States.

Ehrlich and Ehrlich (2004) discuss the belief that America can maintain its high level of affluence despite the rapidly increasing disparity between rich and poor. They believe that this situation (and other political stances) demonstrates a loss of contact with reality. Historic and archeological evidence is used to illustrate that a powerful, prosperous, and culturally advanced society (e.g., Nineveh, located in the nation-state of Assyria) can be replaced by a barren landscape if there is a marked decline in the natural resource base. Assyria had a powerful military establishment that played a major role in maintaining the flow of resources into it, and Assyrian kings used terror to deal with powerful foes. Living unsustainably globally threatens the quality of life of posterity and even its very existence.

Counter trends have surfaced (e.g., one article by Robert F. Kennedy, Jr. in the 11 December 2003 issue of *Rolling Stone* and also available at <http://www.commondreams.org/views03/1120-01.htm>). The United States Senate Climate Stewardship Act, S. 139 (ssi@ucsUSA.org) is a bipartisan effort to set mandatory limits on greenhouse gases from relevant sectors of the American economy. Officers of some of the largest pension funds in the United States are attempting to have the United States Securities and Exchange Commission require disclosure of financial risks involving global warming to the stocks in their pension funds (Environmental News Service, April 2004).

These situations lead to some very puzzling questions. Why is humankind continuing unsustainable practices that put posterity at risk? Why risk a worst case scenario that places the human species at unnecessary risk? Why are nation-states and corporations favoring, even subsidizing, practices that put their citizens and customers at risk? Why is science denigrated when evidence is counter to political agendas and supported when it favors them? Why, when baboons have an emerging peaceful culture, can't humans (Sapolsky and Share 2004)? Why is humankind so reluctant to have a free and open discussion about the worsening environmental crisis?

One possibility for this reluctance is that answers to these questions would expose humankind's vulnerability to the consequences of an environmental destruction unprecedented in human history. Denial of the consequences of unsustainable practices is the best way to avoid major changes in societal behavior, which should, if implemented in time, substantially reduce the risks. Anxiety has not been eliminated—just suppressed. Natural systems should generate a sense of awe in humankind because it still does not understand them fully. Instead, natural systems are labeled “resources” to be used as humans choose.

Although it borders on the heretical to reflect on the decline, even extinction, of *Homo sapiens* in an era of exponential economic growth, a few questioners have done so. Hanh (1993) remarks on the intense anxiety about what the future holds. Berry (1996) considers how the dissolution of the present components of the environmentally destructive system might affect the future. Hill (1994) asserts that ultimately no refuge from nature's laws exists. Dixon and Adams (2003) have labeled the present era the “Human Era” and speculated, with the help of a number of scientists, what might inhabit a post-human world, i.e., humankind's domineering presence will not endure. Heifetz (1994) stresses the need to endure anxiety and pain so that one can learn from these emotional challenges. Humans need to confront their fascination with their environmentally destructive society and develop what Wilson (1984) calls biophilia.

It is reassuring that both Orr (2004) and Ehrlich and Ehrlich (2004) and, of course, all who believe sustainable use of the planet might well be achieved, have suggestions for changing unsustainable to sustainable practices. Orr (2004) remarks that a conference on the “State of the World” included much on the gloomy state of the environment and the human condition; he decided to list the legitimate reasons for optimism about the future. Orr concludes that many individuals are correct in affirming better prospects: “public opinion polls show determined majorities over three decades in favor of clean air, clean water, open spaces, preservation of species, climate stability, less traffic congestion, and solar energy” (Orr 2004, p. 133).

Much of the tolerance for unsustainable practices may be due to “cognitive dissonance”—the result of situations where the pieces of information about the same subject are inconsistent (e.g., Cooper 2004). Cooper (2004) notes that the human psychological need to reduce dissonance is one of the forces that compromises rationality. Humankind is enamored of many unsustainable practices (e.g., population growth, increased material consumption, disposable containers, and the like), but there is no “away” into which to throw or dispose of waste products (i.e., everything is interconnected). Consequently, if natural systems cannot utilize the waste products as a resource, then the wastes will cause problems. Cognitive dissonance is undoubtedly a major problem for politicians, especially those facing frequent elections of 2-4 years, and also for many citizens. Unsustainable practices are not obvious when numerous supermarkets are always well stocked with a variety of

foods, large discount stores carry a wide selection of merchandise, and no long lines form at gasoline stations. All these are frequented by a substantial number of customers, indicating that prices are not beyond the capabilities of the average citizen in some parts of the world (e.g., the United States).

I am comforted by persuasive evidence that life on Earth has survived five major extinctions and that the diversity of life has increased during this period. However, the sixth great extinction, now underway, will almost certainly drive many charismatic species into extinction and compromise the biospheric life support system so favorable to humankind. In terms of evolutionary time, the diversity of life forms will probably be restored, but *Homo sapiens* is unlikely to be the dominant species it is now and could even become extinct as did many hominids of the past. I am saddened and distressed that a species capable of producing superb literature, art, music, and science may disappear. However, this regret is diminished by the knowledge that humankind has been shockingly destructive of natural systems and has already driven many species to extinction. In addition, it is difficult to sympathize with a species that is leaving a less habitable planet for its descendants. Even in this sadness, all is not yet lost—humankind could develop a mutualistic relationship with natural systems, restore damaged ecosystems, live more sustainably, and give eco-ethics a much higher priority. More emphasis should be placed on growth of social capital, including a fair and equitable allocation of resources between humans and the planet's biospheric life support system, as well as within the species. Humankind must earn the privilege of being on the ecological stage in the evolutionary theater by admitting that it is not the only species in the drama, especially since it arrived only recently on the stage. Action not preceded by thought is dangerous at worst and unsatisfactory at best. Many emotional issues are involved, especially those of conflicting loyalties. The 21st century will be a transitional era for the human species, and suffering will occur, regardless of the outcome. Hope exists for sustainability, which is the ultimate quest for the human species. Lifeboat Earth can be managed for long-term use instead of short-term gain.

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CREATING AN ALIEN PLANET

In a sense, we're getting our first sniffs of air from an alien world.

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For approximately 160,000 years, conditions on Earth have favored humankind, thanks to the biospheric life support system. At present, anthropogenic wastes, from hazardous chemicals to carbon dioxide, are damaging the biospheric life support system at a rate unprecedented in human history. The scientific evidence on global heating, and other types of climate change, has changed from persuasive to overwhelming, as it did previously for hazardous chemicals and physical damage to natural systems. However, unsustainable practices continue and the consequences worsen. Humankind may have to suffer horrendous, appalling events before it accepts responsibility for the severe, possibly irreversible, damage to Earth's biospheric life support system.

The Pioneering Prophets

"Where there is no vision, the people perish" (Proverbs 29:18) is a quote from the Christian Bible – it is eerily applicable in 2007. Wilson (1996, p. 184) remarks: "Unlike any other creature that has lived before, we have become a geophysical force, swiftly changing the atmosphere and climate, as well as the composition of the world's fauna and flora." Ehrlich and Ehrlich (1974, p. 11) state: "Our entire society seems to suffer from a sort of mental block and may refuse to take action to correct its fatal course until it has passed the point of no return."

Carl Sagan was invited to give the Gifford Lectures on Natural Theology at Glasgow University in Scotland in 1985 for the lectureship's centennial. Fortunately, his widow and long time collaborator, Ann Druyan, found his notes and published them (Sagan 2006) on the tenth anniversary of his death. The chapter entitled "Crimes against Creation" in that Sagan volume is, regrettably, even more appropriate than when it was written. At the time the chapter was written in 1985, Sagan's concern was about the consequences of nuclear war. At present, however, crimes against creation could be nuclear war, ecological overshoot (O'Driscoll 2007), and/or global heating and other types of climate change. Sagan (2006, p. 19) states: "But when the world is changing very fast, I suggest survival may depend precisely on our ability to change rapidly in the face of changing conditions." The daily news on global heating and climate change indicates precisely such a time is now. Moreover, nuclear war is possible because of weapons built by nation-states, but global heating is the result of billions of individual decisions over which each person has control.

Throughout most of human history, change has been comparatively slow, but now the rate of change is startling. Many major changes occur in the span of a human generation. Sagan also notes (2006, p. 194) that technology that permits travel on a scale unprecedented in human history also enables humankind to destroy itself. What a pity for the human species to destroy itself and much of the life with which it shares the planet because it failed to use Earth's resources wisely or because resource wars seemed to be the most expedient alternative. Of the total number of species that have ever existed, most are now extinct, but life in some form still persists. The quest for sustainable use of the planet is based on the assumption that *Homo sapiens* might be an exception to the transient existence of most species. When writing about the catastrophe that destroyed the dinosaurs (p. 200), Sagan (2006) notes that dinosaurs were powerless to anticipate their extinction or prevent it. In contrast, humankind should be able to anticipate the dangers of nuclear war, ecological overshoot, and/or global heating.

The Metamorphosis

Humankind is already experiencing changes alien to the planet upon which it lives, but is extremely reluctant to alter its unsustainable life styles. Frantic efforts are being made to replace petroleum with ethanol.

However, if half the fuel supply came from switch grass, growing this plant would compete with food agriculture (Crenson 2007). In addition, an alternative fossil fuel, coal, is receiving bad press from world class climatologist, James Hansen, as well as science circles and the business world (Little 2007). Both growing switch grass and coal surface mining in many locations displace indigenous species from their habitat. Both coal mining and use of natural systems for human benefit deprive the planet of the ecosystem services the former natural systems provided.

Persuasive evidence indicates that humans are adversely affecting ecosystems globally. In some areas, deleterious effects such as droughts, desertification, and ecosystem fragmentation have destroyed or seriously impaired ecosystem integrity and, as a consequence, reliability of ecosystem services. In addition, when biomass is removed, nutrients and other valuable ecological components are removed with inadequate requirements for replacement. This scenario is not sustainable use of the environment.

Most of the forces degrading the global environment could be substantively diminished, or perhaps, in some cases, eliminated, by changes in societal behavior and expectations of entitlement. Some illustrative examples follow.

- (1) Humankind lacks compassion for the other life forms that constitute the biospheric life support system upon which human survival depends. What else can explain the systematic destruction of that system?
- (2) Human society does not feel a strong sense of responsibility for posterity. What else can explain continued unsustainable practices that will result in a less habitable, or even an uninhabitable, planet for human descendants?
- (3) With a human population growing (continually updated population information at <http://www.worldometers.info/>) about 91 million per year, millions going to bed hungry nightly, and millions more malnourished, can society justify using foodstuffs (e.g., corn) to produce fuel for automobiles?
- (4) Is it justified to use arable land for switch grass production to provide more ethanol when millions of people lack an adequate diet? Is depriving other life forms of habitat in order to grow switch grass for ethanol production justified?
- (5) A draft report of the Intergovernmental Panel on Climate Control, which is due to be released in June 2007, notes that hundreds of millions of Africans and tens of millions of Latin Americans who now have water will be short of water in 20 years (Associated Press 2007). The report further notes that, by 2050, more than a billion people in Asia could face water shortages. Finally, by 2080, water shortages could threaten 1.1 billion to 3.2 billion people, depending on the level of greenhouse gases that cars and industry spew into the air. Since approximately 1,000 tons of water are needed to produce a ton of corn and much water for any kind of rapidly growing biomass, prudence indicates that more thought should be given to how much water should be allocated to biomass production for conversion to ethanol.
- (6) Human society has failed to grasp the enormity of exhausting the necessary physical prerequisites for the type of lifestyle it now has. Hoyle (as quoted by Duncan 1996) gives an eloquent statement on this issue:

With coal gone, oil gone, high-grade metallic ores gone, no species however competent can make the long climb from primitive conditions to high level technology. This is a one-shot affair. If we fail, this planetary system fails so far as intelligence is concerned. The same will be true of other planetary systems. On each of them there will be one chance, and one chance only.

Present evidence indicates human society is not evolving toward sustainable use of the planet.

Time Span

The time spans for the life expectancy of the industrial civilization (Duncan 1996) vary from highs of 39-million years to about 100-million years, with the majority toward the lower end. The 39-million-year estimate was made in 1927, but more recent estimates, especially the ones involving peak oil and global heating, tend to be very short. Duncan (1996) notes that the industrial age, estimated to cover the time span of 1930-2025, has only a few years left. Life will be difficult when energy supplies diminish, so living sustainably within Earth's resource supply is essential. Profligate use of energy is reckless.

Double the Danger

Earth probably will be in orbit around the sun a billion years from now – very likely it will be in orbit 15 billion years from now when the sun dies. A dazzling succession of life forms will have probably existed,

although their precise nature is impossible to predict. Moreover, how much of this time humans will be present is in serious doubt. What most proponents of perpetual economic growth seem unable to face is that economic growth, as humans define it, will also cease in the absence of humans. The world religions will also disappear. Arguably, they will disappear because they have been divisive rather than unifying on the issues that threaten the quality of human life (e.g., overpopulation, callous exploitation of other life forms, profligate use of fossil fuels), and even human survival. The quest for sustainable use of the planet is based on the assumption that humans will not destroy themselves, even though they are clearly capable of doing so with either nuclear warfare or global climate change or even, horrors!, both.

The drive to obtain ever more material possessions has produced an ecological overshoot (e.g., Wackernagel et al. 2002) of approximately 24% more natural resource use than the planet can regenerate. Obviously, this overshoot is unsustainable, especially since it appears to be increasing at about 1% per year.

Use without Abuse

In nature, organisms “use” each other as food, shelter, etc. However, in nature, abuse is uncommon, although neither enlightened use nor unenlightened abuse is carried out consciously. Surely, nuclear war qualifies as a gross abuse of natural systems, as well as abuse of the Golden Rule. Although the Golden Rule is usually attributed to Christianity, Sagan (2006) notes that, as far as he knows, not one of the 140+ nations on Earth has adopted this Christian principle. On the issue of global heating and other types of climate change, scientific evidence is being increasingly accepted, but emissions of greenhouse gas trends are expected to continue. My regional newspaper, *The Roanoke Times*, carried a front page story (Esposito 2007) on Virginia Tech’s attempts to “green itself,” but pointed out two columns in the Virginia Tech’s student newspaper that argued against the idea of man-made global heating. The preponderance of scientific evidence should have more influence in a university town. This conflict suggests that either the people are so specialized they cannot easily absorb information outside their field or they just do not take the time to become literate on events that affect the entire planet.

Of course, denial may be the dominant motivation for the lack of emphasis. Some consequences of acting on climate change, such as lower use of fossil fuels or using fewer material goods, are so painful that most humans refuse to consider them. The original four horsemen of the apocalypse, death, disease, famine, and war, are good examples of consequences of creating an alien planet. These consequences are difficult and extremely uncomfortable to contemplate, as are the four horsemen of the 21st century – nuclear war, human overpopulation, global heating and other types of climate change, and ecological overshoot. Nuclear war and human population growth are “the elephant in the room” – everybody sees them, but nobody wants to talk about them. Due to former US Vice-President Al Gore’s movie “An Inconvenient Truth,” most people know something about global warming heating, but not many are even taking the simple steps (e.g., reduced driving, energy efficient light bulbs) that would not bother their lifestyle significantly.

Maintaining a Hospitable Planet

The average length of time a species persists on Earth is approximately 1 million years. If intelligence, as humans define it, has survival value, *Homo sapiens* should expect to persist more than 1 million years. However, technology has adversely affected the biospheric life support system and may push the system past a tipping point beyond which it would go into disequilibrium and, when it finally stabilized, might no longer favor humans. Intelligent beings should understand this situation and immediately take steps to reduce the probability of disequilibrium of the biospheric life support system.

Means are available to reduce greenhouse gas emissions and, thus, reduce the risks that accompany global climate changes. Ecological overshoot can be eliminated by reducing natural resource consumption to a level within the regenerative capabilities of Earth. Means (e.g., contraceptives) are also available to stabilize the human population within Earth’s carrying capacity. Countries (e.g., Vanuatu) use far less energy per capita than the United States and Canada, and their citizens lead satisfying lives. An intelligent species would do something before a global catastrophe occurs, except for lack of individual and group responsibility. However, lack of individual and group responsibility is a characteristic of an unenlightened species – a species that uses war rather than reason and negotiation to resolve problems.

In his testimony before the US Congress on 21 March 2007, former US Vice-President Al Gore, who described the present situation as a “planetary emergency,” recommended the following remedial measures:

- (1) immediate carbon freeze, followed by a program of reductions reaching 90% by 2050.
- (2) reduction of taxes on employment and production and replace the difference with pollution taxes, mostly on carbon dioxide.

- (3) earmark a portion of the above revenues for low-income people who will have a difficult time making the needed transition.
- (4) develop a strong global treaty on greenhouse gases with a new name, since the Kyoto Treaty has been demonized.
- (5) insist on a moratorium on construction of any new coal-fired power plants not compatible with carbon capture and sequestration.
- (6) develop an “electranet” – a smart grid; a law that allows widely distributed energy generation to be sold into the grid, at a rate not determined by a monopoly but by regulation.
- (7) raise the CAFÉ standard as a part of a comprehensive package (e.g., cars, coal, and buildings).
- (8) set a date for the ban of incandescent light bulbs.
- (9) create Connie Mae, a carbon-neutral mortgage association to recognize long-term benefits of sustainable activities.
- (10) disclosure required by The Securities Exchange Commission of carbon emissions in corporate reporting.

Fear of relinquishing a materialistic lifestyle is a major factor in maintaining a habitable planet, especially for the super wealthy. Anger at the increasingly disproportionate distribution of wealth is also a major factor, especially for those individuals with inadequate food, health care, education, and shelter. Economic globalization causes fear in many people because countries that exploit both natural systems and people are usually most competitive. Finally, war has not proven a useful means of resource allocation. At present, in a nuclear era, visualizing any benefit from a “nuclear exchange” is impossible. Yet, the threat remains and the risks increase. Worse yet, a nuclear winter may kill more people than a nuclear war (MacKenzie 2007). In addition, a nuclear winter can do as much damage to the food supply as global heating.

On 21 March 2007, Gordon Brown, British Chancellor of the Exchequer, addressed the British House of Commons on major initiatives to reduce anthropogenic greenhouse gases (the climate change levy). In contrast, hearings in the US House of Representatives covered the gagging and rewording of reports of NASA senior scientist Dr. James Hansen by political appointees with no scientific background (e.g., Connor 2007, Revkin and Wald 2007). The contrast was shocking – Britain was making major commitments to diminish global warming heating problems while the United States was effectively censoring federal scientists who wrote and talked about the problem. During a critical stage in World War II, before the United States entered the war, the United States supplied destroyers and other aid to embattled Britain under a “lend-lease” program in which Britain leased certain bases for military use in return. Perhaps Britain could now send the United States their politicians and the United States could lease its politicians for the duration of the global heating emergency. Perhaps remedial action would then be taken in time.

Concluding Statement

Former Vice-President Al Gore summed up the moral issue well: “I promise you, a day will come when our children and grandchildren look back and ask one of two sets of questions. Either, what in God’s name were they doing? What was wrong with them? Did they think all scientists were wrong? What were they thinking?” . . . or “How did the uncommon moral courage to rise above politics and redeem the promise of American democracy and do what some said was impossible and shake things up and tell the special interests, OK we heard you, we’ll take your considerations into account, but we’re going to do what’s right.”

Humankind has done enormous damage to Earth, but its becoming a planet not hospitable to humans may still be preventable. Surely, this possibility deserves immediate attention, coupled with drastic steps to eliminate or make major reductions in global problems. Is it possible for sufficient change to occur in the short time available when both nations and individuals are unwilling to give up high energy use, exponential economic growth, and high material goods consumption? Present lifestyles are primarily a result of cheap, abundant energy and ecological overshoot. Peak oil data indicates that the era of cheap, abundant oil is over, and resource consumption cannot exceed Earth’s regenerative rate for much long. As a consequence, humankind must make major lifestyle adjustments, especially if no attempts are made to prepare for the new circumstances.

To succeed in this new endeavor, humankind’s leaders will have to demonstrate much more leadership by example than they are now doing. Earth cannot continue to exist in its present circumstances if an elite group continues to practice profligate use of resources while lower classes attempt to live sustainably. The majority of citizens need moral leadership in order to make the sacrifices essential to living within Earth’s carrying capacity. Both religious and political leaders must improve the relationship with the biospheric life support system before humankind’s unsustainable practices turn Earth into an alien planet for humans. Surely, continuing reckless energy use and excessive use of natural resources is not bringing the satisfaction everyone

expected. In fact, Marks et al. (2006) have clearly demonstrated no close relationship between resource consumption and happiness and life satisfaction.

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DECALOGUE FOR A PLANET IN IMMINENT PERIL

Live simply that others may simply live.

Quaker Proverb

According to the *American Heritage Dictionary*, a *Decalogue* is a “fundamental set of rules having authoritative weight.” This Decalogue is basically a reminder to me of the ethical/moral relationship I aspire to have with the biosphere and all its components.

- (1) I will not cease efforts to protect and restore the biosphere, even in the context of bad news about its condition.
- (2) I will not willingly engage in unsustainable practices, no matter how many people espouse them.
- (3) I will do everything in my power to avoid contributing to either ecological overshoot or ecological deficits.
- (4) Nothing relieves me of the responsibility for leaving a habitable planet for posterity and for other life forms.
- (5) I must continually confront the ethical/moral question: “Which of my actions promote biospheric integrity and health- which do not?”
- (6) I fear not for the future of life on Earth – at least until the sun becomes a red star. I do fear serious disruption of the planet’s evolutionary processes.
- (7) I fear not that present irresponsible and unethical behavior is a threat to civilization and even the human species. I affirm that I will act responsibly to the best of my ability.
- (8) I pledge to use less fossil sunlight since the post-peak-oil era that humankind is now entering is a serious threat to both civilization and the planet. Coal is a dangerous substitute for petroleum. Biofuels raise the price of food (e.g., corn), endangering the over 800,000 people the United Nations reports are starving.
- (9) I will seek to understand and pay attention to nature’s warnings and lead a life that is harmonious with natural systems and the species that comprise them.
- (10) Since the survival of humankind has depended upon the continuation of the conditions provided by the biospheric life support system (BLSS) for the 160,000 years humans have lived on Earth, I will do everything in my power to preserve the BLSS in its present form. If the effort fails, I am prepared to accept that Darwin’s dice will roll again.

This is a first attempt to express what has been on my mind since the climate change, energy, and population crises made the present situation the worst emergency *Homo sapiens* has encountered. I do not think the Decalogue should be lengthy, but suggestions for improvement are welcome.

Acknowledgments. I am indebted to Karen Cairns for transcribing the handwritten draft and for useful suggestions.

THE END OF THE CORNUCOPIAN* DELUSION

We don't see things as they are, we see them as we are..

Anais Nin

How long will researchers working in adjoining fields . . . abstain from expressing serious concern about the splendid isolation in which academic economies now finds itself?

Wassily Leontief, 1982
Nobel Laureate in Economics

At least half the human population has not experienced anything close to the cornucopian experience and lifestyle. However, many believe that the cornucopian dream can be theirs if they can get to a place, such as the United States, where others appear to be living the dream, even though evidence shows that the Industrial Age and all its material benefits are ending. Even the recipients of the cornucopian fulfillment of their desires may have trouble deciding whether it is a blessing or a curse. McCarthy (2007) quotes a report of the National Petroleum Council that urged cutting back on oil consumption, which should serve as the ultimate wake-up call about a looming energy crunch. Cheap oil has fueled the Industrial Revolution, which made abundance of material goods and food possible. Now that era is ending, and humankind has delayed preparing for the post-industrial world too long.

One would never come to the conclusion that the privileged component of humankind has abandoned the cornucopian delusion from listening to the "debate" about reducing greenhouse gas emissions – at least, not if economic growth is viewed from an anthropocentric viewpoint. Resistance is strong to an attempt to reduce greenhouse gas emissions that *might* adversely affect the economy. However, inadequate attempts are being made to reduce greenhouse gas emissions to protect climatic conditions that have been remarkably favorable to *Homo sapiens* for approximately 160,000 years and the genus *Homo* for about 1 million years. The species that collectively make up the biospheric life support system, which maintains these favorable conditions, are also vulnerable to climate change, and a large percentage of these favorable conditions may be lost in the 21st century. As Hansen *et al.* (2007, p. 1938) note, about one fourth of fossil fuel CO₂ emissions will remain in the air more than 500 years. No "silver bullet" (i.e., rapid fix) is available for the atmospheric gas imbalance now being created. Hansen *et al.* (2007, p. 1939) state:

Given the estimated size of fossil fuel reservoirs, the chief implication is that we, humanity, cannot release to the atmosphere all, or even most, fossil fuel CO₂. To do so would guarantee dramatic climate change, yielding a different planet than the one on which civilization developed and for which extensive physical infrastructure has been built.

In short, humankind would be creating an alien planet (Cairns 2007). Hansen *et al.* (2007, p. 1939) further state that estimated oil and gas reserves, with only modest further use of coal, are sufficient to bring atmospheric CO₂

**cornucopia* (i.e., the horn of plenty) – the symbol of food and abundance (i.e., the property of being extremely abundant). In Greek mythology, Amalthea raised Zeus on the milk of a goat. In return, Zeus gave Amalthea the goat's horn, which had the power to give the person in possession of it whatever he or she wished.

to approximately 450-475 ppm atmospheric concentration. In addition, this scenario includes the need to phase out coal use, except where the CO₂ is captured – unlikely if present and contemplated energy uses prevail. Most important, Hansen *et al.* (2007, p. 1949) propose that Earth will be in imminent peril if initiation of

dynamical and thermodynamical processes on the West Antarctic and Greenland ice sheets, which will produce a situation out of humanity's control with a devastating sea level rise, are not avoided. The authors further note that the gravest threat they foresee starts with surface melt on West Antarctica and interaction among positive feedbacks leading to catastrophic ice loss.

This information is recent and disturbing and provides evidence that Earth's abundance, in human terms, is already declining. However, the older list of climate change consequences (e.g., drought, expanded range of many diseases, reduced freshwater for both municipal and agricultural use) was already cause for concern. The words *imminent peril* add a heightened sense of urgency not previously present. Humankind should have a strong interest in preserving a planet resembling the one on which civilization developed. The present administrator of the US Environmental Protection Agency observed that humankind does not know that the present climate is optimal (ABC News 2007). This observation is true, but the climate has been satisfactory for *Homo sapiens* for 160,000 years and for the genus *Homo* for over a million years. Observed climate changes are much less satisfactory in many areas of the world, and some appear to be unsuitable. As greenhouse gas emissions increase, the rate of change will increase until humankind reaches one or more tipping points, beyond which situations will develop that humankind cannot control.

As the United States approaches an array of ecological and societal tipping points, efforts are being made to avoid reaching them. One effort was the Congressional bill to have 15% of electricity generated with renewable energy by 2020. The so-called Renewable Energy Standard (RES) was nearly undermined by Senator Pete Dominici, who wanted coal and nuclear power in the mix, but failed to get enough votes. Then, Senator James Inhofe held up the bill until it was too late for a vote on the bill and the over 100 amendments attached to it (Dorner 2007). The RES is now moribund for a time. All delays to cope with either the energy or climate crisis increase the probability of crossing one or more tipping points and/or thresholds and, thus, diminish the probability of survival for human society as it now exists and, in the worst case scenario, threaten the survival of the human species.

In contrast, in spring 2007, the US Government Accountability Office finally concluded that peak oil is real, although M. King Hubbard proposed peak oil in 1956. The GAO not only concluded that peak oil is real but also that, if it occurs soon, it could cause a worldwide recession.

Will Economic Growth Survive if the Biospheric Life Support System Fails?

One previously offered idea is that greenhouse gas emissions cannot be reduced because the course to reduction might have adverse effects upon the economy. At present, that situation is slowly beginning to change. However, Gelbspan (2007) remarks:

Humanity is standing at crossroads between a more just, peaceful world and an increasingly chaotic, turbulent, and authoritarian future driven by a succession of climate-driven emergencies. We could find ourselves struggling to survive a desolate era of climate hell marked not only by a degraded and fractured society but also by more authoritarian governments.

Gelbspan makes other important points:

- (1) *The private, corporation forces that have produced the climate emergency are powerless to cure it.*
- (2) *Humanity must cut its use of coal and oil worldwide by about 80 percent in a very short time by shifting to clean energy.*
- (3) *The technical remedies favored by the big energy companies are mostly the wrong ones, such as "clean coal" and mechanical carbon sequestration.*
- (4) *What's required is significant government action, and on a global scale.*
- (5) *The United States, as the world's most disproportionate energy consumer, is in a position either to lead an energy transition, or to thwart it.*
- (6) *In 2004, the insurance industry giant, Swiss Re, noted: "There is a danger that human intervention will accelerate and intensify natural climate change to such a point that it will become impossible to adapt our socio-economic systems in time.*
- (7) *Looking at the transformative economic and political potential of a clean energy future, one can feel very optimistic. What injects a feeling of pessimism, however, is both the looming imminence of runaway climate change and the dismal lack of leadership by U.S. politicians of both parties.*

The Future of *Homo sapiens*

Focusing primarily on the health of the human economic system is clearly a “tunnel vision” approach. The biggest shift humankind must make is from an anthropocentric to an ecocentric perspective. If humankind does not focus on the health and integrity of Earth’s biospheric life support system, the human race will continue to be in grave danger and may not even survive. However, Hawken (2007, p. 1) describes the groups that gathered after one of his talks as follows:

These people were typically working on the most salient issues of our day: climate change, poverty, deforestation, peace, water, hunger, conservation, human rights. They came from the nonprofit and nongovernmental world, also known as civil society. They looked after rivers and bays, educated consumers about sustainable agriculture, retrofitted houses with solar panels, lobbied state legislatures about pollution, fought against corporate-weighted trade policies, worked to green inner cities, and taught children about the environment. Quite simply, they had dedicated themselves to trying to safeguard nature and ensure justice.

These people are the ones upon whom future scenarios should be based – I hope there are enough of them on the planet!

Basic Assumptions for My Future Scenario

My future scenario is based upon the following assumptions.

- (1) No major remedial measures will be taken to reduce greenhouse gases until one or more climate tipping points have been passed and climate change is beyond human control.
- (2) Humankind will not take drastic measures to preserve the remaining petroleum reserves until supply has become too insufficient to make a graceful transition to a low energy global society.
- (3) Economic growth will continue to be humankind’s primary goal until at least 2015.
- (4) The human population will not be stabilized by social action but will be by natural, limiting factors (e.g., starvation and disease).
- (5) Present resource wars will continue until at least 2015, using precious resources to continue fighting rather than sharing resources.
- (6) The environmental refugee problem will become severe, perhaps unmanageable, because of both inaction on climate change and inadequate prior planning.
- (7) Governments will, in some cases, block or delay state or regional efforts to address greenhouse gas emissions from automobiles as the US Environmental Protection Agency is now doing in the case of California and other US states that are making efforts to improve on federal standards.
- (8) Since humankind is faced with a global crisis unprecedented in human history, stochastic events (random or probabilistic but with some direction; synonym of *random* and counterpart of *deterministic*) will occur. Creative groups must be assigned to remediate these events, which may require immediate attention, even though they were unexpected.
- (9) A pandemic disease that disrupts global society for at least six months will probably disrupt human society including health.

This manuscript will seem both frightening and new to many people. However, although I feel a sense of horror about these distressing events, this news is not new. In November 1992, The Union of Concerned Scientists issued a “World Scientists’ Warning to Humanity” (Scientist Statement 1992). I was one of the over 1670 scientists who signed the document, and the signers included 104 Nobel laureates. The primary thrust of the message was that not more than one or two decades remained before the opportunity to reduce the threats now present will be lost and the prospects for the future of humankind will be immeasurably diminished. As one of the signers from Southwest Virginia, I expected at least one phone call from the news media – none came. In fact, the warning received very little attention. Now, over a decade and a half later, events have proved that the issuance of the warning was justified, despite the lack of attention it received. Even though huge amounts of robust data have been generated since 1992, the general public still lacks the necessary sense of urgency needed to make a major reduction of risk in the time remaining. One idea is that the more distant a problem is perceived to be in time or space, the less interest the average individual has in it. Clearly, humankind’s attitude is inappropriate for the global problems that, if not corrected, will have a major deleterious influence on posterity. Starvation and inadequate health care in third world countries will probably not arouse adequate concern in a

developed country that has significant numbers of starving people and inadequate health care for its own citizens.

Peak Oil and Economic Growth

As Duncan (2007) notes, the life expectancy of the industrial civilization is about 100 years. He estimates it reached a critical stage about 1930 and may end about 2030. Duncan includes an excerpt from a letter written by Walter Youngquist on March 20, 2006:

As the British historian, Toynbee, wrote 'The U.S. will set a record in the rate of rise and fall of an empire.' Between wide open borders and fall of the dollar and growing population against a declining resource base, the United States will be defeated from within. Mobs will rule the streets in the nation that is now the third largest in the world – right behind China and India – and unable to support its population except by taking resources from other countries.

Campbell (2005, p. 315) states: “We will have to change the way we live as (oil) production declines toward eventual exhaustion.” Since the human economic system depends on cheap oil and a stable society, things do not look promising for a system based on economic growth.

Walter Youngquist, a geologist, and Richard Duncan, Director of the Institute on Energy and Man, have made a series of ten forecasts of world oil production – one per year over ten years (Duncan 2007). One of the forecasts put the world peak at 2005; two put it at 2006, six at 2007, and one at 2008. The exact year matters short term, but long term, what matters is when advance planning to cope with this major event began. Brazil began such planning three decades ago; Europe was not far behind; and the United States has barely started, and many of its “plans” depend on unproven technologies (e.g., carbon sequestering). Deffeyes (2003) discusses the world oil shortage in some detail. In the US Congress, discussion on biofuels and more energy efficient automobiles has been plentiful; however, discussion is lacking on how roads and parking lots paved with asphalt will be maintained when oil becomes scarce (Walter Youngquist, personal communication). As Youngquist points out, asphalt is the “bottom of oil refining operations and one cannot pave roads with ethanol, biodiesel, or hydrogen.” Youngquist maintains that humankind has been enjoying the “oil interval” – a brief, bright, “blip” in human history. This era will be missed. Will the fragile economic system that must be protected, even above the biospheric life support system, survive the loss of fossil sunlight (oil and coal)?

As Tainter (1996) notes: “Systems of problem solving develop greater complexity and higher costs over long periods. In time, such systems either require increased energy subsidies or they collapse.” Presumably, this statement applies to both economic systems and the nation-states that protect them. Tainter (1988) remarks that the factors that cause societies to collapse take centuries to develop. Arguably, the cluster of problems (global heating and other types of climate change, exponential increase in human population size, peak oil, coal burning pollution, ecological overshoot, and oceanic acidification) is humankind’s greatest challenge. Certainly, the loss of the planet’s favorable (to humans) biospheric life support system is an apocalyptic threat more serious than damage to the human economy. However, Tainter (1995) notes that many aspects of human behavior appear to be complexity averse. After all, humans evolved as a small-group species and, only recently in evolutionary time, have over 50% lived in huge cities and depending on outside sources for food, energy, and housing. Since much of the world’s food supply depends on a suitable climate and adequate but not excessive rainfall, climate change will threaten it. In addition, food conversion (e.g., corn) to fuel threatens the food supply of the poor. Finally, energy is essential to preserve the food and transport it from the source to the consumers. The 24% ecological overshoot is persuasive evidence that humankind has already exceeded Earth’s carrying capacity. When, if ever, greenhouse gas emissions will be reduced or to what level is unknown, so estimating future climate conditions is impossible. They probably will not be as favorable to either humans or agriculture as they were for most of human history. As Kunstler (2005, p. 7-8) notes, the journey back to non-oil population homeostasis will not be pretty.

Hansen (2007) remarks that animals and plants are adapted to specific climate zones, and they can survive only in those zones. Of course, as long as cheap energy is available, *Homo sapiens* is the only species that need not adapt. However, if one regards the human species as a part of an interdependent ecosystem, this advantage is not as attractive as it initially appears. As Flannery (2006) points out, 70% of all people alive at present will still be alive in 2050. As a caveat, I add: unless mass mortality results from a pandemic disease, starvation, or nuclear warfare, to mention a few unattractive possibilities. Flannery is hard on his country of

Australia, but the United States is no model either. He notes that, some time in the 21st century, the time will arrive when human influence on the climate will overwhelm all other natural factors.

Encouraging reports indicate that animals and plants are moving into the new climate zone (i.e., isotherm), but to expect all the species of an entire interdependent ecosystem to move and flourish simultaneously is irrational. As a consequence, natural capital and the ecosystem services it provides will initially suffer a major loss. Also, since the rate of climate change driven by human activities is much greater than natural climate change, preserving both natural capital and ecosystem services will be a difficult ecological problem.

Foraging vs Traditional Agriculture

The fact that at least some species are colonizing new areas with warmer temperatures is good news. However, just as whole ecosystems cannot move as a unit to new areas, neither can agricultural systems. In addition, property lines and state and national boundaries become a problem. Added to this problem is a highly probable, global food shortage enmeshed in a conflict between the use of corn for food or fuel (e.g., Cairns, in press). A balance must be achieved between targeted compassion for motorists and multidimensional compassion for those who use grain for food (Cairns 1998). Costanza *et al.* (1996) discuss the practical issues of ecological economics, and a superb summary of the biofuels issue is presented in Runge and Senauer (2007). Holt-Giménez (2007) presents a somewhat different perspective in an overview paper. In the worst case scenario, severe food shortages will result in anarchy and resource wars, neither of which is likely to result in economic growth and which are more likely to result in a depression.

Those Blessed by the Cornucopia

Uchitelle(2007) reports that only twice before over the last century has 5% of the national income gone to families in the upper 1/100th of 1% of the income distribution – currently, the almost 15,000 families with incomes of US\$9.5 million or more per year (according to an analysis of tax returns by the economists Emmanuel Saez at the University of California, Berkeley and Thomas Piketz at the Paris School of Economics). Uchitelle (2007) compares the present era with the prosperous period before World War I and notes: “The new titans often see themselves as pillars of a similarly prosperous and expansive age, one in which their successes and the philanthropy have made government less important than it once was. He also quotes a former US Federal Reserve Board chairman, Paul A. Volcker, who said in an interview, challenging the contentions of the very rich that they are the driving force of a robust economy, that he did not see a relationship between the extremes of income now and the performance of the economy.

However, the quotation of the day in the 5 August *New York Times* provides yet another viewpoint:

I know people looking in from the outside will ask why someone like me keeps working so hard. But a few million doesn't go as far as it used to. Maybe in the '70s, a few million bucks meant "Lifestyles fo the Rich and Famous," or Richie Rich living in a big house with a butler. But not anymore.

Hal Steger, a Silicon Valley millionaire

In addition, the process of becoming a billionaire may be very damaging to the environment. As Hurowitz (2007) notes

But many of these capitalist converts need watching. While Wall Street's eco-splurge has generated a flood of financing for legitimately clean ventures like wind and solar powers, it's also spawned extremely dangerous projects that are painted green by their unscrupulous backers, but that at their core are as black as, well, coal.

Conclusions

Bartlett (2006) remarks that the term *sustainable growth*, as used by political leaders (i.e., applied to material things), is clearly an oxymoron. He emphasizes that the idea of *sustainable* has to mean “for an unspecified long period of time.” He also emphasizes that humans must acknowledge the mathematical fact that exponential growth gives very large numbers in modest periods of time. Endless economic growth that depends on natural resources of any kind is irrational because, as Meadows et al. (1972) note, factors exist that inevitably limit growth. Hubbert (1972) has established that, for a non-renewable resource (e.g., petroleum), the

expected date of the peak production of the resource can be estimated. After peak oil, the industrial society will be unable to avoid a terminal decline since it was based on cheap energy. Duncan (2007) estimates that peak oil will be reached in 2007. As McCarthy (2007) remarks: "When executives from the world's largest oil companies say we need to cut back on our consumption, it should serve as the ultimate wake-up call about a booming energy crunch."

Humankind is facing the biggest challenges in history – peak oil, global climate change, and exceeding Earth's carrying capacity for humans simultaneously. If the present, profligate fossil fuel energy use is continued, carbon dioxide levels will be approximately twice their value in the past 670,000 years. The human population expanded from between 1.6-1.7 billion in 1900 to 6,612,087 on 10 July 2007. This huge increase in population was made possible by cheap, readily available oil, useful in large scale agriculture, for fertilizer, and for long-range transport and storage. The same biospheric life support system has had to provide suitable conditions and resources for nearly four times as many people in 2007 with far more stresses and damage than it endured in 1900. Most statements that humankind should not decrease greenhouse gas emissions come from politicians with poor or no credentials in the field of economics. In contrast, a statement by 25 of the world's leading economists, including both a number of Nobel laureates in economics and former members of the US President's Council of Economic Advisors, emphasizes that the United States should move to control greenhouse gas emissions (Statement 2005). Ackerman and Stanton (2005) believe the costs of inaction could be as high as US\$74 trillion. Morales (2007) quotes Sir Nicholas Stern (Select Committee on Economic Affairs 2005) as saying that the cost might be US\$9.6 trillion.

Clearly, the economic costs of inaction are very high. The loss of human lives is not easily measured in dollars, but would be unacceptably high if apathy and inaction are the responses of humankind to global heating.

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THE NUMBERS OF FOREVER

When children are asked to do some small chore, they often reply: “Oh, Mom, that will take forever.” Their friends are waiting, and they must have immediate gratification of anticipated pleasures – they cannot wait “forever.” In another context, people often ask how long humankind has to “solve” the problem of global heating, and then they provide the answer of 10 years, 25 years, 50 years, etc. In short, the problem is not an immediate one to them – humankind has “forever” to reduce greenhouse gas emissions.

Even the developing biofuels industry does not have specific goals or greenhouse gas emissions estimates. Wald (2007a) questions whether assessments of the energy losses and pollution releases of ethanol production will inform policy:

For example, a broad-based coalition of biofuels, wind and solar power advocates has formed an umbrella group calling itself “25 x ‘25.” They want 25 percent of the nation’s energy resources to come from renewable sources by 2025. Dozens of members of Congress are endorsing the group, yet at a news conference last spring in Washington, D.C., held to introduce the organization, its leaders could not even say whether wind, solar, ethanol or direct combustion of biomass would be the largest source. There was little desire to blemish the concept with arithmetic.

Enthusiasm is not a substitute for a systematic, orderly plan to achieve a particular goal on a particular date. An uncharitable person might conclude that neither some congresspersons nor the general public wants attractive illusions to be shattered. Wald (2007a) summarizes his thoughts on ethanol as:

In the meantime, relying on ethanol from corn is an unsustainable strategy: agriculture will never be able to supply nearly enough crop, converting it does not combat global warming, and socially it can be seen as talking food off people’s plates. Backers defend corn ethanol as a bridge technology to cellulose ethanol, but for the moment it is a bridge to nowhere.

Pimentel (2003) has published much on energy input/output ratios and asserts that more energy is used to make a gallon of ethanol than is produced when it is burned.

The numbers of the forever charade are endless, but one important set has to do with energy efficient cars. The hearings in the US Congress on efficiency of fuel use in automobiles has very modest goals to be reached years from now, although automobiles already exist that get well over 40 miles per gallon (i.e., the Prius). Why so many years in the future? During World War II, the United States survived a terrible beating at Pearl Harbor and the Philippines and had to do something at once – not in the future, but NOW. Japan’s zero fighter plane was superior to the American one, so better ones were built – at once, not in the distant future. The United States also built amphibious ships that never existed before and vast numbers of ships that could surround Iwo Jima as far as the eye could see. All this activity and much more were completed in a period of approximately 4 years! Are people supposed to believe that the United States cannot produce large numbers of fuel efficient automobiles when Richard Rusk, in the apartment next to mine, is already driving one? Has the nation that survived the Great Depression and World War II suddenly become so fearful that it can no longer function after hearing bad news for which remedial measures are at hand? Major individual conservation (i.e., use less energy per capita) and public transportation matching that in Europe and Japan (e.g., change from rails to trails to trails to rails) could be improved substantially in the short term and dramatically in a few years (i.e., not 2025, but 2015).

Why doesn't humankind address obvious problems with the urgent action they deserve? In his book *The Assault on Reason*, Gore (2007, p. 215) states:

In other words, reason must be separated from the "self-love" of the individuals using it, and focused instead on the public good – by insuring that no individual or small group can exercise power without entering into a negotiation with others who must be convinced that the proposed exercise of power meets the test of reason.

American citizens must cease tolerating the rejection and denigration of science (e.g., global warming is a hoax perpetuated by hysterical scientists) because the science conflicts with political and corporate ideologies. More important, American citizens must understand the processes of science and reject the pseudostudies funded by special interest groups with little or no scientific credentials. For example, in the last decade, much has been made of the uncertainties in science. However, science is a probabilistic determination based on validated evidence. The general public has been persuaded that scientific theories are mere guesses instead of being told they are carefully structured statements based on the preponderance of scientific evidence. The news media has not been helpful (it has even been called *dysfunctional journalism* that fails to inform the people) in informing the public. If the public is inadequately informed, a reasoned discussion cannot occur. However, in the Internet era, apathy is the only excuse for not being informed. Since not only national but global security is threatened by the global environmental crisis, apathy is not a valid survival response. Former US President Roosevelt used leadership to control fear and anxiety at the outset of World War II: "The only thing we have to fear is fear itself." Fear of terrorists can divert attention from the global climate crisis, especially when demagogues exploit fear. Government efforts to rewrite scientific articles on climate change result in failure to curb greenhouse gas emissions when they should be dramatically reduced. Indifference is substituted for concern when the apparent magnitude of the crisis is diminished.

The estimate has been made numerous times that enough coal is available to last 250 years. This estimate is still being used, despite the fact that it was made in the 1970s and was based on the assumption that 25% of the coal that had been located was recoverable with current technology and at current prices (Wald 2007b). However, as the US Congress considers billions of dollars in subsidies to make gasoline and diesel substitutes from coal, a more robust information base is essential. A report by the US National Academy of Sciences, released in June 2007, estimated the probability of enough coal to meet US needs *at current rates of consumption for more than 100 years* (italics mine), but if Congressional policies are put in place, the rate of use will increase markedly. Worse yet, recent studies by the US Geological Survey showed that, at least in some areas, only 5% of the coal was recoverable with today's technology and at current prices (Wald 2007b). Something tells me that numbers must be more precise and the citizenry must realize that only finite resources exist on a finite planet.

The decline in petroleum availability is not new information. Klare (2004, p. xiii-xv) mentions US President Franklin D. Roosevelt's February 1945 meeting with King Abdul Aziz ibon Saud of Saudi Arabia, which produced the unprecedented oil-for-protection arrangement that has governed American ties with Saudi Arabia ever since. Clearly, President Roosevelt recognized, near the end of World War II, how essential oil was to the US economic vigor and lifestyle and that, without cheap oil, neither could endure. The President was keenly aware of the drain that World War II had placed on American oil reserves and could envision a day when the United States would need to import foreign oil. Subsequent US presidents have had a similar view, since petroleum is considered a national security matter, falling under the purview of the US Department of Defense and other administrative entities responsible for safeguarding American vital interests. In addition, the finite supply of oil was recognized globally. King Hubbard's publications of the 1950s indicated that oil was not going to last forever and that peak oil would be in the early part of the 21st century. What is astonishing is that no robust plans were made in the period after World War II for the post-petroleum era. The most discussed alternative, biofuels, seems to assume that the profligate use of energy will continue "forever."

Perhaps concern for the planet's victims of global climate change will be the forcing factor for immediate remedial action on energy use. Kristof (2007) calls attention to the fact that gas guzzling automobiles are adversely affecting the subsistence of African farmers and may well cost them their lives.

The insistence on robust numbers rather than meaningless numbers that, at best, only indicate intent is long overdue. Questioning the basis for the numbers is long overdue. May it be so!

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VOLUNTARY INCOME TAX, VOLUNTARY SPEED LIMITS

I am proud to be paying taxes in the United States. The only thing is I could be just as proud for half the money.
Arthur Godfrey

The best measure of a man's honesty isn't his income tax return. It's the zero adjust on his bathroom scale.
Arthur C. Clarke

Where there is an income tax the just man will pay more and the unjust less on the same amount of income.
Plato

If you steal \$10 from a man's wallet, you're likely to get into a fight. But if you steal billions from the commons, co-owned by him and his descendants, he may not even notice.
Walter Hicckel

Recycling and speed limits are bullshit, they're like someone who quits smoking on his deathbed.
Chuck Palahniuk

I think the world is run by "C" students.
Al McGuire

Broder (2007) notes that the US position on global warming and climate is still markedly apart from most of the other developed countries, although its long overdue acknowledgment that climate change is a real problem has improved the US position slightly. Many years of ignoring, even challenging, the preponderance of scientific evidence has made many nations skeptical of the somewhat more enlightened US position. However, the biggest barrier, especially for European nations, is the US administration's insistence that any plan to reduce greenhouse gas emissions be voluntary and devised by individual nations rather than as part of a worldwide treaty (Broder 2007). John Ashton, a special advisor on climate change to the British foreign secretary, called voluntary measures ineffective and remarked that dozens of nations had agreed to nonbinding goals for emission cuts in 1992; these same nations then watched pollutants linked to global heating rise at a double-digit percentile rate over the next decade. If nations believe that voluntary measures are suitable to avoid catastrophic climate change, why not have voluntary US income tax and voluntary speed limits? Any observant citizen knows the answer to this question, although many would favor these two voluntary measures. If the failure of a voluntary plan is evident, then why pursue such a hopeless cause?

The call for voluntary action on greenhouse gas emissions appears even less credible since the US House Committee on Oversight and Government Reform obtained documents that suggest the Bush administration has conducted a concerted behind-the-scenes lobbying campaign for generating opposition to California's request to regulate greenhouse gas emissions from that state's cars and trucks (Eilperin 2007). California's proposed greenhouse gas emissions standards would reduce emissions from their present levels. How can opposition to such a situation be understood?

Humankind has three urgent problems: (1) global climate change, (2) an energy crisis resulting from reaching peak oil, (3) exponential growth of the human population. No voluntary effort has arisen that appears likely to solve any of these problems before they reach major tipping points. Why obstruct any voluntary effort (California) that offers more promise than any other?

A laissez-faire solution to global climate change is very attractive to politicians because it is perceived as causing fewer short-term political problems. Many potential solutions (e.g., emissions standards and goals) seem absurd because humankind and its representatives are adept in avoiding solutions to serious long-term problems. Hardin (1993, p. 201) gives a blunt, and still appropriate, analysis of the situation:

Acknowledging the reality of the “greenhouse effect” and modifying human behavior to reduce its consequences will require changes in education and human economy throughout the world. We may fail; if so, we will surely be the first species to have foreseen its own demise.

This statement was made 14 years ago – plenty of time for voluntary remedial action – however, the situation has appreciably worsened. Worse yet, humankind is nearing one or more global tipping points, beyond which events will exceed effective human control. This moment is not a time for indecision! It is a time for decisive, all out, global coordinated effort with very specific goals and time framework. Both goals and times should be based on the preponderance of scientific evidence. This situation does not need multiple, uncoordinated meetings on the same problem, especially since US Secretary of State Condoleezza Rice repeated US President George Bush’s insistence “that the solution could not starve emerging economies of fuel or slow the growth of advanced nations. Every country will make its own decisions, reflecting its own needs and interests” (Broder 2007). Nature neither waits while bureaucrats are indecisive nor is it affected by human obsession with exponential growth. Hubris and technology do not make humans immune to natural law. Brown (2007) remarks: “Nature has many thresholds that we discover only when it is too late. In our fast-forward world, we learn that we have crossed them only after the fact, leaving little time to adjust.”

How successful has voluntary action been in resolving some of humankind’s most intractable problems?

(1) Ecological overshoot

Ecological overshoot has been evident since the early 1980s, and nothing effective has been done to diminish this problem (<http://pnas.org/cgi/content/full/99/14/9266>). The dominant economic world view requires that all stakeholders be well informed. Even if they were, it is by no means certain that substantive effective action would be taken to eliminate ecological overshoot.

(2) Exponential population growth

Ecological overshoot demonstrates that resource consumption and human population size are not in balance. On a finite planet with finite resources, this imbalance should be abundantly clear. However, the addition of 1.5 million persons weekly does not seem to alarm people. Malthus studied this problem over 200 years ago, and voluntary measures have not only failed but the problem has worsened over the last century. For example, Jacques Diouf, the UN Food and Agricultural Organization Chief, warned that the global rise in cereal prices could lead to “social and political troubles” in developing nations (Staff Writers 2007). According to the UN, 800,000 persons on the planet go to bed hungry each night. Consequently, an already bad situation would worsen (<http://www.worldpopulationbalance.org/pop>).

(3) Peak oil

Over 90% of US energy comes from fossil sunlight (Congressman John Peterson, Pennsylvania; C-Span, 3 October 2007). Kohl (2007) calls attention to how vital fossil fuels have become in meeting the planet’s energy demands. Peak oil is either here or near, but the important point is that the era of “easy” oil is over and the era of “tough” oil is here. Most of the world’s oil is in politically unstable areas, and the remaining untapped supplies are primarily in small pockets that are difficult to access. Earth’s primary energy source is sunlight, and the “fossil sunlight” is being used very rapidly. Replacement of fossil energy will be difficult. For example, (a) 27 to 42 barrels of oil are needed to construct an average car, (b) construction of the average desktop computer requires more than 10 times its weight in fossil fuels, and (c) every calorie of food eaten in the United States requires roughly 10 calories of fossil fuels (Angel Research Staff 2007). Humankind should have already become aware of the consequences of peak oil since M. King Hubbert’s now classic publication in 1956 (Hubbert 1956). More recently, Heinberg (2005) argues persuasively that human society is headed for serious trouble in the near future. In the few years since Heinberg’s book was published, huge amounts of evidence have accumulated that confirm his analysis. Worse yet, humankind is still partying as if petroleum will last forever. Fortunately, some reassuring signs indicate that some parts of the world are moving in the right direction. For example, the province of Quebec enacted Canada’s first carbon tax on energy companies (Associated Press 2007), but this effort is not enough to reverse greenhouse gas emissions globally.

Fatal Disconnects

Humankind has a fatal disconnect with reality. The assumption that Earth is a vast cornucopian paradise with unlimited resources is a fantasy. The belief that the human population can grow forever on a finite planet and always have adequate resources is delusional, as is the belief that global problems (e.g., global heating) can be solved by voluntary action. When these beliefs and expectations prove to be unrealistic, a period of stunned disbelief occurs, followed by a period of finding someone to blame. Finally, humankind may realize that expectations are far greater than Earth can fulfill and that everyone is responsible for letting this

situation occur. One hopes that the next step will not be increasingly violent resource wars, but rather a much more austere lifestyle with limited resources shared equitably and fairly.

Probably the first amenities to disappear will be energy and water supplies. These two are closely linked problems since biofuels (e.g., corn) require 1,000 tons of water to produce a ton of grain. Recent evidence indicates that biofuels production, except with sugar cane, may be contributing to an increase in greenhouse gas emissions (Quitério 2007). Very few people have ever heard of peak oil, and many who have think biofuels will fill the gap left as petroleum become increasingly scarce. They will not abandon their carefree, high-mileage habits voluntarily, nor will they willingly limit family size to match Earth's carrying capacity. High per capita energy use is regarded as a "right." I reluctantly conclude that the default position will be brutal and effective natural law, which will limit resource use to match carrying capacity, unless humans finally use their vaunted intelligence to avoid such a catastrophic event.

A Comparison of Two Nations

China and the United States are the major emitters of greenhouse gases globally, and both have, in practice, different systems of coping with the environmental stressors that are endangering both the biospheric life support system and their citizens. Pan Yue, a vice minister of China's State Environmental Protection Administration (SEPA) warned in 2005: "The [economic] miracle will end soon because the environment can no longer keep pace. . . . China's rapid development, often touted as an economic miracle, has become an environmental disaster" (as quoted by Economy 2007). Economy (2007) further notes that "China's leaders are worried about the environment's impact upon the economy." However, Beijing has structured its environmental protection efforts in much the same way it has pursued economic growth: by granting local authorities and factory owners wide decision-making power and by actively courting the international community and Chinese non-governmental organizations for their expertise while carefully monitoring their activities. Economy (2007) also notes that SEPA operates with barely 300 full-time employees in the capitol and only a few hundred throughout the country. In contrast, the US Environmental Protection Agency has a staff of almost 9,000 in the capitol city of Washington, DC, alone. Economy (2007) remarks that China's highly decentralized system has meant limited progress: only 7 to 10% of China's more than 660 cities meet the standards required to receive the designation of "National Model Environmental City" from SEPA. Economy's (2007) superb article has many examples of other failures to control environmental pollution.

Thornton (2006) notes that, after 28 years of reform, China faces challenges of an unprecedented scale, complexity, and importance. China has already liberalized its markets, but now its leaders and people must deal with popular dissatisfaction with local government, environmental degradation, scarce natural resources, an underdeveloped financial system, an inadequate health care system, a restless rural population, urbanization on a massive scale, and increasing social inequality. In addition, the energy crisis resulting from reaching peak oil could be added.

Thornton (2006) notes that China's three decades of reform have made undertaking new reforms more difficult and further remarks that the structure of the country's bureaucracy stifles initiative and promotes mediocrity. Worse yet, he feels that many officials, from the village to the central government, are corrupt and are eroding the government's effectiveness and feeding popular discontent with the system. He concludes that only by freeing its managers and leaders from the shackles of organizational politics and old-line thinking will China be able to find a dynamic but stable path toward the democratic future aspired to by an ever-larger number Chinese citizens.

By leaving conformity up to local officials and organizations, Beijing has, de facto, made compliance with national and global (e.g., greenhouse gas emissions) pollution control goals and standards optional. In short, persons with inadequate scientific credentials are making decisions that degrade not only the local environment but also the biospheric life support system. This process is no way to address global problems already having major deleterious effects upon human society.

The United States and China share a major obsession that overrides the differences in the two nations – the dedication to and belief in exponential economic growth. During his successful election campaign, former US President Clinton proclaimed "It's the economy, stupid!" Since then, President Bush, now in office, has stated more than once that nothing that interferes with the economy will be done in addressing climate change. In both China and the United States, citizens want the government to do more about climate change and other environmental problems. Many polls show that citizens in the United States want involvement in the civil war in Iraq to end, which would free funds for alternative energy, health care, pollution control, and a variety of other domestic issues. An excerpt from Bruce Levine's (2007) book *How to Find Morale, Energy, and Community in a World Gone Crazy* delves into the roots of depression and links the increasingly consumer-based culture and standard-practice psychiatric treatments to worsening depression, instead of solving it. In addition, political

appointees with few or no scientific credentials have been altering scientific reports from government agencies, particularly those addressing human-caused components to climate change. The Intergovernmental Panel on Climate Change reports, although viewed as overly conservative by many scientists, provide much evidence for remedial and preventative action by governments. If China and the United States fail to make major changes in present policies, altering present climate change trends will have little chance of being successful.

Conclusions

The title of this commentary is intended to illustrate that some individuals will not be voluntarily socially responsible. Nations also have their particular agendas, such as the US administration's insistence that any plan to reduce greenhouse gases be voluntary. Corporations perceive that they would have to diminish their profit goals and place social responsibility before profit. Some corporations might place social responsibility first, but they might lose their competitive edge. Globalization has made corporations more influential than ever in national politics, and relentless advertising has markedly affected consumer choices. In the United States, consumers now demand protection against imported toys painted with toxic substances. Some sort of social contract that benefits all of humankind is essential, and, sad to say, too much reliance on voluntary compliance often fails.

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**Wear It Out
Use It Up
Make It Do
Do Without¹**

The era of cheap, abundant fossil energy is ending, which means that the acquisition and production of material goods will be greatly diminished. Availability per capita will depend primarily on two factors: (1) the extent to which global heating and other types of climate change affect agricultural productivity and regeneration of natural resources (e.g., forests, fisheries) and (2) the time it takes to stabilize human population and reduce it to remain within Earth's carrying capacity for humans.

Finite Resources/Finite Planet

Trainer (2007) notes: "The most serious fault in our society is the commitment to an affluent-industrial-consumer lifestyle and to an economy that must have constant and limitless growth in output." The degree to which various nations achieve this goal varies. For example, Trainer remarks that rich countries, with about one-fifth of the planet's people, are consuming about three-fourths of the planet's resource production. Clearly, production of foodstuffs is declining, due to climate change (e.g., droughts, floods, pests), while the population is increasing at about 1.5 million/week. This increase is occurring despite marked reductions in life expectancy in some regions of the world. For example, Brown (2006, p. 99) calls attention to the fact that life expectancy among the 750 million people living in sub-Saharan Africa has dropped from 61 to 48 years of age due to the spread of the HIV virus. In addition, the production of oceanic fisheries, which supplied 17 kilograms of seafood per capita worldwide in 1988, has fallen to 14 kilograms (Brown 2006, p. 91). Since fisheries are collapsing worldwide and oceans are becoming more acidic and since persuasive evidence shows that plastic is actually choking sea otters and turtles and being ingested even by krill (Weisman 2007, p. 116-118), a variety of adverse ecological effects will only become more severe. The decline in the productivity of oceanic fisheries will continue, especially since 90% of the large fish in the oceans have disappeared over the last 50 years, according to a Canadian-German science team's published study in the journal *Nature*.

Economist Boulding's Utterly Dismal Theorem

In 1798, Thomas Malthus made his famous prediction that the human population would outrun food supply, initially leading to a decrease in food per person. He has been denounced for over two centuries because cheap fossil energy (e.g., petroleum, coal, natural gas), plus agricultural technology, have provided major increases in the food supply. In 1802, just a few years after Malthus published his essay on population, the global human population was 1 billion. At present (2007), the global human population is approximately 6.6 billion. These numbers would appear to negate Malthus' prediction. However, the huge surge in human population growth in just over 200 years was made possible by two factors that are unique and temporary: (1) an abundance of cheap, readily available fossil energy (i.e., petroleum, coal, natural gas) and (2) increased productivity of a finite supply of arable land made possible by fertilizers (some from petroleum) and an infrastructure to plow, care for crops, harvest crops, and transport crops to distant markets – all facilitated by cheap fossil energy. Diminished fossil energy supplies and global heating and other types of climate change are having a negative effect upon agriculture and marine fisheries (already suffering from over harvesting). It is quite probable that production of foodstuffs will not keep pace with human a population growth.

Boulding's (1971) Dismal Theorem states: "If the only ultimate check on the growth of population is misery, then the population will grow until it is miserable enough to stop its growth." Boulding's (1971, p. 137) Utterly Dismal Theorem addresses the population surge made possible by cheap fossil energy and improved agricultural technology. This theorem states:

¹ This saying is from a hand-stitched sampler that my companion of 63 years, Jeannie, made for our oldest daughter Karen at her request. It beautifully sums up the low-material-possession lifestyle that must now replace the "shop-til-you-drop" lifestyle of many American citizens.

Any technical improvement can only relieve misery for a while, for so long as misery is the only check on population, the (technical) improvement will enable the population to grow, and will soon enable more people to live in misery than before. The final result of (technical) improvements, therefore, is to increase the equilibrium population, which is to increase the total sum of human misery.

Persuasive evidence of this situation is available at present when 1 billion (the total population in Malthus' time) are starving or malnourished, poorly housed, lacking adequate health care and safe drinking water, and inadequately educated for the present highly technical world. It would appear that Malthus (and more recently Paul R. Ehrlich [1968]) was right after all – as was Kenneth Boulding.

Global Food Situation

Use of corn and other foodstuffs for production of alternative fuels has already substantially increased the price of corn and, since corn is used as animal feed, the price of beef, milk, poultry, etc. In addition, China's prosperity is also increasing the price of milk – more discretionary income has led to a more than 25% higher demand for milk per year; China is now consuming about 30% of the world's milk output (Walker 2007). China has approximately 20% of the world's population, but only 7% of its arable land – 0.27 hectares per capita, or less than 40% of the world's per capita average, one-eighth the US level, and one-half India's level (Walker 2007). However, China's recent affluence has caused significant inflation, which could easily be exacerbated globally if the 1.1 billion people in India also become more prosperous.

Effect on the Ever Present Poor

The Millennium Development Declaration of the United Nations of September 18, 2000, included eradicating extreme hunger and poverty. Economist William Easterly is quoted by Schlesinger (2007, p. 61) as estimating that, while developed nations have donated \$568 billion in aid to Africa since the 1960s, the poverty has only worsened. The population of sub-Saharan Africans living on less than US\$1 per day rose from 41 to 46% between 1981 and 2001 – indicating that 150 million more individuals are in unenviable circumstances. Worse yet, the life expectancy of the 750 million people in this region is now about 46 years. Economist Jeffrey Sachs believes that the UN Millennium Villages Project will simultaneously improve agricultural yields, health care, and societal infrastructure and increase available clean water and access to sanitation. Economist Sachs believes this project will provide an economic cushion against unexpected problems.

The Severe Penalties of Ecological Disconnects

The professions of economics and ecology have virtually no theoretical and working relationships. Even though the UN Millennium Villages Project (Schlesinger 2007) appears insightful, carrying capacity for humans is not mentioned for the sub-Saharan habitat that serves as the life support system. Achieving the goals of the project means developing a harmonious relationship with the local ecosystems. Subsidizing the habitat with fertilizer and outside financial aid is only a short-term, temporary tactic for the transition period that is expected to lead to sustainable use of the habitat.

The situation in China is no more reassuring since food has been imported since at least 2004. However, pollution of aquatic systems, which has apparently driven China's freshwater dolphin to extinction (World Service Staff 2007), and the loss of arable land through development are arguably more serious problems. As a caveat, developed countries, such as the United States, have ecological deficits that are often rather large. These deficits are the consequences of overusing the biological capacity available per capita. The world has 11.2 billion hectares of biologically productive land and water, or 1.7 global hectares per person (11.2 ÷ 6.6), assuming no land is set aside for other species that constitute the human biospheric life support system.

However, Klinkenborg (2007) remarks that a June issue of the journal *Science* noted that by 1995 only 17% of the world's land area had escaped direct influence by humans. The article takes as a working assumption: "There really is no such thing as nature untainted by people." However, nature provides both natural capital and ecosystem services to humans without which humans could not survive. Moreover, humankind is not treating natural systems as the life support systems necessary to its survival and well being. Worse yet, practices are reducing biocapacity globally. For example, Shapiro (2007) reports on the severe shortage of water in Crete, which a local official, Costas Kaliokannakis, says was not known in his childhood years: "this is the first time I've seen that we've completely run out of water." Rainfall has been slight, and water is inadequate for irrigation. Temperatures have been over 40°C and have caused wildfires, electrical blackouts, and some deaths.

Professor Costas Kosmas of the University of Athens wants people to think intently about the problems of heat and drought and about the way people make these problems worse (Shapiro 2007) – good advice for the entire planet, not just for Crete. Professor Kosmas explains: “When the land is degraded and desertified, this affects the climate, affects the economy, affects the environment.” One does not need to be a professional ecologist to know that the biocapacity of Crete is diminishing.

John Maynard Keynes

Keynes was a member of the “Bloomsburg Group” at Cambridge University, which included Virginia Woolf, Arnold Bennett, H. G. Wells, and John Galsworthy (<http://www.blupete.com/Literature/Biographies/Philosophy?Keynes.htm>). This group believed that man has power to change things and attacked “naturalists” who believed that humans are creatures of their environment (i.e., natural systems):

For at least another hundred years we must pretend to ourselves and everyone that fair is foul and foul is fair; for foul is useful and fair is not. Avarice and usury and precaution must be our gods for a little longer still (Keynes quote from 1930; http://www.brainyquote.com/quotes/authors/j/john_maynard_keynes.html).

The day is not far off when the economic problem will take the back seat where it belongs, and the arena of the heart and the head will be occupied or reoccupied, by our real problems – the problems of life and of human relations, of creation and behavior and religion (Keynes quote from 1930; http://www.brainyquote.com/quotes/authors/j/john_maynard_keynes.html).

Capitalism is the astounding belief that the most wickedest of men will do the most wickedest of things for the greatest good of everyone (http://thinkexist.com/quotes/john_maynard_keynes/).

Why all the focus on John Maynard Keynes? Because economic growth has been the primary focus of both world leaders and the world society in the 20th century and the beginning of the 21st century, and Keynes has been described as the most influential economist of the 20th century. In contrast, Earth’s ecological life supports are in imminent peril. The best evidence of this danger is that US President George Bush has stated that efforts to reduce greenhouse gas emissions would not be considered if they interfered with the economy. In practice, the US Congress and the general public have been unable to agree on the strong measures needed to avoid a major climate tipping point, although there is much discussion of planning to do something by 2050.

Of particular interest in the Keynes’ quote is the idea that economic growth should not be perpetual but rather last “. . .at least another hundred years.” Since this statement was made in 1930, the time span is remarkably similar to the estimated 100- year industrial era of 1930 to 2030, which depends on cheap fossil energy. Equally interesting is another portion of the quote: “Avarice and usury and precaution must be our gods for a little longer still.” A subsequent quote indicates that the economic problem will take the back seat and the arena of the heart and mind will be occupied or reoccupied. This statement seems startlingly similar to Eisler’s (2007) call for a caring, compassionate economics. Eisler (2007, p. 153) notes that John Maynard Keynes and John Kenneth Galbraith were deeply concerned about human welfare but that the primary, often sole, focus in US economic schools continued to be market centered. Of course, economists such as Herman Daly take a broader view, especially in the field of ecological economics. They are aware of the massive threats to natural systems and call for a more ecologically responsible economic system.

The Disconnect Between Science and Politics

Science is a system of acquiring knowledge based on the scientific method, as well as the organized body of knowledge gained through such research. Politics is the process by which groups of people make decisions. As Bill McKibbin (2007, August 11 letter to environmental community) states:

There are occasional moments in history when we desperately need leadership, and this is one of them. If we’re going to deal with global warming, then we need to go beyond politicians who say the right words and find champions who will do the tough work to transform our energy economy.

His goals are: an 80% reduction in carbon emissions by 2050, 10% in three years; a moratorium on new coal-fired plants; and a Green Jobs Corps to help fix homes and businesses so their targets can be met. Begley (2007) has written a superb article about one of the major factors responsible for the vast gulf between science and politics in the United States – this factor is the well funded effort that gives equal time to the tiny group of minority global warming doubters, some with no scientific credentials, despite the well established scientific process, which is based on the preponderance of validated evidence and published in peer-reviewed professional journals.

Ethics Anyone?

Keynes expected individuals to treat avarice and usury as gods for at least 100 years and then enter the arena of the heart and head after that time. This ethical transformation is a Dr. Jekyll/Mr. Hyde act, very difficult for an individual and arguably impossible for a society. As a caveat, my hope for a willing transition from a fossil energy to an alternative society may be equally hopeless.

Some of these disconnects are due to disconnects between disciplines (e.g., economics, ecology, the social sciences) and, alternatively, deliberate deception. For example, Monbiot (2007) notes:

While no expense is spared in expanding motorways, airports, and thermal power stations, every possible tactic is used to frustrate the programme for installing renewable power. The reason is not hard to fathom; big business has invested massively in constructing old technologies, and wants to maximise its returns before switching to the new ones. It also demands the hyper-mobility which enables its executives and its goods and services to go anywhere at anytime.

Monbiot (2007) also raises an important question about the effect of advertising upon societal decisions. The *Independent* (a UK newspaper) raises a difficult question about where to draw a line beyond which advertisements cannot go. However, nearly all advertising promotes excessive consumption, which damages the biospheric life support system. Thomas Jefferson hoped that an informed, literate citizenry was the answer, but that does not seem to be working now. Perhaps the right questions are just not being asked.

What are the Right Questions?

Physicist John Wheeler observes: “We make the world by the questions we ask” (as quoted by ecological economist Herman E. Daly 2007). Daly suggests: “Why not ask, can we systematically continue to emit increasing amounts of CO₂ and other greenhouse gases into the atmosphere without eventually provoking unacceptable climate changes? Scientists will overwhelmingly agree the answer is no.” Some illustrative questions follow, not necessarily in order of importance.

- (1) Is it wise for the United States to allow persons with no significant scientific credentials to alter scientific reports and attempt to impede government scientists from informing the general public about new developments in their field of competence? The answer should be “no,” but the record shows otherwise. The experiences of world-class government scientist James Hansen documents that the answer is not a resounding “no.”
- (2) Is it ethical/moral to have more than 1.3 billion people “over-nourished” (i.e., obese) and more than 800 million people starving or severely malnourished (Stix 2007)? The answer should be a resounding “no”; however, the poor can also be obese (e.g., Popkin 2007), so the problem is more complex than it initially appears. Pinstrup-Anderson and Cheng (2007) also note that one-eighth of the world’s people do not have enough to eat.
- (3) Is economic growth more important than preserving the integrity of the biospheric life support system that has produced conditions favorable for the genus *Homo* for over 1 million years and for *Homo sapiens* for approximately 160,000 years? Enlightened self interest should produce another resounding “no,” but, in practice, economic growth is worshipped worldwide and the environment is being degraded globally.
- (4) Should humans have empathy and compassion for other life forms even if they did not constitute the biospheric life support system? The answer to the question depends on whether humans consider themselves *a part* of nature rather than *apart* from nature. Perhaps the answer is already evident by the practice of labeling natural systems as resources and commodities.
- (5) Is producing biofuels an environmentally friendly (i.e., green) process? Brahic (2007) answers this question:

It sounds counterintuitive but burning oil and planting forests to compensate (for greenhouse gas emissions) is more environmentally friendly than burning biofuels. So say scientists who have calculated the net emissions between using land to produce biofuels and the alternative: fuelling cars with gasoline and replanting forests on the land instead.

(6) Is the carbon footprint larger when one travels by air? Protesters camped out at Heathrow Airport, near London, in mid-August 2007, to say “yes.” Merrick, one protestor, stated: “Aviation is a luxury we can live without. It has to be scaled right back” (Rice-Oxley 2007). Rice-Oxley (2007) makes some important points: (a) “aircraft not only produce carbon dioxide but also nitrous oxide (a powerful greenhouse gas) and condensation trails, which may also contribute to global heating,” (b) “given the limited prospects for a technological solution, a growing body of evidence is arguing for efforts to manage demand for air travel,” (c) “some experts believe that personal carbon budgets – rationing – may be the only solution,” (d) “it is too late for voluntary mechanisms; carbon allowances are the only fair way to deal with this.”

(7) Is living in coastal cities safe? “No” say many of the former and present residents of New Orleans! Freudenburg et al. (2007) remark: “Katrina showed, unfortunately, that we do not seem to have the same level of technological capacity to undo the damage we create – to nature, to humans, or both.” And further:

When Katrina hit New Orleans, what came through the levees was more than just a rush of floodwater. It was tragically graphic evidence that scientists’ warnings about the risks of environment damage need to be taken seriously, and that boosters’ claims of economic benefits need to be subjected to equally serious scrutiny. The leaders of New Orleans ignored that evidence, and the city suffered the consequences. The rest of us watched the painful learning experience. The question is whether we will actually learn from it.

In addition, living in other coastal cities is risky, too. Almost 80% of the world’s population lives less than 50 kilometers (30 miles) from a coastline, an inconvenient location since one of the effects of global heating is rising sea levels (Mongalvy 2007).

(8) Would individuals drive less to reduce greenhouse gas emissions and, thus, reduce the rate of global heating? The answer to this question usually is “I cannot possibly reduce my driving.” However, if the question is rephrased to: “Would you like to leave a habitable planet for your children and grandchildren?”, the answer is almost always “yes.” Usually the person then asks: “How can I do that?” People just have not connected personal lifestyle with the future of their descendents. The planet is in imminent peril because people cannot, or will not, connect the most obvious dots.

(9) Are individuals part of the solution or part of the problem (i.e., environmental degradation)? Some people remember the early Earth Day statement: If you’re not part of the solution, you’re part of the problem. Anyone who believes that peak oil will occur in the middle of the 21st century is part of the problem: “Based on (our) analysis,’ the U.S. Department of Energy confidently asserted in 2004, ‘[we] would expect conventional oil to peak closer to the middle than to the beginning of the 21st century’” (as quoted in Klare 2007). Klare (2007) notes: “As originally formulated by petroleum geologist M. King Hubbard in the 1950s, the concept holds that worldwide oil production will rise until approximately half of the world’s original petroleum inheritance has been exhausted; once this point is reached, daily output will hit a peak and begin an irreversible decline.” The exact year of the peak is of some interest, but the part of the century in which this occurs is critical to industrial society. Klare (2007) notes that Hubbert’s successors, including Professor Emeritus Kenneth Deffeyes of Princeton University, contend that about one-half of the original supply of oil has been consumed and, it is, or very near, the peak production moment predicted by Hubbert. Klare (2007) makes another very important point – the first half of the world’s oil to be extracted and consumed will be the *easy* half. The last half will be the *tough* half. The remaining oil is located in politically dangerous areas, deep below the surface, and mostly in small, hard to find reservoirs. Depending on biofuels to replace lost fossil energy is not sound policy. For example, a team of UK-based scientists have suggested (in the journal *Science*) that reforestation and habitat protection are better options. The scientists state that forests could absorb up to nine times more carbon dioxide than the production of biofuels could achieve on the same area of land (BBC News 2007).

Actually, one can reduce the questions to a few that are so brutally frank that they will offend many people.

- (1) Is this automobile or plane trip so important that I am willing to be part of collective actions that will place billions of people at risk because the ultimate result will be irreversible climate change that might well be unsuitable for humans, including my children and grandchildren?
- (2) What if everyone on the planet consumed as many resources (e.g., energy, material goods, food) as one average citizen of the United States? What then?
- (3) How will future generation of humans, if they exist, view over consumption and other excesses of the Industrial Age?

Conclusions

Humankind is now living in very perilous times and the peril is imminent. When Jeannie produced the sampler that serves as the title for this commentary, she was concerned with the resources in our possession, not the planet's. Humankind's profligate use of finite fossil energy and excessive use of Earth's natural capital are not only unsustainable but may be fatal for civilization and even the human species. Humankind is sleepwalking toward the precipice of a global climatic tipping point, but is focused primarily on perpetual economic growth. Time may exist, a decade at most, to initiate strong remedial measures (e.g., 80% reduction of greenhouse gas emissions), but motivation to do anything that might be effective is lacking – I cling to the probably irrational hope that political leaders will emerge who will be willing to accept scientific evidence, rather than suppress or ridicule it. Perhaps my hope is just the ultimate expression of denial. May it not be so!

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MOTHER NATURE DOES NOT BARGAIN OR FORGIVE

Pity the meek, for they shall inherit the earth.

Don Marquis

Let us not go over old ground, let us rather prepare for what is to come.

Cicero

Hansen et al. (2008, p. 1) express the present global crisis bluntly: "If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO₂ will need to be reduced from its current 385 parts per million to *at most* [italics mine] 350 ppm." The first response from people is usually: "What can I do? I'm only one individual." My response to them is that billions of individuals caused the present climate problem; therefore, billions of individuals should be able to correct it by individual lifestyle changes. This effort would involve using far less fossil fuels for transportation (i.e., petroleum), electricity (i.e., coal), and heating (i.e., fossil fuels). Hansen et al. (2008) remark that a 350 ppm atmospheric carbon dioxide target may be achievable by phasing out coal use, except where carbon dioxide is captured (technology not yet available), and by adopting agricultural and forestry practices that sequester carbon.

The 350 ppm target may be too high since persuasive circumstantial evidence (e.g., polar ice sheet melting, Australian "big dry") indicates that 350 ppm was a climate tipping point. If this value is the tipping point, then staying well below it would be prudent in order to avoid the possibility of initiating irreversible catastrophic effects.

Actually, the best way to set a target for atmospheric carbon dioxide is by determining the assimilative capacity of the biospheric life support system for atmospheric carbon dioxide. If atmospheric carbon dioxide continues to increase, as it is in 2008, the assimilative capacity of the biospheric life support system is being exceeded (Cairns 2008). If the carbon dioxide concentration continues to exceed Earth's assimilative capacity, it will continue to accumulate in the atmosphere and klimakatastrophes will increase in severity and frequency.

If Mother Earth were capable of musings, they might read like the following.

"Increased atmospheric carbon dioxide is increasing global heating. I wonder if melting the polar ice sheets might attract humankind's attention to this urgent problem. — Good heavens, humans are viewing the loss of the Arctic ice cover as an opportunity to acquire more petroleum that, when burnt, will increase greenhouse gas emissions."

"Humans seem to be fascinated with food, judging from the number of television shows devoted to cooking. Perhaps if climate change interfered with food production, they might notice the change in the climate. — Oh, no! They not only didn't notice, they are turning corn into ethanol to keep their SUVs going. Why can't they connect the dots?"

"Perhaps increasing the number of pests might attract humankind's attention — such as rice leaf hopper or wheat rust. I might even move some human tropical diseases toward the poles. Just for good measure, destroying large forests with beetles might attract some attention. — Wrong again! Humans are even less observant than I thought. Of course, they gave themselves the species name Homo sapiens, although a wise species should have taken note that the planet is less habitable."

"Humans love talking about the weather. Perhaps a change in rainfall patterns — droughts in some places, floods in others — might increase their focus on the climate. — It worked! But their solution is technological — make freshwater from ocean water. They still haven't associated climate change with their high fossil fuel/technological/automobile culture."

“The vast oceans cover approximately 70% of the planet’s surface, are an important source of protein, and are recreationally important (e.g., scuba diving at coral reefs), so any adverse effects upon them (e.g., acidification and declining fishery stocks) should attract immediate, concerned attention. After all, restoring damaged oceanic ecosystems in time frames of interest to humans is highly unlikely. — Sigh. . . wrong again. Humankind has been told about all of these problems but seems unconcerned, even possibly indifferent. Even a charismatic species, such as the polar bear, is not getting protection in its home US state of Alaska. The governor of Alaska, Sarah Palin, has stated that the state will file a lawsuit in the US District Court in Washington, DC, challenging US Interior Secretary Dirk Kempthorne’s decision to grant Endangered Species Act protections to the polar bear. Governor Palin feels that listing the polar bear as a threatened species will slow development in the state (Rosen 2008). What has happened to these humans and the way they think? They should feel a responsibility for all other species with which they share the planet, not just dwell on their fixation on economic growth, which primarily benefits a small portion of their own species. This responsibility requires paying attention to the health and integrity of the biospheric life support system, which has provided conditions favorable to all life now present on the planet. Faith in technology should not replace or impede “good works” that benefit all life forms. Knowing how the world works is more important than knowing how the human economy “works,” since the latter derives its well being from the biosphere, without which the human economy would cease to function. Humans must develop an ecocentric perspective – an understanding of how the complex, interlocking systems are structured and function.”

“Humans don’t realize that I don’t bargain – if they make plans for 2025, 2050, or some other dates and greenhouse gas emissions keep rising, basic natural laws will not be suspended or modified. Human laws can be repealed or ignored, but not natural laws. The consequences of violating natural laws are severe, often fatal. I do not forgive either, as the fossil record shows. Five great extinctions have occurred and the sixth is well underway. These great extinctions caused species impoverishment, after which new and different complex systems evolved over substantial periods of time. Humans must accept that they are part of a pulsing system – ups and downs will always be present. The tragedy is that humans are causing the pulse, which has already driven approximately 33% of the planet’s species to extinction. Humankind is not the compassionate, lovable species it believes it is.”

Since Mother Nature neither negotiates nor forgives, what should humans do once they accept that they are on a finite planet with finite resources and that the fossil fuel, which enabled them to create a temporary high carrying capacity, is running out quickly? Population growth must be eliminated and then decreased, as well as consumption of natural resources. The Reverend Thomas Malthus failed to foresee the effects of technology based on cheap, abundant fossil fuel, but his analysis was sound, as humans are about to find out. The amenities that humans have taken for granted – abundant food, exponential economic growth, human population growth – must cease. Resources will still exist, but the instinct to solve the problem with resource wars must be effectively suppressed or far too many resources will be used for combat instead of facilitating the transition to resource scarcity.

The new goal for humankind is to determine the planet’s new carrying capacity, which has been adversely affected by global climate change and the decline of cheap petroleum. In addition, humankind must resist the temptation to keep the flow of energy up to peak oil levels by using coal that produces much more greenhouse gases.

Dependence on Oil

No US citizen was surprised when US President George Bush observed in his January 2006 State of the Union address that “America is addicted to oil,” and the remark has been widely quoted. However, Bob Hopkins has concluded that dependency is a better metaphor than addiction (as quoted by Heinberg 2007, p. 135). Heinberg (2007, p. 137) notes:

Let us translate this thought exercise (societal dependence) to our oil dependency. Might we simply end it by developing new supplies of alternative fuels such as ethanol and biodiesel, or liquids from coal and natural gas? If the analogy holds, the result is likely to be not an actual reduction in oil consumption but merely an added dependency on these alternatives. And indeed this is exactly what we see in most cases; it is difficult to find an instance in which any nation has substantially decreased its existing oil consumption as a result of the development of alternative fuels. In nearly every case alternatives serve merely to reduce the rate of growth in demand for oil. It doesn't hurt, but neither does it address the core problem.

In my opinion, humans are placing their perceived needs well before Mother Nature's needs – that is, preserving the integrity and health of the biosphere. In this case, the health of the biosphere means staying at or below the biosphere's assimilative capacity for greenhouse gases. Since greenhouse gases are rising at a rapid rate, a reduction in consumption of oil and other fossil fuels is essential. Reduction can only be accomplished by dealing head on with the dependency (Heinberg (2007, p. 137). Heinberg (2007, p. 141) remarks: "The problems of Climate Change and Peak Oil both result from societal dependence on fossil fuels. But just how the impacts of these two problems relate to one another, and how policies to address them should differ or overlap, are questions that have so far not been adequately addressed." Climate change concerns carbon emissions and their effects. Peak oil concerns coming shortfalls in the supply of fuels on which society has become overwhelmingly dependent. In my opinion, both problems are being addressed from a homocentric perspective. Climate change studies have a major ecocentric perspective, especially in the scientific reports, but the implementation of remedial actions (or lack thereof) is in the hands of politicians who have a strong homocentric perspective: "I put people ahead of fish (or some other groups of organisms)." Rarely is human dependence upon the biospheric life support system given much attention.

Speculative Future Scenario

An infinite number of possible scenarios exist for the future of life on Earth, all of which may be strongly influenced by stochastic events. As a father and a grandfather, I hope the following assumptions are wrong.

- (1) The term *sustainable* means a practice that can be maintained over time. I have always preferred the phrase *sustainable use without abuse* since *sustainable development* on a finite planet is an oxymoron. Bartlett (1997-1998) gives a detailed discussion of the term *sustainability* that superbly analyzes the use and misuse of this term. Present human population growth and the use of fossil fuels and other natural resources are clearly not sustainable. Tainter (1988) and Diamond (2005) both note that collapse of complex societies is frequently the fate of societies that ignore the basics of carrying capacity and resource use.
- (2) Humankind is damaging the biospheric life support system by driving species to extinction and co-opting both space and resources needed to preserve the system's health and integrity. The biospheric life support system has maintained conditions favorable to the genus *Homo* for approximately 2 million years. The biospheric life support system will probably return to a quasisteady state even after a major extinction (i.e., 90+%), but the new conditions may not favor the genus *Homo*.
- (3) As Heinberg (2007, p. 6) notes: "Nevertheless the general picture is inescapable; it is one of mutually interacting instances of overconsumption and emerging scarcity." In short, humankind has grossly exceeded Earth's carrying capacity. No cheap, abundant energy will be available to fuel an attempt to further increase humankind's resource base. The inevitable result is a major population crash, featuring starvation, disease, and death.
- (4) Climate change will persist for centuries due to the long residence time of carbon dioxide in the atmosphere.

How Did We Get in this Predicament?

Heinberg (2007, p. 175-176) remarks:

The economists had been operating on the basis of their own religion – an absolute, unshakable faith in the Market-as-God and in supply and demand. They figured that if oil started to run out, the price would rise, offering incentives for research into alternatives. But the economists never bothered to think this through. If they had, they would have realized that the revamping of society's entire energy infrastructure would take decades, while the price signal from resource shortages would come at the exact moment some hypothetical

replacement would be needed. Moreover, they should have realized that there was no substitute capable of fully replacing the energy sources they had come to rely on.

Hardin (1998, p. 1) discusses another human attribute – the ability to ignore unpleasant things. He uses the example of an infant trying to escape a threatening face by burying its head in a blanket as in the myth of an ostrich burying its head in the sand. He speculates that the infant's mind moves along the following sort of logical path: "My world is what I see. If I do not see something, it does not exist. I will cause the fearful object to cease to exist by wiping out its image." At the other end of the age range, the elderly might simply say: "I don't want to hear about that (e.g., global heating, peak oil, price increases for food)." Hardin (1998, p. 45) also addresses another human foible – doing nothing: "Yet to do nothing is not a realistic option because *nothing ever happens*." For example, humankind is not following the conservative recommendations in the Intergovernmental Panel on Climate Change reports to any significant degree, and, as a consequence, anthropogenic greenhouse gas emissions are increasing markedly. In fact, Sherwood Rowland, Nobel Laureate atmospheric chemist, estimates the peak atmospheric concentration of carbon dioxide could be 1,000 ppm. The current concentration is about 385 ppm, after never topping 280 ppm for at least 650,000 years (Revkin 2008a).

New and Old Words

The growing urgency of the climate crisis has generated some new words. *Klimakatastrophe* (climate disaster) is the German Language Association word of 2007. An equally alarming new word is *hypermortality*, which is defined as an extraordinary tendency toward death (Walker 2008). The UN Development Program Report entitled "Demographic Policy in Russia" states: "The Russian phenomenon of hypermortality comes to be observed primarily in working-age populations. . . Compared to the majority of countries that have similar levels of economic development, mortality is 3-5 times higher for men and twice as high for women" (Walker 2008). Another new word is *envirogee*, whose "semi-official designation *climate refugee* is defined as a displaced person who has been forced to migrate because of environmental devastation" (Thill 2008). Perhaps these new words will create a sense of urgency which seems, at times, to be totally lacking in public discourse on climate change.

However, one's expectations for change should not be too high! The term *peak oil* was used in 1956 by M. King Hubbert, a petroleum geologist, who predicted that US oil production would peak in the early 1970s, followed by a declining curve. This curve, now validated, is a classic, but still causes fear (Wilson 2008). The reason for the fear is that petroleum has produced a period of unparalleled economic growth, and resistance is strong to the idea that limits to growth exist or, worse yet, a return to a lower growth era. Wilson (2008) makes another important point:

When speaking of energy issues, politicians will often use the euphemism of energy security, acknowledging that the US has only three percent of the world's oil reserves and warning that most of the rest of it belongs to unfriendly or unstable governments. While there is truth to this type of statement, it sets up a framework for conflict by creating the perception that there is plenty of oil left but bad people are keeping it away from us.

Wilson (2008) further remarks that politicians of both parties are willing to play the fear card and promote quick-fix measures that are ineffectual or downright ridiculous. This approach does not develop a good relationship with Mother Nature. Many congressional Republicans favor drilling in the Arctic National Wildlife Refuge, which would, at peak production, only meet 2% of the US oil demand (Wilson 2008). However, the Congressional Peak Oil Caucus Co-chair, Congressman Roscoe Bartlett (Rep), favors saving the Arctic oil for a real emergency. Clearly, the automobile culture puts drilling far ahead of alternative energy sources.

US Legislation

At present, many energy bills are before the US Congress. However, a recent poll carried out by the Public Opinion and Policy Center (2008) of the National Center for Public Policy Research found that 65% of Americans reject spending even a penny more for gasoline in an effort to reduce greenhouse gas emissions. A 203-page report, "The Effects of Climate Change on Agriculture, Land Resources, Water Resources and Biodiversity in the United States," is a part of a continuing assessment of global heating questions that was initiated by US President George Bush in 2003. The report notes that the rise in concentrations of carbon dioxide in the atmosphere from anthropogenic sources is influencing climate patterns and vegetation across the

United States and will significantly disrupt water supplies, agriculture, forestry, and ecosystems for decades (Revkin 2008b)

One would hardly guess that the climate report just discussed had little influence on the Lieberman-Warner climate bill, which effectively died in the Senate on 6 June 2008 (Sheppard 2008). The bill aimed to cut global heating emissions by 66% by 2050 (Zabarenko 2008). This value is far below the reduction in emissions recommended by the Intergovernmental Panel on Climate Change reports, but would have been a step in the right direction.

Tim Profeta, Director, Duke University's Nicholas Institute for Environmental Policy Solutions, stated: "Not many people see this [the Lieberman-Warner Bill] as a serious piece of legislation that will become law this year" (Eilperin and Mufson 2008). US Senator Barbara Boxer has stated: "This is landmark legislation, and enacting landmark legislation is never as easy task. There is always an excuse not to act – but in this case, the longer we wait, the harder it gets to solve this problem. Time is our enemy, and every expert has told us we face dangerous consequences from unchecked global warming if we do not address this problem now" (Eilperin and Mufson 2008).

Why Did Humankind Get into this Perilous State?

The short answer to the question of why humankind got into this perilous state is that it ignored scientific evidence. The "investigative reporters" failed to state that the preponderance of evidence confirms that global heating is indeed occurring and that anthropogenic greenhouse gas emissions were a major component of the change. Of course, overwhelming scientific evidence exists, but not enough in the United States to elicit major remedial actions.

Unquestionably, denial was a major factor in humankind's failure to address climate change threats. Worse yet, in the United States, science was suppressed and distorted when it was perceived as a threat to political ideology. For example, *The New York Times* stated:

The Bush administration has worked overtime to manipulate or conceal scientific evidence – and muzzled at least one prominent scientist – to justify its failure to address climate change . . . This administration long ago secured a special place in history for bending science to its political ends. One costly result is that this nation has lost seven years in a struggle in which time is not on anyone's side" (Editorial 2008).

The editorial also reported that an internal investigation by the National Aeronautic and Space Administration's inspector general concluded that political appointees in the agency's public affairs office had tried to restrict reporters' access to its leading climate scientist Dr. James Hansen. The investigation also found that politics played a heavy role in the office and that it had presented information about global heating "in a manner that reduced, marginalized or mischaracterized climate-change science made available to the general public" (Editorial 2008). Fortunately, humankind is better off because James Hansen refused to be silenced. Few scientists could have endured the stress he was subjected to and continued their research, but Hansen did.

Finally, humankind got where it is because the CEOs of some corporations require scientific evidence far beyond what they provide when they engage in an activity that affects the environment. For example, Cattaneo (2008) states:

Rex Tillerson, chairman and chief executive officer of Exxon Mobil Corp., the world's largest oil-and-gas company, came out swinging Wednesday against the environmental movement, arguing the science of climate change is far from settled and that his company views it as its 'corporate social responsibility' to continue to supply the world with fossil fuels . . . Mr. Tillerson also said he expects little delay in the \$8-billion Kearsley oilsands project in Alberta, after a court challenge by environmental organizations this month resulted in the withdrawal of a key federal permit, halting important work.

Redesigning to Favor Mother Nature

Scientists at Brown University (MLA 2008) have demonstrated that richer plant diversity significantly enhances an ecosystem's productivity. This evidence highlights a very important benefit – capturing a major

contributor to global warming – carbon dioxide. Despite persuasive evidence of this type that humans derive enormous benefits from ecosystem services, such as carbon dioxide capture, they still depend upon undeveloped, unproven technology (e.g., “clean” coal). Ecosystem services must be given the attention they deserve before humans damage natural capital so severely that the services decline, disappear, or no longer benefit the genus *Homo*.

Social Evolution

In their superb book *The Dominant Animal*, Paul and Anne Ehrlich (2008, pp. 3, 4) state: “Humanity’s rise to dominance is a result of both genetic and cultural evolution, both of which led to scientific advances that have spawned ever more powerful technologies . . . Knowledge of these reciprocal evolution-environment interactions is critical to our ability to make wise decisions affecting the long-term success of our species and of the natural world upon which it is utterly dependent.” The Ehrlichs then note (2008, p. 4) the astonishing increase in knowledge about how Earth and its inhabitants – including humans – interact and how they have changed over time: “In theory, we could use that knowledge to create a sustainable civilization – one in which human beings live happy, productive lives into the indefinite future. Whether we can manage that in practice remains to be seen.” Humankind has made no acknowledgment that it is utterly dependent upon Earth’s life support system, although discussion of the human economic system is dominant. Wynn (2008) reports that the US chief climate negotiator, Harlan Watson, has commented that big cuts in greenhouse gas emissions cannot be met by 2020: “It’s frankly not do-able for us.” Had the United States not been a climate change denier for nearly eight years, a more positive statement might have been made.

The Ehrlichs (2008, p. 368) conclude:

Humanity’s globalizing civilization must take this enhanced opportunity to explore conscious evolution and try new ways of organizing societies to cooperate to solve its burgeoning global problems. . . And humanity must do this even without assurance that the steps taken will be successful. Dealing with such profound questions along with the consequences of overpopulation, economic inequity, and the erosion of environmental resilience will surely not be easy. But each day that we do nothing forecloses options for creating a better future for ourselves and our fellow inhabitants of Earth. The qualities that made it possible for us to become the dominant animal could now be put to use in creating a sustainable future for ourselves and the rest of the world.

Conclusions

Anthropogenic greenhouse gases are still pouring into the atmosphere at a rate that far exceeds the biosphere’s capacity to absorb them. Much talk and little corrective action have been the response to catastrophic climate change thus far. In the United States, resistance to remedial action has been formidable in the federal political system and from organizations funded by some powerful corporations. The general public has inadequate literacy and numeracy to grasp fully the complex systems-level climate change problem. All too many political leaders emphasize adverse effects on the economy when greenhouse gas emission reductions are discussed. However, the human economy will not survive if climate change adversely affects water supply and food production or makes much of the planet uninhabitable by humans. If climate change continues at its present rate, *Homo sapiens* could become extinct or suffer a massive reduction in population size. If biotic impoverishment (i.e., species extinction and/or population declines of many species) continues at its present rate, the biospheric life support system may cease to maintain conditions favorable to humankind.

Still, scientists must continue to generate information about the effects of greenhouse gas emissions and do everything possible to dramatically reduce them. Doing nothing is not an option, however daunting the obstacles to success.

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The Mother of all Positive Feedback Loops?

Saving civilization is not a spectator sport.

Lester Brown

Well it had to happen! Humankind knew that “business as usual” would reach a tipping point after which climate change would be beyond human control. “New U.S. government data estimates that worldwide emissions of carbon dioxide have gone up 38% since 1992 . . . The Kyoto Protocol, which industrialized nations other than the United States have agreed to adhere to, aims to reduce emissions in those countries 5% *below* 1990 levels by 2012” (Shapely 2008). No robust evidence indicates that this goal will be reached. As a consequence, Earth’s assimilative capacity for greenhouse gases will continue to be exceeded, and humankind will move the climate closer to major, irreversible tipping points.

“British scientists have discovered hundreds more methane ‘plumes’ bubbling up from the Arctic seabed, in an area to the west of the Norwegian island of Svalbard . . . It is likely that methane emissions off Svalbard have been continuous for about 15,000 years – since the last ice age – but as yet no one knows whether recent climatic shifts in the Arctic have begun to accelerate . . . climate change” (Connor 2008a) and “. . . details of preliminary findings suggesting that massive deposits of sub-sea methane are bubbling to the surface as the Arctic region becomes warmer and ice retreats” (Connor 2008b). Global carbon dioxide anthropogenic emissions last year (2007) outpaced the most dire predictions of international scientists (Eilperin 2008). “In 2007, carbon released from burning fossil fuels and producing cement increased 2.9 percent over that released in 2006, to a total of 8.47 gigatons, or billions of metric tons, according to the Australia-based Global Carbon Project . . . It is unclear how much industrialized countries will be able to reduce their carbon output in years to come,” (Eilperin 2008) if at all, but, even if they do, increased emissions from third-world countries will probably cancel any reductions and still add to the global atmospheric carbon total. Carbon “sinks” such as oceans and forests “have absorbed 54 percent of carbon dioxide emissions since 2000, a drop of 3 percent compared with the period between 1959 and 2000” (Eilperin 2008). In short, Earth’s ability to assimilate greenhouse gases is declining while greenhouse gas input into the atmosphere is increasing.

In addition to these increased anthropogenic emissions, emissions from formerly sequestered carbon, in the form of methane, appears to be increasing in the Arctic and probably elsewhere on the planet. These emissions will increase the rate of warming and result in increased release of carbon now sequestered in wetlands, tundra, permafrost, and frozen hydrated methane in the depths of the oceans and, thus, accelerate the rate of global climate change. More important, the essential point is that climate change is getting beyond humankind’s control. The feedback loops did not seem to be at current levels of activity at 350 ppm carbon dioxide and were presumably essentially inactive at the pre-industrial atmospheric carbon dioxide level of 280 ppm. Humankind probably has warmed the planet sufficiently to activate the release of stored carbon from a variety of sources. Various parts of the planet have effects on other, sometimes quite distant, areas of the planet (e.g., Tierney et al. 2008). These sources of carbon sequestered by nature at rates difficult to estimate or measure are clearly now emitted at rates significantly above the recent past. Nearly a year ago, the Intergovernmental Panel on Climate Change (IPCC) “issued its strongest call for immediate action to save humanity from the deadly consequences of unrestrained greenhouse gas emissions” (Romm 2008). Instead, greenhouse gas emissions increased last year, setting a course that could push beyond the worst case scenario of leading scientists (Times Wire Services 2008).

Nobel Laureate Svante Arrhenius noted the greenhouse effect of carbon dioxide in 1896, so the science is not new. The preponderance of scientific evidence demonstrates that anthropogenic greenhouse gases have a major effect on climate change, and no credible scientific evidence shows that they do not have effects. Of course, deniers are active, but they are usually persons with few or no scientific credentials and lacking publications in peer-reviewed, scientific literature. Vocal deniers in the US Congress and administration have delayed reaching agreement on treaties to set quantitative goals on greenhouse gas emission reduction. In some cases, these actions go beyond global climate change to anti-science. The Union of Concerned Scientists has documented many cases in which the US government has changed, altered, or falsified science.

Uncertainty

Science is always a probabilistic determination based on evidence. Some uncertainties are characteristic of all scientific research. Furthermore, all scientists are responsible for continually probing for any weakness in scientific data and hypotheses. This quality control is essential to a robust, credible, scientific process. Regrettably, the general public, possibly strongly influenced by the news media, views these actions as scientific confusion rather than quality control. In global climate change, the preponderance of evidence that anthropogenic greenhouse gases play a major role is now awesome.

If continuing “business as usual” is likely to be catastrophic, precautionary measures are justified, even if scientific uncertainty exists in certain areas. For example, uncertainties involving the ebb and flow of continental ice sheets are unlikely to be resolved for many years. The exact greenhouse gas concentrations that will exceed major climate tipping points will probably never be known until they have been passed. The assumption that a new, dynamically stable biosphere will develop after major ecological disequilibrium will probably not be known for thousands of years – a time frame not commonly used in human decisions. Finally, Americans unused to US\$4/gallon gasoline want to “drill here, drill now, pay less,” which might make more fossil fuel available at a low cost but will increase greenhouse gas emissions. Coal, which emits more greenhouse gases per unit of energy, is increasingly favored for electric power generation – this burning also vastly increases greenhouse gas emissions. In the year-long US presidential debates, global climate change was barely mentioned.

Are Catastrophic Climate Changes Needed for an Adequate Wake-up Call?

Even climate scientists are surprised at the present rate of climate change. Former US Vice-President Al Gore, although not a scientist, is so disturbed at the depth and rate of change that he made the following statement at the recent Clinton Global Initiative: “. . . we are at a point in our world’s history, and in need of such immediate action, that if you are a young person it’s time for civil disobedience. In particular, to bring coal plants to a halt” (Brewer 2008).

I have never felt civil disobedience has been productive, except in Ghandi’s case, but I understand fully Gore’s desperation at the failure to reduce greenhouse gas emissions when time is so short to take remedial action. If another major climatic tipping point is passed in the near future, which will probably happen if the positive climate feedback loops increase rates of activity, humanity might survive in areas of the world that remain habitable, but the quality of life will not be attractive. Regrettably, loss of human life could be in the billions. Most of humankind’s societal infrastructures will probably not survive a worst case scenario, and resources to repair or replace them will most likely be scarce. All these events are possible, even probable, if the positive climate feedback loops escape human control.

Why Worry?

Earth has had conditions suitable for the genus *Homo* for over two million years, and no context exists with which to integrate present day events. However, ancestors in the genus *Homo* faced major challenges, such as leaving trees for the savannah, and survived, although the price was probably often horrendous. The present generations have a significant advantage over their ancestors – they have the power to reduce greenhouse gas emissions. At present, humankind only seems to lack the will.

Infectious Exuberance

The recent financial meltdown in the United States has some lessons that may be applicable to the global climate change crisis that has yet to evoke fear in the US citizenry and in much of the rest of the world, although, based on evidence available, climate change could easily kill and/or displace billions of people. Shiller (2008) notes that financial bubbles are like epidemics – both should be treated the same way. Most of the world, and the United States in particular, worships economic growth, and all that is needed to kill legislation to reduce greenhouse gas emissions is to suggest that the legislation might have adverse effects upon the economy. However, in the United States, citizens were not protected against a financial meltdown and are not being protected from adverse consequences of global climate change. “Many culprits have been fingered for the housing crisis we’re in today: unscrupulous mortgage lenders, dishonest borrowers, underregulated financial institutions. And all of them played a role” (Shiller 2008, p. 19). However, too little attention has been paid to the most fundamental cause – the contagious optimism, seemingly impervious to facts, that often takes hold when prices are rising (Shiller 2008). Bubbles (e.g., financial, housing) are primarily social phenomena. Until society understands and addresses the psychology that fuels social phenomena, they are re going to keep forming. “Speculative bubbles are fueled by the social contagion of boom thinking, encouraged by rising prices.

Sooner or later, some factor boosts the transmission rate high enough above the rate for an optimistic view of the market to be widespread" (Shiller 2008, p.20).

Tipping Points Again

Clearly, very few, if any, people realized that a financial tipping point was being approached. Or, if they did, Secretary of the US Treasury Paulson issued no warning, nor did US President George Bush. The US Congress appears to have been caught unawares along with, of course, the major financial institutions and the general public. As of 4 October 2008, a US\$700 billion bailout was passed (+US\$150 billion in "pork" for congresspersons who otherwise might not have voted favorably on the bill) and rapidly signed by US President George Bush. Despite the large sum of money, the bailout might not work. The original bill submitted to the US Congress was three pages long; the final bill, the one signed into law, was reported to be 454 pages long – its size increased in just a few weeks. Surely, few people had adequate time to read the final, authorized bill carefully or systematically.

In short, no thoughtful approach was in place before the financial tipping point was passed. In fact, faith in the free market system was too encompassing and the free market ideologists disregarded common sense. In any case, perpetual growth of population, economics, resource use, and all non-cerebral growth cannot continue indefinitely on a finite planet.

Conclusions

Crossing a financial tipping point does not seem to have altered people's attitudes on population growth, ecological overshoot, global climate change, or even infectious exuberance, although all involve global tipping points. Perhaps enough time has not passed for reaction, although people should be asking what else could go wrong.

Acknowledgments. I am indebted to Alvin Lucier, Paul Ehrlich, Karen Cairns, and Paula Kullberg for calling useful references to my attention.

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Just Give Me a Freeze Dried, Talking Fish on a Stick

Some months ago, I attended an interdisciplinary meeting where problems of pollution were discussed. One of the nonecologists present plaintively but humorously asked, "Why can't you environmental toxicologists just give us a freeze dried, talking fish on a stick? This fish could be inserted in any aquatic ecosystem where pollution problems were suspected and the fish would immediately expand, determine the biological condition of the water, and give the person holding the stick the answer verbally."

If one vigorously suppresses the automatic impulse to explain the complexities of ecology and toxicology to this "ignorant" individual, it becomes abundantly clear that those two simple sentences contain a beautiful description of the kinds of methods the rest of the world wants from ecologists and environmental toxicologists. My interpretations of these characteristics follow:

- The method is simple and the apparatus portable.
- The all-purpose method will work well in any aquatic ecosystem.
- The method can be used by a variety of individuals with little or no professional training.
- Results are obtained immediately and communicated in generally understood terms.
- Because of the stick, the investigator need not expose himself unnecessarily to the potentially harmful material.
- The device is inexpensive and readily available. (This is less apparent from the two-sentence hypothesis, but on checking with the originator of the statement, I found my assumption is correct.)

Although there is always the possibility that some creative individual who does not know "it can't be done" will develop the freeze dried, talking fish on a stick, for the foreseeable future, we must live with the existing methodology.

When developing or improving methods to assess the probable or actual damage caused by persistent chemicals, ecologists would do well to keep these criteria in mind, particularly in terms of communicability. Scientists could, of course, adopt the "trust us" attitude of some professionals – the matter is too complicated to explain to laymen and, therefore, no attempt should be made to so.

This has not been a smashing success in the past for environmental problems and is unlikely to be so in the future. What will probably happen if this is done is that unqualified persons with simplistic solutions will take over. Of course, meeting the needs (which are not well understood) of others is just as difficult as meeting the needs within a discipline, even though the requirements are different. This requires an investment of time and energy in a period when it is impossible to keep up with all the literature within a single discipline. Nevertheless, it is abundantly clear that we must improve methods as well as communication among ourselves.

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“Hail Mary” Technologies to Engineer Earth’s Climate*

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A variety of technologies has been proposed to avoid further increasing Earth’s temperature by emissions of anthropogenic greenhouse gases in excess of Earth’s ability to assimilate them. The two most popular technological approaches are (1) reflecting solar energy back into space and (2) sequestering and storing carbon so that it will not reenter the atmosphere (e.g., Brahic 2009). These two approaches are among a group of mind-boggling concepts now being referred to as “Hail Mary” technology. [The term “Hail Mary” was first used in [American football](#) to describe a [forward pass](#) that is made in desperation and that has only a small chance of success.] Humankind is now giving serious consideration to “Hail Mary” technologies that have not been adequately researched to address one component of a much larger problem (e.g., increase in global mean temperature).

You Cannot Do Just One Thing

Humans are not superior to the biosphere – they are a part of the biosphere. However, humans are acting as if they are apart from the biosphere. The biospheric life support system (also called *Gaia* by James Lovelock) has maintained conditions favorable to the genus *Homo* for approximately 2 million years and the species *Homo sapiens* for 160,000-200,000 years. The biospheric life support system is a highly interactive, dynamic system that has evolved over the last 3½ billion years. Therefore, actions have many interrelated consequences – no one activity can be completed in isolation from the effects on other components of the biosphere.

For example, other “Hail Mary” suggestions include using aerosol particles to reflect solar radiation into space or spraying seawater mist from ships toward low-lying clouds to make them brighter so they would reflect more sunlight away from Earth (Tierney 2009). The intent of both approaches is to reduce global heating. However, all these technologies must be considered in the context of what else they would do besides possibly lowering global mean temperature. How many side effects will be identified before the technologies are used on a large scale? Politicians have indicated that global mean temperature should not rise more than 2°C. Since politicians have been reluctant to restrict anthropogenic greenhouse gas emissions, they may be tempted to use one of the “Hail Mary” technologies in a few years.

Global-Scale Experiments

Engineering global climate will be the largest experiment carried out by humankind. How will quality control be carried out on experiments that could have unintended global consequences? In fact, Turney (2008, p. 29) notes: “A recent paper suggests that the odds are only in our favour of keeping below 2°C – with an estimated risk of 28% – if the equivalent level [Greenhouse gases have different heat trapping abilities – it is useful to refer to them collectively as carbon dioxide equivalents.] is kept to 400 ppm; a value of 550 ppm has a 68 to 99% chance of breaching 2°C. It’s not very heartening when we add together the heating capability of today’s greenhouse gases and find we’re at around 460 ppm. We’re already beyond a safe level.” Furthermore, no global agreement has been reached on reducing greenhouse gas emissions. Every year that passes without a substantive reduction in anthropogenic greenhouse gas emissions increases the probability that a desperate situation will arise that will persuade politicians to use a “Hail Mary” technology. Without an agreement on either the rate or extent of anthropogenic greenhouse gas emission reduction, the crisis could occur at any time.

Hegerl and Solomon (2009) state: “Observations indicate that attempts to limit climate warming by reducing incoming shortwave radiation risk major precipitation changes.” The contrast with the promoters of climate change engineering is stark. They are primarily focused on climate engineering as a commercial, for profit, project, and their information is not primarily published in peer-reviewed, scientific journals. I am not

against for profit solutions to environmental crises. What is of concern is both the tunnel vision focus on what the climate engineering will do and the failure to document what else it will do. One Hegerl and Solomon (2009) publication is a perfect example – the “Hail Mary” technology might be effective in reducing global temperature but might not the changed rainfall patterns affect agricultural productivity and wildlife? Even though Hegerl and Solomon (2009) analyzed rainfall patterns, any “unexpected” events should also be the responsibility of the climate engineers (i.e., people and organizations that benefit financially should bear the costs of unexpected [i.e., not studied enough] outcomes). Such a situation could occur in the freshwater of Asia if climate engineering reduced rainfall, which would affect production of food (BBC News 2009). Other problems could occur as well. Should the climate engineers bear the fiscal and ethical responsibility?

“One would think that by now most people would have figured out that climate change represents a grave threat to the planet. One would also have expected from Congress a plausible strategy for reducing the greenhouse gas emissions that lie at the root of the problem” (Editorial 2009). However, climate engineering that produces unexpected climate change would also be a threat to national security (Editorial 2009). Shouldn't this possibility be considered before a climate engineering project is approved? What government agency/agencies should be assigned the responsibility for authorizing and monitoring climate engineering projects?

Role of Scientists

Scientists working for the Intergovernmental Panel on Climate Change (IPCC) have worked for a decade on examining and analyzing an enormous amount of data. Other research investigators, including James Hansen and Susan Solomon, have also carried out research on climate data. The preponderance of scientific evidence and the majority of qualified scientists agree that humans are a major cause of global heating. However, the political system has not made much use of this scientific information. Some members of the US Congress even vigorously denounce global heating science (e.g., Senator Inhofe and Congressman Barton). In addition, substantial lobbying occurs against global climate change science. National Academies of Science or their equivalents in other nations agree that anthropogenic greenhouse gases are a major factor in global heating. However, the news media treat the issue as if an equal number of scientists support each side. The media refer to this situation as balanced coverage, but the impression is that a major disagreement exists within the scientific community on global heating and other aspects of climate change – this situation is far from true.

This skewed representation is understandably upsetting for many scientists who serve on climate change committees without compensation. All have a variety of other responsibilities, such as teaching, advising, supervising or serving on graduate committees, writing grant proposals, serving on various academic committees, carrying out their personal research, and so on. Naturally, they are upset to find their scholarly contributions denounced in the news media by politicians. However, the most discouraging aspect must surely be having their publications, which have been accepted, even applauded, by the scientific community, denounced by politicians and ridiculed in the news media. The time they spend, as a public service, on global climate change could have been spent on students, family, or some civic activity.

Should Industrial Civilization Be Saved?

A recent debate between Paul Kingsnorth and George Monbiot (2009) puts the climate engineering question in perspective. Portions of a letter from Kingsnorth to Monbiot state:

Yet very few of us are prepared to look honestly at the message this reality is screaming at us: that the civilisation we are a part of is hitting the buffers at full speed, and it is too late to stop it. Instead, most of us – and I include in the generalisation much of the mainstream environmental movement – are still wedded to a vision of the future as an upgraded version of the present. We still believe in 'progress', as lazily defined by Western liberalism. We still believe that we will be able to continue living more or less the same comfortable lives (albeit with more windfarms and better lightbulbs) if we can only embrace 'sustainable development' rapidly enough; and that we can then extend it to the extra three billion people who will shortly be joining us on this already-gasping planet.

A portion of Monbiot's response reads:

But the interesting question, and the one that probably divides us, is this: to what extent should we welcome the likely collapse of industrial civilisation? Or more precisely: to what extent do we believe that some good may come of it? I detect in your writings, and in the conversations we have had, an attraction towards – almost a yearning for – this apocalypse, a sense that you see it as a cleansing fire that will rid the world of a diseased society. If this is your view, I do not share it.

I strongly recommend reading the entire exchange (Monbiot 2009).

My Personal Perspective

I have children and grandchildren and have chaired 74 graduate committees and served on many others. I am sad and dismayed at what we have left for posterity. Still, humankind had over 200 years to use its intelligence more effectively and has failed to do. I concur with Kingsnorth that his message had to be said. I also fear that Monbiot (2009) was prophetic when he stated: "However hard we fall, we will recover sufficiently to land another hammer blow on the biosphere." I agree that the human population is well beyond Earth's carrying capacity for it. The total biocapacity of Earth is 5.1 acres/person, and the total ecological footprint is 6.7 acres/person. This measurement results in an ecological deficit of -1.6 acres/person or a percent overshoot of 31% (2005 data from World Population Balance at www.WorldPopulationBalance.org). Earth is a finite planet with approximately 33.6 billion acres of biologically productive land and water. Whatever our emotions, millions, possibly billions, will suffer, even die.

Brown (2009) remarks: "The throwaway economy is on a collision course with the earth's geological limits. Aside from running out of landfills near cities, the world is also fast running out of the cheap oil that is used to manufacture and transport throwaway products. Perhaps more fundamentally, there is not enough readily accessible lead, tin, copper, iron ore, or bauxite to sustain the throwaway economy more than another generation or two." Of course, such actions are very damaging to the biosphere. Earth is losing species very rapidly due to a multiplicity of causes, including habitat fragmentation and loss. These species collectively constitute the biospheric life support system that maintains conditions on Earth that favor humans. In short, more than one crisis is brewing (e.g., Prugh 2009), and, if nothing is done now, humankind may well face multiple crises simultaneously and be greatly tempted to use a "Hail Mary" climate engineering technology.

Conclusions

If humankind does nothing effective to address the multiple, interactive problems, which may soon pass various tipping points that will place various complex systems into instability, the situation will probably be beyond its control. Humans have been addicted to the conviction that a technological solution is available for every problem despite the fact that technology has actually caused, directly or indirectly, the problems. Wiser use of technology is essential, especially if it accompanies major changes in human behavior and lifestyle.

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Ecological Overshoot is Suicidal*

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Tuesday, October 10, 2006, was ecological deficit day – the day humankind began living beyond its means (i.e., ecological overshoot) and creating a deficit for that year. Humanity's first ecological deficit day was December 19, 1987 (www.footprintnetwork.org/gfn_sub.php?). In 2008, the day was September 22. In 2009, ecological deficit day will occur sometime in September (www.footprintnetwork.org). The trend is shocking, but it is almost unknown to the general public and its political representatives. Each year since 1987, humankind has used more resources than the biosphere can regenerate (ecological overshoot).

A good metaphor for the concept of ecological overshoot is a bank account – living off the interest means not using any of the capital. However, living beyond one's means results in using some of the capital to do so. Each year that some of the capital is used will diminish the capital and reduce the interest. The part of the biosphere that generates "interest" (i.e., ecosystem services) is termed *natural capital*, and if it is used, then ecosystem services (i.e., production of resources, maintaining the atmospheric gas balance) are reduced.

At the same time that ecological overshoot is occurring, Earth is adding 215,000 new consumers daily (births minus deaths). If humankind cannot keep its population within Earth's carrying capacity, Mother Nature (natural law) will do so with her usual methods of starvation, disease, and death.

At present, humankind is far from achieving sustainable use of the planet and moving further from that goal daily. Since global climate change has an adverse effect on agricultural production, one immediate remedial step is for both individuals and nations to reduce emissions of anthropogenic greenhouse gas. Individuals can reduce their carbon footprints and eliminate rampant consumerism, which is an important factor in ecological overshoot.

Barnosky (2009, p. 22) notes that the average species of mammal has a life span (as a species) of between 1.7 and 2.5 million years. *Homo sapiens* has inhabited Earth for only 160,000-200,000 years. Humans need to "shape up" if they intend to match or beat the average mammal.

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The End of Abundance: Will It Bring Resource Wars or Sharing?*

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When industrial civilization began, the global human population was small and widely scattered. Forests and other natural resources were abundant and relatively easy to obtain. Naturally, humans used the resources that were most easily acquired. In some places, petroleum was readily accessible on the surface (e.g., Pennsylvania, USA). However, limitations on resources are increasing at present – humankind is simply running out of everything at a dangerous rate (Grantham 2009). For example, the largest oil discovery in the Gulf of Mexico for the last 20 years will keep automobile engines running for a mere 41 days; 30 tons of ore once produced a ton of copper – now 500 tons of ore are needed (Grantham 2009). Common commodities such as water (1,000 tons are needed to produce 1 ton of corn) are necessary for a variety of activities and are becoming increasingly scarce.

Friedman (2009) states the problem succinctly: "We're trying to deal with a whole array of integrated problems – climate change, energy, biodiversity loss, poverty alleviation and the need to grow enough food to feed the planet separately. The poverty fighters resent the climate-change folks; climate folks hold summits without reference to biodiversity; the food advocates resist the biodiversity protectors." Humankind persists in attempting to address the crises individually, but this approach is not working. The biosphere (nature) is a seamless, interactive system and must be viewed from a holistic perspective. The recent attempt of the US Congress to produce an effective climate change bill is a perfect example of this battle between holism and special interests. Civilization as presently known will probably not survive a 3°C global temperature increase. However, attempts to limit anthropogenic greenhouse gas emissions are met with fierce resistance by special interest lobbyists. Even an increase of less than 2°C has had adverse effects on food production in nations widely separated geographically – Argentina, Australia, and Kenya.

Some biologists (Palmer and Pringle 2009) disagree with the idea that integration of solutions is the answer to all problems: "You can't integrate a bull with a china shop. In the 1960s and 70s, environmentalists learned what politicians have always known: people hate being told that they can't always get what they want." This statement is true, but at times when individuals can see for themselves the situation and the objective, they can approve a stalwart procedure – for example, Prime Minister Winston Churchill told his nation that it could only look forward to blood, toil, tears, and sweat (Cairns 2009) in his famous speech at the outset of World War II. The present crises need a respected leader who is unafraid of the truth – no small task, and one that will be shunned by most politicians. Humankind needs courageous leaders who are aware that the cornucopian era is over. "Plenty" disappeared with the decrease in cheap, abundant gas, excess food, and the belief in "more" always being available.

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Let's Talk About the Elephant in the Living Room*

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It is harder to conceal ignorance than to acquire knowledge.

Arnold Glasgow

Overpopulation is the "elephant in the living room" – everyone sees it but no one wants to talk about it. Exponential growth on a finite planet is neither sustainable nor desirable; however, even though sustainability is the "buzz word" de jour, humankind worships growth. Most politicians would rather walk through a mine field in their bare feet than discuss population control with their constituents. One reason for their fear may be that perpetual economic growth is often linked to perpetual population growth – more consumers = more economic growth. However, the reluctance to discuss overpopulation must be more than just fear of alienating people. For example, in the United States, a several-year, heated debate ensued on immigration, but overpopulation was rarely, if ever, mentioned. Abortion clinics have been bombed and physicians who performed abortions have been shot and killed, so passions run high. A civil, objective debate must be held on a global scale NOW.

In 1950, approximately 2.5 billion people inhabited Earth; in 2009, the population is nearly 7 billion. This exponential growth simply cannot continue on a finite planet. Barnosky (2009, p. 9) remarks:

By the time babies born today are in their fifties, even the best-case scenario predicts that more greenhouse gases will be in the air than has been the case in three million years – if we go on our merry way without any mitigation efforts. In just the years since 1950, we have approximately doubled the amount of greenhouse gases in our atmosphere. That was on top of the doubling that had already taken place between the start of the industrial revolution, say around 1700, and 1950.

However, species in ancient time frames often experienced a comparatively slowly changing environment that allowed more opportunity for relocation and/or adaptation. At present, a hot Earth is probably here for a long time, especially if human population expansion continues. The sad aspect of the situation is that humankind flourished with the Earth it had, but humankind is probably changing much of the planet irreversibly.

Earth's human population has more than doubled in my 86 years of life. Some projections place population size at 15 billion by 2100. With nearly half the present population starving or malnourished; lacking potable water; and needing better medical care, housing, and educational facilities, the 2100 estimate is probably not plausible. A major consideration is that, every time the population doubles, then food supplies, housing, school systems, medical systems, police forces, sewage treatment plants, and energy supplies must also be doubled to maintain at least the status quo after the last doubling. Of course, humans should use less polluting energy, but even this approach is beside the point – the point is that the human population simply cannot double within one human lifetime even one more time.

Earth's resources are already being used far faster than they can be regenerated. The population must be stabilized within Earth's long-term carrying capacity as rapidly and humanely as possible. To do less will condemn posterity to a life of squalor and misery.

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How Much Space on Earth Should be Allocated to the Biospheric Life Support System?*

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I believe wolves need to be eliminated.

Rex Rammell, Republican Candidate for Governor of Idaho
(as quoted in Egan 2009)

Since *Homo sapiens* appeared on Earth approximately 160,000 years ago, the species has gradually encroached on the space and resources that were originally the domain of the biospheric life support system. Only a few spaces are left on Earth that are not significantly affected by humans in some way. Despite persistent stories of a mutualistic relationship of humans and natural systems, humankind has always been a rogue genus. For example, humans were responsible for the extinctions of the late Pleistocene megafauna, even though humans had only primitive weapons and tools. When humans acquired fossil fuel energy and developed better tools and technology, they became a global geophysical force now termed the Anthropocene, which began about 1800. Evidence is widespread of the vast damage done to the biospheric life support system (Steffen et al. 2007).

Humans Are Still Taking Space from Wild Creatures

Most people have never heard of the biospheric life support system, although their lives depend upon it. Many of the "wild" places on Earth are now markedly different than they once were. Block (2009) laments the encroachment of humans into coyote territory:

A neighbor, fed up and sleep deprived, appeared one night at our front door with a lantern and a shotgun, asking my dad to hold the light while he fired. My dad – an urban Jew of Eastern European descent – knew a thing or two about displacement and assured the man that the coyotes, starved of their resources and their freedoms, would soon leave on their own. June proved my dad right; the howling finally ceased. The city, confident that the residents and Shih Tzus of Glenhollow Estates had nothing to fear, built a concrete walking path that wound along the creek.

The wild creatures had lost their space. Wild places are ever diminishing ecosystems that are usually quite isolated from each other. Diminishing them further by building shopping malls, "big box" stores, and housing developments is suicidal.

The Oceanic Biospheric Component

The oceans occupy about 70% of Earth's surface and are a key component of the biosphere. No robust information has been gathered on the relative activity of the land and the ocean components of the biosphere, but the oceans have been a major sink for carbon dioxide and are now less so. This situation alone justifies serious concern. At present, another major issue needs attention – a huge mass of waste plastic is floating in the North Pacific between Hawaii and Japan. This garbage patch is estimated to contain 100 million tons of plastic debris and is twice the size of the US state of Texas. The physical damage to marine creatures is already known and serious, e.g., turtles and seals have been trapped in pieces of plastic. However, a possibly more serious danger has become known – the plastic breaks down more rapidly than expected and releases contaminants (Editorial 2009). More evidence is needed to document these risks fully, but adding to the oceanic contaminant load is not prudent.

Two Possible Scenarios

Scenario #1 – (1) Humankind pushes the present biospheric life support system beyond its tipping point, (2) it loses more biodiversity, (3) goes into disequilibrium, and (4) the surviving species build a new biospheric life support system.

The new biospheric life support system will not likely produce conditions as favorable to humans as the present system. Consequently, the population will diminish to fit the carrying capacity for humans (if any) of the new system. Once a tipping point is passed, the situation is irreversible. Unfortunately, the tipping point is not known until it has been crossed. Species are becoming extinct, possibly at 1,000 times the normal rate, but the human population is still growing exponentially; resources per capita are markedly diminished; the era of cheap oil is over; and climate change is having adverse effects on agricultural productivity.

Scenario #2 – (1) Humankind systematically returns space to wildlife – not space for which humans have no use but space suitable for wildlife and (2) nurtures the biospheric life support system as its highest priority.

Economic growth has badly damaged the biospheric life support system, so economic growth in its present form is a threat to the integrity of the biospheric life support system. Nothing should be discharged into the atmosphere that is beyond Earth's assimilative capacity – a good start would be the marked reduction of carbon dioxide and other greenhouse gases emissions and, next, chemical substances that are endocrine disruptors. Even at present, Earth's assimilative capacity for these discharges may be zero. The human population must be reduced to fit Earth's carrying capacity. Ecological overshoots (deficits) must cease now.

These changes require an unprecedented adjustment in human behavior. "Business as usual" is no longer possible if the biospheric life support system is to be maintained in its present form. The already lost species cannot be replaced, but species that remain could be given a change to achieve optimal function. To assume that a replacement biospheric life support system, if one develops, would provide equally suitable conditions for humans is delusional! The only choice is preserving the present biospheric life support system.

Conclusions

The general public and its political representatives have not grasped the unique nature of tipping points. Reaching a tipping point is basically incremental – take more on a regular basis, and, if nothing happens, take even more. A good metaphor for a tipping point is walking toward a cliff on a pitch black night without a flashlight – take a tentative step forward and nothing happens – take another step and nothing happens – the third step is the catastrophic step off the cliff. The point at which the biospheric life support system will go into equilibrium is unknown. However, it will eventually collapse, and, over evolutionary time, a different biospheric life support system will be produced. This different system may support life, but probably not the life forms with which humankind currently shares the planet.

A prudent course of action would be to nurture the present system in hopes of its continuing to nurture humankind. Human nurturing should include allocating more space for the biospheric life support system over the entire planet. Eliminating toxic stressors and ecological overshoot is also a prudent step. Life support for humankind should be the primary goal of human society – not using natural systems to fuel economic growth.

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THE INTELLECTUAL ELECTRIC FENCE¹

¹Reprinted from: *Environmental Literacy and Beyond*, President's Symposium, Vol. V. B. Wallace, J. Cairns, Jr., and P. A. Distler, ed. Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1993, pp. 57-60

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The world is increasingly a place of interactions. The world's major problems of population, environmental pollution, ecological destruction, ozone holes, acid rain, hazardous materials that must be stored for thousands of years while they decay, short-falls in water quantity and quality, global loss of agricultural soils, and biotic impoverishment (just a few examples) transcend the capabilities of one discipline. The present structure of the educational system is toward depth in a particular discipline rather than in breadth in a variety of disciplines as one ascends the educational ladder from secondary school to a B.S., M. S., and finally to the Ph.D. Reductionist science is the norm and integrative science is the exception, although less so than it was a decade or two ago.

This separation is regrettable because almost every activity of human society (except perhaps such passive activities as meditation) has an environmental impact. The per capita energy use in developed countries, as well as use of other natural resources, is markedly higher than it is in developing countries. On the other hand, rate of population increase is at unprecedented levels in many of the developing countries and appears unlikely to stabilize as a consequence of societal efforts until well into the next century, if then. There is always the possibility of large-scale human deaths due to disease, malnutrition, hazardous water supplies, etc. The Union of Concerned Scientists (Cambridge, Ma., 1992) issued a "World Scientists Warning to Humanity" indicating that the present rates of population increase and environmental destruction cannot continue without severe impact on human society. The fact that this was signed by over 100 Nobel laureates and over 1,600 members of the U.S. National Academy of Sciences and its counterparts in other countries indicates that mainstream science believes there is substantive evidence to support this view. Additionally, the officers of the Royal Society of London and the U.S. National Academy of Sciences (1992) released a report with essentially the same view.

Why, with all the environmental crises in the world requiring the interaction of two or more disciplines, has interaction and integration not occurred in the educational system and in the larger world more frequently than it has? The root cause is the intellectual electric fence which each discipline uses to prevent defection from the discipline and to repel invasion from other disciplinary tribes. From the moment a student enrolls in an institution of higher learning, there are "jolts" to keep her/him within the tribal boundaries of the chosen discipline.

The most powerful of these deterrents are the prerequisite courses, without which a B.S. or B.A. is unattainable. These are so numerous and so carefully structured that it is virtually impossible for a student to develop substantive literacy in any other professional field, except on labeled "the minor." If a student strays too far outside the disciplinary boundaries, mild to severe penalties occur. The worst of these is not having the necessary prerequisites for graduation, which is a penalty in both money and time because it may require an extra semester or even an entire academic year to fulfill the needed requirements. Not only are money and time lost, but this delay might raise questions about the student's sincere interest in a particular discipline when he/she applies for graduate school in the same discipline or for a position in that discipline.

In graduate school, the penalties for straying outside disciplinary boundaries are continued by requiring additional courses, most with a strong disciplinary orientation. Graduate students share offices with other students in the same discipline and may not be encouraged to attend seminars in other disciplines that are attended by students and faculty from a variety of disciplines. Finally, preliminary examinations and final examinations for the Ph.D. are committee examinations of the candidate by tribal "elders" (i.e., staunch disciplinarians) who decide whether a candidate qualifies to be an apprentice elder.

A number of barriers or intellectual electric fences are designed to reinforce disciplinary purity and to avoid or reduce substantive relationships with other disciplines. A powerful barrier is a series of tribal languages (which the uncharitable might call disciplinary jargon) not intelligible to the uninitiated. The jargon does serve a useful purpose within the discipline to convey much information in a few words if a large, common-knowledge

base is shared by all members. It does inhibit exchange with disciplinary tribes that do not share the common-knowledge base and, therefore, are mystified by the jargon. Implementers of disciplinary language “purity” are the editors of, and the reviewers for, tribal journals who exclude publication of research that does not emphasize the disciplinary language. Manuscripts intelligible to a wide variety of disciplines are generally designated as “shallow” and as “lacking knowledge of the field.” Since professional status is usually determined within a discipline, failure to conform to these requirements can have serious, sometimes fatal effects on professional careers.

Tribal languages and the journals that reinforce them are by no means the only isolating mechanisms with which the intellectual fence is charged! Disciplines on a university campus have a patchy distribution, each discipline occupying a particular spatial patch. On those rare occasions when space shortages or other problems prevent a high degree of geographic integrity for a particular discipline, the least senior members or the departmental outcasts are housed in areas predominately occupied by another discipline. The graduate students and faculty are encouraged to gather for reinforcing rituals, such as departmental seminars and the like. Seminars given by world-class outside speakers are poorly attended at some institutions because the faculty feel the seminar is not on a topic “in my field,” which translates into “not my specialty.” This is particularly incongruous when uttered by people with a Doctor of Philosophy degree.

Another important segregation occurs at the major annual meeting of a particular discipline, either nationally or internationally. This is the intellectual equivalent to the aggregation of some species at a particular breeding ground each year where the attributes of the species that will be dominant in the population are determined. This intellectual isolation is, in some important aspects, analogous to genetic isolation where outbreeding is discouraged. Thus, a species that is actually capable of successfully mating with another species does not do so for behavioral rather than genetic reasons.

Practically everyone in academe needs money in order to foster intellectual renewal through research. In the past, most of the gatekeepers (i.e., people who decide who will be funded and who will not) were selected by discipline and represented a relatively homogeneous group in the sense that, while they might not have the same areas of specialization, they were all within a discipline or subdiscipline. The gatekeepers have the power to exclude applicants by denying access to funding – the surest way to impair a professional career. Without funding, a researcher cannot have postdoctoral fellows, graduate students on research assistantships, technicians or other assistants, substantive computer time, major travel funding for meetings, or even the money to pay for page charges for publications and to buy reprints to honor requests from colleagues. Those so afflicted are less able to exchange ideas with colleagues at other institutions, either personally at professional meetings or through exchange of reprints.

Ironically, however, extramural funding is becoming one of the major factors facilitating interdisciplinary activities. Comprehensive research universities are sensitive to shifts in funding priorities and sources of funding. Without extramural funding, their research programs would be a pale shadow of their present activity level, the graduate programs would be severely attenuated, their faculty would cease to win the accolades and honors that have a major effect on university ranking, and last, but far from least, a major source of income through overhead would be lost. Furthermore, since major problems that transcend the capabilities of a single discipline routinely generate major funding far in excess of the typical grant for a “lone wolf” investigator, these shifts in funding have not gone unnoticed by comprehensive universities dependent upon extramural funding. In a real sense, faculty research fitness requires skill in foraging for resources, and this influence upon individual professional survival, strongly coupled with institutional academic stature, has seriously weakened the intellectual electric fences that were so successfully maintained by the disciplines for many decades.

I hasten to add the caveat that the barriers to interdisciplinary interactions are not entirely bad. For example, quality control is much easier when the attributes of the “product” are crisply identified. A comparable robust quality control system for interdisciplinary activities has yet to emerge, although professional organizations, such as the Society for Environmental Professionals, have a certifying process that exercises quality control at a society level, but only for those who voluntarily apply for certification. Additionally, the basic quality control process should be at the degree-granting institutions. An additional caveat is that reductionism and specialization within a discipline will continue to be as essential in the academic system as it has in the past. However, maintaining disciplinary integrity should no longer be permitted to impede interactions among the disciplines or exercise penalties on those individuals who choose to study problems that transcend the capabilities of a single discipline.

The thrust toward interdisciplinary activities is now too well underway to be stopped. In the last 15 years, numbers of interdisciplinary journals have appeared on the international scene, such as *Environmental Toxicology and Chemistry* (combining environmental toxicology and environmental fate of chemicals), *Ecotoxicology* (combining ecology and environmental toxicology), *Ecological Economics*, and *Integrated*

Management. Research investigators, frustrated by the fact that their interdisciplinary research is not a “good fit” with the disciplinary orientation of most journals and the fact that the reviewers are more suited to comment on the quality of a manuscript in only one area, have finally found that it takes less energy to launch a new journal more suited to their needs than to fight the established system. Thus, the intellectual electric fence has been weakened further by the inability of the classical journals to deny publication of manuscripts that lack disciplinary purity. Again, the quality control system for interdisciplinary activities is far from perfect, and some journal space must be expended because the readers do not share the same information base to the extent that they do in a specialized or strongly disciplinary journal. However, this is a transient problem since the number of persons working in the interfaces between and among the disciplines is increasing markedly.

The most serious weakening of the intellectual electric fence will probably result from the events discussed in the Virginia Tech President’s Symposium on Environmental Literacy. The environmental literacy movement is an inevitable result of the information age. For policy- and decision-makers, information is of greatest value if it can be integrated with a variety of other information to make policy and decisions about complex, multivariate systems. Almost every major global problem, and practically all regional and national problems, comfortably fit within this category. Because we are in a global market and because society depends on both an ecological and a technological life support system, environmental literacy (or knowing something about how the natural world works) is of importance to all disciplines. It is interesting that the impetus for this appears to have come primarily from outside the academic system because of the need of corporations active in the international marketplace to have management employees who can make decisions based on information from more than one discipline. Therefore, students in economics must understand ecological restoration, and those in biology must understand economics. Natural resource managers must understand both the benefits and limitations of waste treatment technology; engineers must understand the nature of the receiving systems (i.e., natural systems) into which their wastes are discharged. Additionally, the political and cultural aspects of all decisions must be given serious consideration. These are but a few of the illustrative examples of the wide array of information that is routinely involved in landscape level natural resource planning and management.

However, students cannot become environmentally literate if the faculty is not. Therefore, along with all the other changes occurring in teaching methods, course structure, student preparation, and the like, faculty members must become environmentally literate in the context of their basic disciplines. Although environmental literacy appears to focus on the environment, in fact, its primary focus is interdisciplinary; and, if carried out properly, it will not focus entirely on environmental matters but rather on a suite of information of which the environment is one component. If this movement is successful, even though it may be altered considerably by feedback loops that modify the original plan, it may be the single most important factor weakening the intellectual electric fence. After all, today’s students are tomorrow’s gatekeepers and are the ones who will decide how potent the barriers to interdisciplinary activities should be and, more importantly, what the new boundaries should be.

As a person who has repeatedly ventured beyond the boundaries of my original discipline of biology, I welcome this expansion of intellectual horizons. At the same time, I am apprehensive that the intellectual quality control system, which was and is one of the major contributions of a disciplinary orientation, does not yet have a counterpart in the rapidly developing interdisciplinary system. This is probably an unwarranted fear because, if the will to develop a robust quality control system exists, it should not be any more difficult for it to develop.

It is worth remembering that, in the early days of science, it was not uncommon for astronomers, biologists, geologists, chemists, and a variety of other disciplines, including those in the humanities, to exchange ideas on a common ground such as the British eating clubs. The enormous increase in both numbers of professionals in the various categories and a concomitant increase in amount of information and literature weakened the interactions among the disciplines that was once taken for granted by scholars. We should, therefore, remember that we are not abandoning the disciplines in re-establishing the interactions among and between them, but rather returning to an earlier mode of information exchange that pre-dates the intellectual electric fence.

Adapting to the New Biosphere*

*This posting is a simultaneous submission for "Climate Change and You: Putting a Face on Global Warming," EcoRes Forum Online E-Conference #3, October 19-29, 2009. Further information available at www.eco-res.org.

Business as usual is dead – green growth is the answer to both our climate and economic problems.

Anders Fogh Rasmussen
Danish Prime Minister

Speculation about the future is essential in this era of rapid environmental change lest human society gets caught by unexpected events. Species are being lost at a rate unprecedented in human history. Rainfall patterns are changing, and habitats, such as forests, are still being lost. All too frequently, surprising shocks occur, such as the unexpected decomposition of plastics in the oceans and the probable release of toxics.

Surviving Species

The surviving species of the present great extinction will be dominated by ones least affected by human activities and technologies. If "business as usual" continues, the further loss of species can be expected. From those remaining, a new array of species will evolve, if the past five great extinctions are a reliable guide. If politicians are unable to adopt legislation to reduce anthropogenic greenhouse gas emissions sufficiently to arrest climate change, the temptation will emerge for using "Hail Mary" climate engineering technologies to manage Earth's climate. These technologies may or may not do what they are designed to do and may also do things they are not designed to do. Another adaptive challenge for humankind for the new biosphere will be those organisms highly resistant to human control. Perhaps the lesson from this experience will be that humans have less control over nature than they once thought.

Energy Resources

The discovery of petroleum gave humans more individual power than any other species has ever had. However, now the era of cheap, abundant energy is ending. At one time, petroleum was near Earth's surface and easily acquired with a minimum of effort. At present, drilling for small pockets of oil that are miles below Earth's surface is not uncommon. Petroleum is very useful to agribusiness, which generally involves huge tracts of land. The price of oil is, at present, a major factor in the price of food and is likely to continue to be so for decades to come.

A major unknown is how well domesticated species will respond to climate change. Already climate change has affected wheat and meat production in places as widely separated as Australia and Argentina. Grapes previously grown in a Mediterranean climate are now being grown in southern England because of climate change. If global mean temperature continues to increase, the agricultural system can be moved ever closer to the poles if temperature is the only limiting factor. Rainfall patterns are also critically important – rain must fall when the crops need it. Quantity of water is also important – 1,000 tons of water is need to produce a ton of grain.

"A study, recently published online in Proceedings of the National Academy of Sciences, looked at three frequently used scenarios for global warming. It found the average U.S. yields for corn, soybeans and cotton could plummet 30 percent to 46 percent by the end of the century under the slowest warming scenario, and 63 percent to 82 percent under the quickest" (Price 2009). "David Walter Wolfe, a Cornell University expert on the effects of climate change on crops . . ." has stated: "They're no longer farming in a static environment . . . They can't rely on the calendar to tell them when to plant, they can't rely on the variety of seeds they have always used, and they can't rely on dealing with the same insect pests, because it's all a moving target now" (Price

2009). Humans might adapt to a slow warming scenario, but only if it ceased after a few decades. Adapting to changing conditions will never be easy. Failure to adapt could be fatal.

Rate of Climate Change

McGrath (2009) notes: “The worst-case scenarios on climate change envisioned by the UN two years ago are already being realised, say scientists at an international meeting. . . . More than 2,500 researchers and economists attended this meeting designed to update the world on the state of climate research ahead of key political negotiations set for December this year [in Copenhagen, Denmark].” Although most of the tools needed to reduce anthropogenic carbon dioxide emissions are available, they are not being widely used and probably will not be until politicians take global climate change seriously. Some political leaders are acting on scientific evidence – for example, “Japan’s next leader [Yukio Hatoyama] has promised a big cut in greenhouse gas emissions, saying he will aim for a 25% reduction by 2020 compared with 1990 levels” (Black 2009).

Conclusions

Two volumes – Mark Lynas’ *Six Degrees: Our Future on a Hotter Planet* (2008) and Chris Turney’s *Ice, Mud, and Blood* (2008) – are useful reading on the problems of adapting to a hotter planet. Lynas used the Intergovernmental Panel on Climate Change reports as a basis for the global mean temperature (in °C) increases and devotes a section of the book to each °C increase. A 2°C increase is not something to look forward to; above 2°C is the stuff that causes bad dreams. Turney spends quite a few pages in his book discussing the Paleocene–Eocene Thermal Maximum (PETM). This warming occurred about 55 million years ago and provides fascinating information on what Earth might be like if the global mean temperature increase is hovering about 3°C. Human society has not faced up to the hard facts that thousands of credentialed scientists have provided, and now is the time to act!

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Your Personal Responsibility for Earth*

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. . . the tender flower of objectivity is really crushed by what is taken to be the necessity of the moment.

Garrett Hardin

In the 20th and 21st centuries, Earth has been regarded as a supply of resources to promote perpetual economic growth. The thinking was that, if a resource were depleted, human ingenuity and creativity would soon find an acceptable substitute at a reasonable cost. The other species with which humans shared the planet were viewed as just components of the resource base. However, humankind recently has become aware that it is also just a component of the biospheric life support system that has maintained conditions favorable to the genus *Homo* for approximately 2 million years. Humankind is now beginning to realize that its activities (e.g., anthropogenic greenhouse gas emissions) have a major influence on global climate. In addition, if "business as usual" continues, it will soon accelerate the positive feedback loops that will put climate beyond human control. Eilperin (2009) states: "Human-generated greenhouse gas emissions have helped reverse a 2,000-year trend of cooling in the Arctic, prompting warmer average temperatures in the past decade that now rank higher than at any time since 1BC. . ." Only a few non-scientists seem disturbed by this situation. Perhaps individuals have lost the sense of a personal responsibility for the integrity of the biosphere. Some illustrative ways to correct this lack of responsibility follow.

(1) Develop a systems perspective

Hardin (1985) states: "The basic insight of the ecolate citizen is that the world is a complex of systems so intricately interconnected that we can seldom be very confident that a proposed intervention in this system of systems will produce the consequences we want." The US Congress has been working on legislation to avoid deleterious global climate change. However, rarely are members of Congress exposed to a perspective of how the global climate system works. Unfortunately, special interest groups (i.e., lobbyists) are most likely to be focused intently on one component of an extremely large, complex system. Members of Congress are then expected to integrate this fragmented information – an elusive goal since the debates generally focus on the fragments.

(2) Develop a high level of environmental/ecological literacy for integrating disparate bits of information

(3) Numeracy

The evidence of climate change studies consists of both numbers and the analysis of numbers. One must understand the enormous changes that can occur in both ecosystems and agricultural systems following a 1° to 2°C shift in the global mean temperature. Although Al Gore and the Intergovernmental Panel on Climate Change have accomplished much on climate literacy and numeracy, public debates and town meetings show how very far citizens and their representatives have to go.

(4) Become familiar with science as a process

"It's only a theory" is often stated, which implies that the premise is just a guess when, in fact, it is a carefully structured statement based on a body of evidence.

(5) Do not be fooled by the "balanced view" tactic

The US news media often imply that a major disagreement exists among scientists about a specific issue (e.g., the role of anthropogenic greenhouse gas emissions on global climate change). In actuality, scientists give most weight to the preponderance of evidence, but the news media usually give equal time to deniers and believers, even when deniers number only a few and believers number in the thousands. This situation gives the impression that scientists are confused even though the National Academy of Science, or its

equivalent in other nations, has stated for decades that anthropogenic greenhouse gas emissions have had a major influence on global mean temperatures for decades.

(6) Corporations and their lobbyists have set up a number of institutes with impressive names and staffed by people with impressive titles to advocate a variety of special interests. A number of very useful, objective organizations, such as the Earth Policy Institute, exist. Individuals must be environmentally literate enough to identify false or misleading information and become immune to its destructive influence. Hardin (1985) called environmental literacy the mental shields and “Filters Against Folly.” When individuals use fear rather than reason to persuade people and shout slogans to prevent discussion – beware! Hardin (1985, p. v) remarks: “Ecology’s most profound insights call for far-reaching modifications of long-standing social arrangements. It takes intellectual independence to achieve and voice such insights, as well as financial support to make the intellectual work possible.”

Conclusions

Financial globalization moved quite rapidly during the last part of the 20th century and the first part of the 21st century, but protection of the biospheric life support system has not. Individuals can do much to protect and nurture the biospheric life support system, as can sovereign nations through taking a leadership role. Even though this challenge is formidable, both individuals and sovereign nations must effectively address global climate and other system-level problems that will determine the future of humans and civilization.

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Conditions for Crew Membership¹ on Spaceship Earth²

¹"Crew membership" applies to the officers and captain – Spaceship Earth has no passengers.

²This posting is a simultaneous submission for "Climate Change and You: Putting a Face on Global Warming," EcoRes Forum Online E-Conference #3, October 19-29, 2009. Further information available at www.eco-res.org.

Freedom is the recognition of necessity.

Friedrich Engels

We travel together, passengers on a little spaceship, dependent on its vulnerable reserves of air and soil; all committed for our safety to its security and peace; preserved from annihilation only by the care, the work and I will say, the love we give our fragile craft.

Adlai Stevenson

Garrett Hardin's (1968) *Exploring New Ethics for Survival: The Voyage of the Spaceship Beagle* introduced the metaphor of Earth as a spaceship. (The ship that carried Charles Darwin to the Galapagos Islands was the HMS Beagle.) Although the metaphor did not receive the attention it deserved, perhaps because humankind retained the cornucopian mindset, the current global crises in 2009 make the spaceship metaphor even more appropriate than when it was first published. Humankind must be continually reminded that it is on a finite planet – Spaceship Earth. The conditions humans must accept or perish are all based on natural law, which has existed for at least 4 billion years. In contrast, human law, the late arrival, has existed for 200,000 years at the most. Some illustrative conditions follow.

(1) Spaceship Earth's carrying capacity must never be exceeded – doing so endangers the entire crew. The crew member who is responsible for allowing the additional person has endangered the present and the future and can only make amends by ceasing at once to occupy a space on the ship. Harsh – but reality is harsh.

(2) Ecological overshoot/ecological deficits provide evidence that humankind is using resources 40% more rapidly than Spaceship Earth can regenerate them. Even a large, traditional spaceship of television/movie fame would have crew members who know each other and would have a shared empathy. On Spaceship Earth, crew members have little in common with most other crew members and, thus, only a tiny sense of community. Crew members are unaware that globalization has increased the probability that all humans are likely to share a common fate. Also, politicians are unlikely to view all problems through the lens of sovereign nations. The "negotiations" on global climate change have shown this all too clearly.

The spaceship metaphor is cruel because it prohibits all the usual delusional and denial tactics used to avoid unpleasant decisions on Earth. "I don't want to hear about that" is a common avoidance tactic that would not be permissible on a spaceship. "Let me know when you have good news" is another tactic; however, crew members must be informed about all situations pertinent to the integrity of the spaceship. Ideologies of any kind (e.g., race, politics, economy) are counterproductive in the operation of a spacecraft. However, Earth is self-maintaining, and every condition for sustainable use is being violated. Only scale is a key factor in determining which conditions are acceptable and which are not.

(3) Resource Allocation

On a spaceship, resources are finite and can be viewed by the crew. On Spaceship Earth, resources are also finite, but so widely distributed as to be beyond the view of a single individual. In addition, many of Earth's resources can be regenerated by the biosphere. Regeneration of resources might be possible on a spaceship constructed by humans if it had a biologically based life support system.

Even with its importance, the metaphor of Spaceship Earth is flawed. Mother Nature (i.e., natural law) favors quantity from which she selects quality – a process called natural selection. A large number of

individuals are not suited (i.e., fit) for the habitat of a particular time and perish, although they may have been competitive at some time in the future. Evolution is “wasteful” because quality is selected from quantity. However, the process is “efficient” in selecting the fittest (i.e., most competitive) individuals for a particular habitat that existed at a particular time. The pivotal question is: should humans depend on Mother Nature to keep the human population within Earth’s carrying capacity with her usual methods of starvation, disease, and death? With approximately half the planet’s human populations starving, malnourished, and living in poor conditions, a tipping point is in the near future or has already been passed. Mother Nature’s way is very hard on individuals now living but more humane toward future generations.

Conclusions

The carrying capacity of a constructed spaceship can be estimated accurately and has been done successfully for limited space travel not far from Earth. However, all crew members of the constructed spaceship are volunteers who have met particular predetermined conditions deemed necessary for space travel. The crew of Spaceship Earth was born on the planet and has the broad range of fitness that one would expect in a population of nearly 7 billion. Controlling human population size is a subject most people avoid discussing. However, if no discussion takes place and exponential human population growth continues, Mother Nature will reduce population size until it is within Earth’s carrying capacity. Her methods will not be applauded by most humans. Nevertheless, humans will probably start talking and appointing investigative committees when the catastrophes worsen. Effective action is highly improbable. Doing nothing is always costly with global problems.

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The Midas Touch in the 21st Century*

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One day when King Midas was walking in his garden, he saw an elderly satyr asleep in the flowers. Taking pity on the old fellow, King Midas let him go without punishment. When the god Dionysus heard about it, he rewarded the king by granting him one wish. The king thought about it for a second and then said: "I wish for everything I touch to turn to gold." And so it was.

The beautiful flowers in his garden turned toward the sun for light, but when Midas approached and touched them, they stood rigid and gold. The king grew hungry and thin, for each time he tried to eat, he found that his meal had turned to gold. His lovely daughter, at his loving touch, turned hard and fast to gold. His water, his bed, his clothes, his friends, and eventually the whole palace was gold.

King Midas saw that soon his whole kingdom would turn to gold unless he did something right away. He asked Dionysus to turn everything back to the way it had been and take back his golden touch. Because the king was ashamed and very sad, Dionysus took pity on him and granted his request. Instantly, King Midas was poorer than he had been, but richer, he felt, in the things that really count.

(from <http://www.hipark.austin.isd.tenet.edu/mythology/midas.html>)

The 21st century equivalent of gold is economic growth – everything humans touch in the biosphere (i.e., natural systems) is degraded and all too soon ends up as trash or artifacts (e.g., shopping malls) that displace natural habitats and cause species impoverishment. Unfortunately, the mythical god Dionysus cannot return Earth to its previous ecological state. However, preserving the present biosphere may still be possible, but would require an immediate massive change in human practices (e.g., reduce human population size to fit Earth's carrying capacity).

Following each of the five great species extinctions on Earth, a new biosphere evolved. Such an event will probably occur after the sixth great extinction (which is now in progress). Of course, predicting what the new biosphere will be like is impossible, but the species composition of Earth changed after each of the five great extinctions and will presumably happen again. Adaptation to the rapidly changing conditions during the transition from one biosphere to another will not be easy for any species, including humans.

Careful examination of the problems of adapting during a transition period where rapid change is the norm and adapting to a quite different new biosphere might persuade humankind to nurture the present biosphere with the hope that it might be saved. Estimating how close the present biosphere is to a major tipping point is not possible. As a consequence, nurturing should begin at once, even though the effectiveness of this nurturing is uncertain. However, equal or greater uncertainty exists about humankind's ability to adapt to the conditions (e.g., atmosphere) produced by the new biosphere.

King Midas was fortunate in having his "golden touch" reversed by Dionysus, but humankind must reverse its "trashing touch" itself. Yes, humankind can!

Humankind's Faustian "Pact" with Fossil Fuels*

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A Faustian "pact" is a myth indigenous to parts of the world where a belief in the devil occurs. In the myth, the devil offers diabolical favors in exchange for an individual's soul. Although the pacts are usually made by individuals, societies apparently are not excluded.

When humankind discovered it could obtain large amounts of energy from fossil fuel, no oral or written pact was made between them and nature. Humans found they could have huge amounts of energy at their disposal (or a nation's disposal) merely by extracting fossil fuel and burning it. Individual humans had more energy per capita than any other species on the planet. Humankind knew what fossil fuel could do – provide energy for transportation, heating houses, and what appeared to be control and mastery of nature.

Humans became so addicted to the benefits of fossil energy that they failed to ask what else its use would do to the planet. Extraction and use of fossil fuel made possible the doubling of the human population within a single human life span (at least for developed countries). Cheap, abundant fuel made globalization possible. Ordinary people could travel over the planet at low cost, sometimes carrying diseases and agricultural pests with them. Raw materials could be shipped to China from all over the world and finished material goods could be shipped anywhere in the world.

However, burning fossil fuels produced greenhouse gases that changed the climate since coal produces much more carbon dioxide per unit of energy generated than either petroleum or natural gas. In addition, Heinberg (2009, p. 55) notes that coal consumption has been rising at a rate of up to 10% per year, which means a doubling of demand every seven years. This situation is high risk, even if non-carbon alternatives (e.g., solar and wind) were available, which they are not, in adequate quantity in the United States. Also needed is an updated, national, electric transmission line.

Heinberg (2009, p. 27) lists three conclusions concerning coal reserves.

- (1) *World proven reserves (i.e., the reserves that are economically recoverable at current economic and operating conditions) of coal are decreasing fast . . .*
- (2) *The bulk of coal production and export is getting concentrated within a few countries and market players, which creates the risk of market imperfections . . .*
- (3) *Coal production costs are steadily rising all over the world, due to the need to develop new fields, increasingly difficult geological conditions and additional infrastructure costs associated with the development of new fields.*

Brown (2009) reports:

The United States has entered a new energy era, ending a century of rising carbon emissions. As the U.S. delegation prepares for the international climate negotiations in Copenhagen in December, it does so from a surprisingly strong position, one based on a dramatic 9 percent drop in U. S. carbon emissions over the past two years and the promise of further huge reductions.

Before getting carried away by optimism, human society needs to remember that greenhouse gas emissions still exceed Earth's assimilative capacity for them. Even with the heartening present reductions, the emissions will continue to accumulate in the atmosphere.

Conclusions

Humankind is, figuratively, driving full speed (powered by gasoline, naturally) toward a brick wall (i.e., energy crisis) without a reduction in speed. A major part of the problem is that, as socialist Robert Brulle remarks: "At best, global warming remains an abstraction for many people" (as quoted in Revkin 2009).

Freedom has been won by the blood of citizens, but it is nurtured by a well informed citizenry. However, the "news" media (as in the United States), under pressure from advertisers and other special interest groups, has morphed from employing investigative reporters like Walter Cronkite to a medium for the propagation of misinformation. As a result, far too many citizens in the United States believe "clean coal" technology is available at present when it may never be economically or technologically feasible (e.g., Weld 2009). This unsubstantiated belief is how a society makes Faustian "pacts" that it will later regret.

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The 21st Century Fountain of Youth*

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The ability to delude yourself may be an important survival tool.

Jane Wagner

The Fountain of Youth is a myth based on legends that anyone who drinks its water will have a restoration of youth. Juan Ponce de Leon, Governor of Puerto Rico, searched for the Fountain in 1513 in Florida. Some other cultures have similar myths.

The 21st century counterpart of the idea of the Fountain of Youth is sustainable use of the planet (i.e., use for an indefinite period). If Earth's population were reduced and everyone had smaller ecological and carbon footprints as well as a lifestyle that nurtured the biospheric life support system, sustainable use of the planet should still be possible. However, more than a sustainability tee shirt, an efficient light bulb, or a bumper sticker on a Prius is needed to achieve sustainability.

Achieving sustainability will not be easy – as many people are discovering. Seeking eternal youth is also difficult – successive face lifts and other cosmetic procedures are both expensive and time consuming. Even with these modifications, nothing makes the inner body younger. Healthful living could help, but the lifestyle requires knowledge and focus. Even this approach will not bring eternal youth, but it may help achieve a longer and healthier life.

Sustainability can be achieved, but it will require nurturing the biospheric life support system, getting and keeping the human population within Earth's carrying capacity, eliminating ecological deficits/overshoot, reducing greenhouse gas emissions to match Earth's assimilative capacity for them, using no more natural resources than Earth can regenerate, and not treating other life forms as commodities. The changes constitute a tremendous challenge, but it is one that humankind can meet.

Sustainability is basically a gift (leaving a habitable planet) from older people to younger people now alive and to future generations. Older people should make a major shift to begin the effort to achieve sustainable use of the planet as an example to their children and grandchildren because of their love for them and as a final gift to them. Lifestyle would have to change in developed nations, who must also assist developing nations during the transition period, which will take the entire 21st century or more. Everyone must change, but an initial step by the older generation would energize the effort. Material goods, possessions, and energy per capita will decrease in developed countries, but, if the effort comes from the heart, social capital will increase. The possibility of a habitable planet for future generations will result in great joy.

Putting the Cart before the Horse*

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Cowardice asks the question, "Is it safe?" Expediency asks the question, "Is it politic?" Vanity asks the question, "Is it popular?" But conscience asks the question, "Is it right?" And there comes a time when one must take a position that is neither safe, nor politic, nor popular but one must take it because one's conscience tells one that it is right.

Martin Luther King

All the resources for economic growth originate in the biosphere (natural capital). Hawken et al. (1999) list four types of capital: (1) natural capital, on which the other types depend, (2) financial capital, (3) manufactured capital, (4) human capital. Why then, at the recent G20 meeting (Climate Change Summit in New York), attended by Chinese leader Hu Jintao and US President Barack Obama, was the upcoming December 2009 meeting on climate change sidelined (Corcoran 2009)? Andrews (2009) reports: ". . . leaders from both rich countries and fast-growing powerhouses like China agreed on Friday to a far-reaching effort to revamp the economic system." If economics is judged more important than the environment by world leaders, then the important relationship between economics and the environment will be ignored at any systems-level, global conference. However, the biosphere should be the key component in all global conferences – after all, it is the life support system! Not connecting all the dots can be fatal in any undertaking – especially one that is global!

The biosphere is already endangered by global climate change. However, Krugman (2009) states:

So the main argument against climate action probably won't be the claim that global warming is a myth. It will, instead, be the argument that doing anything to limit global warming would destroy the economy. As the blog Climate Progress puts it, opponents of climate change legislation "keep raising their estimated cost of the clean energy and global warming pollution reduction programs like some out of control auctioneer."

The claims of the deniers (of global climate change) appear to inhabit a different planet. How can they possibly believe that ignoring the damage to the biosphere will somehow protect them? Or, in the unlikely event that they could flee to another planet, would they, as destructive new arrivals, be welcomed? Krugman (2009) believes, as I do, that bogus claims of immense economic damage are as bogus, in their own way, as climate change denial.

The biosphere is not only the source of the resources that are the foundation of the human economy, but is also Earth's life support system. The biosphere cannot be excluded from discussions on human economy.

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21st Century Cassandras in an Era of Climate Change Denial*

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Cassandra was blessed with the gift of prophecy by Apollo. However, she shunned Apollo's romantic advances, and he added a twist to her gift. Cassandra was doomed to tell the truth, but never to be believed (Fitton 1998). Scientists are not prophets but do make statements and predications based on the preponderance of evidence.

Krugman (2009) comments on the present day situation: "These days, dire warnings aren't the delusional raving of cranks. They're what come out of the most widely respected climate models, devised by the leading researchers. The prognosis for the planet has gotten much, much worse in just the last few years. . . In a rational world, then, the looming climate disaster would be our dominant political and policy concern. But it manifestly isn't. Why not?"

Most individuals who carry out research on troublesome problems have been called a Cassandra. In much older times, the emperor, king, or chieftain had the bearer of bad news beheaded – but, the bad news did not disappear. Every academic institution has at least one Dr. Doom. Better yet, they are not beheaded or even injured. A common reaction to bad news is "Let me know when you have good news!" Obviously the best way to make good news is to do something about the bad news. "Why don't you scientists do something about global heating?" is becoming an increasingly common question.

Deniers of the global heating are encouraged to persist in their position by a constant barrage of misinformation, counter arguments, and, sometimes, falsehoods. The news media have not been helpful. All too often, the preponderance of evidence is on one side (plus data) and a handful of deniers (with questionable or no data) are on the other. However, the public gets the impression that no scientific consensus is possible and even that scientists are confused. Lawson (2009) comments on one writer who used religious arguments against Darwin's theory of evolution: "The validity of any scientific theory can only be established by scientific methods." The proper place to assess scientific theory is in peer-reviewed, scientific journals.

Of particular concern is that global warming is speeding up (Associated Press 2009), but public understanding of the problem is not keeping pace. Humankind did not even keep pace when things were moving much more slowly. Had it done so, one hopes that more effective, direct remedial action would have been initiated (e.g., marked reduction of anthropogenic greenhouse gas emissions).

If humankind wishes to keep Earth's climate hospitable, it would be wise to pay attention to the "Cassandras" who are using evidence.

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“The Gift of the Magi”: Slashing Living Standards*

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*Lord, make me an instrument of your peace,
where there is hatred, let me sow love;
where there is injury, pardon;
where there is despair, hope;
where there is doubt, faith;
where there is darkness, light;
where there is sadness, joy;*

*O Divine Master, grant that I may not so much seek to be consoled as to console;
to be understood as to understand;
to be loved as to love.*

*For it is in giving that we receive;
it is in pardoning that we are pardoned;
and it is in dying that we are born to eternal life.*

St. Francis of Assisi

Live simply that others may simply live.

Mahatma Gandhi

In the short story “The Gift of the Magi” by O. Henry, the characters of Jim and Della lived in poverty. Neither had much money for a present for the other as Christmas time approached. Della decided to sell her extremely beautiful, long hair (which Jim loved) for \$20 so she could buy a fob for Jim’s pride and joy – his grandfather’s gold pocket watch. Unknown to Della, Jim had decided to sell the watch so he could buy her combs for her beautiful, long hair. The irony of the situation touches the reader’s heart, but O. Henry remarks: “O all those who give and receive gifts, such as they are wisest. They are the magi.”

Humankind can give a great gift to its descendants and to all life on Earth by reducing anthropogenic greenhouse gas emissions and reducing the threat of runaway climate change. Webster (2009) quotes Professor Kevin Anderson, Director of the Tyndall Centre for Climate Change Research: “The wealthier parts of the world . . . will have to seriously consider reducing their levels of consumption over the next 10-15 years while we put in place low-carbon technologies.” This message is one that most politicians fear to give their constituents, especially if an election is in the near future. Many citizens are so strongly against government intervention that dissent and lack of civility will impede global negotiations on global heating. Most people do not understand that the wealthy countries have exported much of their manufacturing to third world countries, which accounts, in part, for the rapid rise in greenhouse gas emissions in developing countries. Per capita emissions also show a vast difference – “20 tonnes per person per year in the US and 10 tonnes in Britain but only 5 tonnes in China and less than 2 tonnes in India” (Webster 2009).

Ardipithecus ramidus (“Ardi”), a current fossil find, indicates that hominids have been around for over 4 million years (Hale 2009). The genus *Homo* has been around for about 2 million years and *Homo sapiens* (humans) has been around for 160,000-200,000 years. Except for the last 10,000 years, when the Agricultural Revolution occurred, hominids appear to have been tribal – certainly *Homo sapiens* was. At present, in less than 100 years, political globalization must occur rapidly to avoid catastrophic, runaway climate change. No

signs show that this change is happening, but *Homo sapiens* has been a remarkably adaptable species, so it is capable of achieving the needed changes.

Humankind must slash its living standards, yet retain compassion for each other and other life forms, in order to leave a habitable planet for posterity. The world's population is now 7 billion – lifestyles must change so that humans fit into the finite carrying capacity of Earth. Undertaking the challenge is this generation's "gift of the Magi" as expressed by O. Henry.

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Globalize or Perish*

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The issues of global climate change, overpopulation, ecological overshoot, species extinction, and resource depletion are interlocking and interactive. Failure to solve any one of them could mean the end of civilization as presently known. Greenhouse gas emissions must be reduced, which will require maximum participation by all nations.

Reducing overpopulation will benefit from individual action, but a call for such action has not reduced the population size to fit Earth's carrying capacity. Exponential population growth simply cannot continue on a finite planet.

Ecological overshoot is using more resources than Earth can regenerate. In 2009, Overshoot Day occurred in September. For the rest of this year, humankind will be depleting natural capital, which provides the ecosystem services upon which humankind depends for survival. Humankind's survival also depends upon the biosphere, which includes all Earth's species.

Five great extinctions have already occurred and have reduced the number of species to as low as 5% of the original total. However, life is resilient and eventually diversity was restored, although the biosphere did not resemble the predisturbance condition. Earth is now in the sixth great extinction. Clearly, remediation action is needed now!

All living species require resources, and all species are subject to limits to growth (i.e., carrying capacity). Usually one resource (e.g., water) is limiting.

While half the population of humans is living well, the other half is not. Starvation, malnutrition, disease, and death are the penalties. They are unattractive but are the inevitable result of inadequate resources. Should humankind see how many people can be packed on the planet or how many can be fed at an optimal level? Most people would select feeding all at the optimal level, but human practices are leading more to just a subsistence level living for many people.

The economy is a subset of the biosphere because the resources come from the biosphere to run the economy. Economic growth has caused problems in the areas of overpopulation, ecological overshoot, species extinction, and resource depletion.

A wide variety of reactions have been developed to avoid responding to these problems: "I don't want to hear about that!" or "I didn't do it" or "I'm only one person, what can I do?" or "No catastrophes will occur in my lifetime." Everyone on Earth caused the problems, and the people who caused the problems should do something about them! Some people may have caused fewer problems than others, but, when catastrophes occur, all will suffer. No one can say "Your end of the boat is sinking!" because everyone is in the same boat and will have a common fate if a catastrophe occurs. So what is humankind waiting for?

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The City Mouse and the Country Mouse^{1,2}

¹This posting is a simultaneous submission for "Climate Change and You: Putting a Face on Global Warming," EcoRes Forum Online E-Conference #3, October 19-29, 2009. Further information available at www.eco-res.org.

²From *Aesop's Fables*, Illustrated by Heidi Holder, 1981, Viking Press, New York, NY.

The tale of the city mouse and the country mouse (the country mouse learns that a modest life with peace and quiet is better than a material one with danger and strife) is a useful metaphor because humankind is destroying the present biosphere as it worships perpetual economic growth. Before the recent, global economic meltdown, the "shop till you drop" slogan was widespread in affluent societies and the top one or less percent of impoverished societies. However, billions of people are starving or impoverished. How can the affluent part of humankind be so insensitive to the fate of other humans and other life forms with which it shares the planet? Worse yet, humankind is destroying the integrity of the biospheric life support system that made and makes the planet habitable for humans. Human activities can and are endangering humankind's security, but it seems, except for a small part of the population, blissfully unaware of its fate. Earth cannot afford the excessive loss of resources to produce more stuff for more people. The country mouse figured out the situation – perhaps humankind will as well.

The Bee Hive: Controlling Environmental Temperature with No Brains*

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Bees are very vulnerable to small changes in temperature within a hive – as vulnerable, for example, as humankind is to small changes in global mean temperature. Violent fluctuations in hive temperature could be fatal to bees, just as global heating is already having adverse effects upon agricultural productivity. For honey-bees, "temperature modifies their reactions more than any other [climate] factor" (Dunham 1931). Maintaining hive temperature is a colony activity involving large numbers of individuals (Dunham 1931).

Humankind is not facing changes in temperature (climate) as a colony (globally) because it worries about the cost of reducing greenhouse gas emissions (e.g., Eilperin 2009) and the effect of doing so on economic growth (e.g., Jung 2009). This viewpoint exists despite the deleterious effects of economic growth on the biosphere. Both the honey-bee economy and the human economy are dependent upon the biosphere. Even though the United States should take the lead in climate negotiations, "President Obama's top climate and energy official said . . . that there was virtually no chance that Congress would have a climate and energy bill ready for him to sign before negotiations on a global climate treaty begin in December in Copenhagen" (Revkin 2009).

Bees have existed for 100 million years (Goudaryi 2006) without a brain, but *Homo sapiens* (humans) may commit suicide with excessive greenhouse gas emissions after a mere 160,000-200,000 years despite having a brain. Brains have enabled scientists to provide evidence that rising greenhouse gas emissions could destabilize the climate to a degree that would prove devastating to agriculture (Dumanoski 2009). Shouldn't humankind's intelligence enable it to grasp the catastrophe that will result if "business as usual" continues? Greenhouse gas emissions could be markedly reduced if humankind had the will to do so.

If a catastrophe affects human society, the human economy will probably not survive in any semblance to its present form. Global climate change has already adversely affected the biosphere, which produces the natural resources on which the human economy is based. The biosphere also constitutes Earth's life support system. Humans are a part of the biosphere. The human economy is a subset of the biosphere, without which it could not survive. Perhaps some day humankind will understand this relationship.

If humankind wishes to persist as long as the honey-bee, it would benefit from observing the model of a species with no brain – which knows how to regulate the temperature upon which its survival depends.

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Lessons from Avoiding Overpopulation: “Primitive” Polynesians*

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History is a vast early warning system.

Norman Cousins

Since humankind persists in carrying out global experiments (e.g., global heating) with Earth’s biospheric life support system and since islands often experience biological phenomena that occur more rapidly on them, they are worth studying. Charles Darwin was the first person to use islands to study speciation. The small Pacific island of Tikopia has avoided overpopulation and is worthy of examination. “The small size of the island of Tikopia and its isolation has meant that for generations past the maintenance of an adequate relation between quantity of land and population has been a problem of fundamental importance in the economy of these natives. In olden days they appear to have attained a rough equilibrium, and kept it by various mechanisms of adjustment; in recent years this has tended to be upset as a result of contact with European civilization” (Firth 1983, p. 367). In 1929, the population was 1281 (Firth 1983, p. 368). “. . . until recent years the population of Tikopia was normally in a state of equilibrium with its food supply” (Firth 1983, p. 373). This situation was partly the result of occasional famines. “The relation of population to natural resources is not expressed in purely individual terms, but in terms of family equilibrium” since each family has a finite portion of the land (Firth 1983, p. 373). The number of people on each family tract of land is kept sustainable by (1) celibacy, (2) *coitus interruptus*, (3) abortion, (4) infanticide, (5) war, (6) sea-voyaging (especially by young, unmarried men).

“It might be thought that the so-called sanctity of human life is not an end in itself, but the means to an end, to the preservation of society. And just as in a civilized community in time of war, civil disturbance or action against crime, life is taken to preserve life, so in Tikopia infants just born might be allowed to have their faces turned down, and to be debarred from the world which they have merely glimpsed, in order that economic equilibrium might be preserved, and the society maintain its balanced existence” (Firth 1983, p. 376).

If the planet’s population were only 1 billion, instead of nearly 7 billion, humankind’s present lifestyle would not be a problem. Earth has more humans than it can sustain, and approximately 215,000 new mouths (births minus deaths) are added daily. Obviously, nurturing the biosphere is an act of enlightened self interest. Global heating and other types of climate change might destroy millions of species and civilization, but a new, different biosphere will emerge – almost certainly one that will not favor humans as the present one does. Saving the present biosphere is essential to the survival of civilization. Talking about the dangers to economic growth is a transparent tactic. Where would the economy be without humans?

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Life is Uncertain: Get Used to It*

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The only thing that makes life possible is permanent, intolerable uncertainty.

Ursula Le Guin

Would we listen to nature if our lives depended on it?

Derrick Jensen

Life is uncertain – eat your dessert first.

Ernestine Ulmer

In the early part of the 21st century, substantive action on reducing greenhouse gas emissions was delayed because some politicians were using the idea of uncertainty in science as a justification for delayed action. Of course, science is a probabilistic endeavor based on hard data (persuasive evidence). Rarely will scientists claim they are certain about a particular outcome. However, all of life is uncertain – politicians may not live up to their campaign promises, the global financial meltdown shocked people who believed the free market was self regulating, all too many people found their "secure" jobs were not secure and their house would not appreciate in value at 10% annually, climate change reduced the global agricultural productivity, and some corporations (e.g., General Motors) needed government financial aid to survive. In short, the "secure" civilization turned out to be far less secure than anyone expected. Tsunamis and wildfires have shown that nature has greater "control" than people thought. Arguably, above all, the reduction in agricultural productivity, when the human population is still growing exponentially, can no longer be ignored or be based on greenhouse gas reduction plans with dates like 2020, 2025, or 2050. Finally, positive feedback loops could release greenhouse gases from the frozen hydrated methane in the ocean depths or locked up in the permafrost, putting the global climate system beyond human control. The fear that these things might happen should not prevent taking action now.

Humankind has delayed action on all global problems far too long, but the interactive problems must be addressed now with concrete action. Talk and world conferences have not led to major or even significant remedial action, but this situation is no excuse for inaction now. Of course, even if atmospheric carbon dioxide is reduced to 350 ppm, risk should be reduced for runaway climate change. Too much time has been spent doing nothing about reducing greenhouse gas emissions.

By using uncertainty to delay action on reducing greenhouse gas emissions, uncertainty about the climate of the future has been increased at least an order of magnitude. "Business as usual" increases the risks, increases the cost of remedial action, and increases uncertainty about the future climate. Life is full of uncertainty, and some remedial action may provide enormous benefits. Why wait?

The Fisherman and His Wife: More Does Not Make You Happy*

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Human nature, in no form of it, could ever bear prosperity.

John Adams
Letter to Thomas Jefferson

Success has made failures of many men.

Cindy Adams

Failure changes for the better, success for the worse.

Lucius Annaeus Seneca

The tale of the fisherman and his wife (collected by Jacob and Wilhelm Grimm) is about greed and recognizing when enough is enough. Basically, a fisherman and his wife live in a filthy shack near the sea. One day, the fisherman catches and releases a flounder that is an enchanted prince. When the fisherman relates the experience to his wife, she tells him to go back to the fish and ask for a little cottage for them. The flounder immediately grants the wish and, when the fisherman returns to his wife, she has a nice, little cottage. However, the wife is not satisfied and sends the fisherman back to ask for a palace; the wish is granted. Next, the wife wants a kingdom; the wish is granted. Then she wants to be emperor; the wish is granted. She continues by asking to be like God; however, the flounder sends the fisherman home to his wife, who is in their filthy shack again. Often the addiction to material possessions and the desire for more does not ensure satisfaction or happiness.

In its quest for evermore material possessions, humankind has impoverished the biosphere, and profligate use of fossil fuel has added more greenhouse gases to the atmosphere than the biosphere can assimilate. The result is that global climate change is already endangering human society. Politicians seem unable to grasp that the only solution is to reduce greenhouse gas emissions until they match the biosphere's assimilative capacity for them. Percentage reductions of greenhouse gas emissions by 80% by 2050 or 20% by 2020 have no relationship to the biosphere's assimilative capacity (which is not constant) for greenhouse gases.

In short, humankind's quest for more material goods and energy has endangered the biosphere, altered Earth's climate, and still left billions of people in poverty. The upper 1% of the planet's population has accumulated much wealth, but the rest of the population has not. Even the very wealthy do not feel more secure and have not achieved happiness (i.e., satisfaction in life). Present destruction of the biospheric life support system brings neither security nor happiness, so why do people still want more?

“Better the devil you know than the devil you don’t know”

Benjamin Franklin

Unless someone like you cares a whole awful lot, nothing is going to get better. It's not.

Dr. Seuss, “The Lorax”

Exponential population growth, increasing anthropogenic greenhouse gas emissions, markedly decreasing biodiversity, ecological overshoot, and harm to the biosphere are rapidly changing the environment in which *Homo sapiens* evolved and flourished. In the last 200 years, “more” has been the motto of a growing population. This delusion is the “devil” that humankind knows and expected to last forever. However, perpetual growth cannot continue indefinitely on a finite planet. At present, the “devil you know” is undergoing irreversible change. In short, the “devil you know” (e.g., cheap, abundant fossil fuel) is rapidly becoming the “devil you knew.” Even with approximately half the world’s population not living the “good life,” plus most of the financial “rewards” going to 1-2% of the population, reluctance to change is still strong. Of course, the corporations of “the devil you know” era are fighting change. “Clean coal” is not yet a reality and not likely to become one soon. Alternative carbon-free energy sources (e.g., wind, solar) are not just ignored – in some areas, they are actively shunned.

Risk Adverse Societies

The approach to risk in the United States is irrational. Americans spend huge amounts of money to thwart a few terrorists, but are ambivalent about global climate change, which is by far one of the most formidable challenges that *Homo sapiens* has ever faced. Continuing present, unsustainable practices will almost certainly result in effects on the biosphere that will be catastrophic (Simms and Johnson 2010). Yet, politicians express no sense of urgency, although scientists are verging on barely controlled panic.

Addiction to Economic Growth

The very notion of growth includes some concept of maturity or sufficiency beyond which physical accumulation gives way to physical maintenance (Daly 1991). Development continues but growth gives way to a state of dynamic equilibrium. A notable exception is cancerous growth. Perpetual economic growth requires either more consumers or more consumption per capita. Neither is good for human society or the biosphere. The perpetual growth “devil” known at present is a dangerous companion – humankind must find a new companion!

Failure to Change Not due to Lack of Information

The climate in which humans developed and flourished is changing rapidly, and the changes are irreversible. The preponderance of scientific evidence indicates that anthropogenic greenhouse gas emissions are a significant part of the problem. Publications on global warming first appeared in the 1800s. In the last two decades, a vast amount of peer-reviewed literature has appeared – much of it has been summarized by the Intergovernmental Panel on Climate Change (IPCC), which won the Nobel Prize for its research. In 2009, several papers appearing in the US National Academy of Sciences Proceedings pronounced climate changes irreversible. In short, no excuses can be given for not knowing about global warming and other types of climate change. The message is simple – the devil we know is changing into the devil we don’t know and we are responsible.

The Basics of Determining Information Quality

The preponderance of peer-reviewed, scientific information provides verified evidence that global climate change, including global warming, is real and that anthropogenic greenhouse gas emissions are a significant component of the problem. A well financed, substantial disinformation campaign (e.g., Hoggan and Livermore 2009) has created an impression that scientists are divided on the issue. This impression is reinforced by the common practice in the news media of treating the issue as if the numbers of scientists on each side were equal, which the news media calls “balanced coverage.” Disinformation is delaying environmental action.

How Much Time is Left?

The exact location of the tipping point for runaway, irreversible climate change will not be known until it is passed. Decisive action is needed now. Even if some of the precautionary measures are not necessary, a healthier biosphere will result. The biosphere presently known is preferable to a vastly different, replacement biosphere.

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'Tis the Gift to be Simple

*'Tis the gift to be simple,
'Tis the gift to be free,
'Tis the gift to come down where you ought to be,
And when we find ourselves in the place just right,
It will in the valley of love and delight.*

*When true simplicity is gained,
To bow and to bend we shan't be ashamed.
To turn, turn will be our delight,
'Tis by turning, turning we come round right.
'Tis the gift to be loved and that love to return,
'Tis the gift to be taught and a richer gift to learn,
And when we expect of others what we try to live each day,
Then we'll all live together and we'll all learn to say,*

*'Tis the gift to have friends and a true friend to be,
'Tis the gift to think of others not to only think of "me,"
And when we hear what others really think and really feel,
Then we'll all live together with a love that is real.*

Elder Joseph Brackett
Shaker community, Alfred, Maine, 1848

For a decade, numerous discussions have centered on anthropogenic greenhouse gas emissions that are changing the world's climates. However, little or no remediate action has occurred. Humankind already knows several facts.

- (1) Much carbon was sequestered and stored safely underground in the form of fossil fuels.
- (2) Climate problems became severe when the stored carbon was brought to the surface and burned.
- (3) Climate changes are irreversible.
- (4) Anthropogenic carbon emissions will remain in the atmosphere for well over 100 years.
- (5) The natural laws of physics, chemistry, and biology cannot be altered by any political process.
- (6) The most direct way to decrease emissions of carbon-based greenhouse gases is to tax fossil fuel combustion directly. (Cap and trade is more complicated and easier to "game" than a direct carbon tax.)

"Business as usual" with increasing anthropogenic greenhouse gas emissions ensures crossing one or more tipping points, leading to irreversible climate changes that are unpredictable. Precautions should be taken to avoid producing an alien planet due to these irreversible climate changes.

One obstacle to the badly needed quest to preserve a habitable planet is the insistence of some developed countries (particularly the United States) that developing countries show "good faith" by reducing their anthropogenic greenhouse gas emissions. However, any reductions they could make would have, at most, a minor effect on total emissions. The world's richest people (roughly 7% of the world's population) are currently responsible for 50% of the world's carbon dioxide emissions, while the world's poorest 3 billion are responsible for just 6 % (Assadourian 2010, p. 6).

Presumably, humankind's purpose is to save the present biosphere and not to engage in word games with low per capita emissions nations. Time is short and should not be wasted on trivial issues. The primary goal is to reduce atmospheric carbon dioxide to match Earth's assimilative capacity. Keeping direct focus on the major problem increases the simplicity of the task.

"Preventing the collapse of human civilization requires nothing less than a wholesale transformation of dominant cultural patterns. The transformation would reject consumerism – the cultural orientation that leads people to find meaning, contentment, and acceptance through what they consume – as taboo and establish in

its place a new cultural framework centered on sustainability. . . . Human beings are embedded in cultural systems, are shaped and constrained by their cultures, and, for the most part, act only within the cultural realities of their lives” (Assadourian 2010, p. 3). This approach can be stated more simply as: exponential population growth, coupled with rampant consumerism, threatens the health and integrity of the biosphere that is humankind’s life support system. Powerful forces maintain a consumer society, and the most potent is the worship of economic growth.

Monbiot (2010) notes: “. . . we revert to irrational destruction [of nature] as soon as our economic interests are threatened. . . . We could lose badgers and – except for those of us who spend summer evenings watching them as they shuffle out of their setts – suffer few tangible losses. But the urge to destroy them springs from the same pathological instinct for power which would deprive us of almost everything.”

Humans are destroying the biospheric life support system because of their addiction to ever more stuff. “Ultimately, whether high consumption levels make people better off is irrelevant if they lead to the degradation of Earth’s systems, as ecological decline will undermine human well-being for the majority of society in the long term” (Gardner and Assadourian 2004, as quoted in Assadourian 2010, p. 9).

British economist Paul Ekins (1991) describes consumerism as a cultural orientation in which “. . . the possession and use of an increasing number and variety of goods and services is the principal cultural aspiration and surest perceived route to personal happiness, social status, and national success.” A strange cultural pattern that presumably produces contentment and acceptance at the cost of damaging biospheric health and integrity should not be our goal. Possibly the ultimate expression of consumerism is the opulent wedding that costs much more than many individuals in the third world earn in a lifetime.

Until the global financial meltdown, the United States was the “poster child” for unrestrained consumerism. This American lifestyle was, and still is, the polar opposite of the simple life with few material possessions. Some unfortunate patterns of consumption reflect the “needs” of a car culture: “The 107 million tons of grain that went to U.S. ethanol distilleries in 2009 was enough to feed 330 million people for one year at average world consumption levels” (Earth Policy Institute 2010).

For practically all of human history, humankind was aware that resources were limiting and that limits existed to growth (Meadows et al. 2004, Hardin 1993). Population control for all other species is accomplished by Mother Nature’s ruthless methods – predation, starvation, disease, and death. The present, unavoidable issue in the 21st century is: should human society keep population size within Earth’s long-term carrying capacity or, through inaction, let Mother Nature do it? Far too many humans are already living in misery and represent a superb breeding ground for pandemic diseases. Eliminating rampant consumerism will help reduce the misery during a transition to a population within Earth’s carrying capacity; however, if humankind does not take measures to see that this reduction is accomplished, Mother Nature (i.e., natural law) will.

Much attention has been given to sustainable transportation, sustainable agriculture, cool cities, and the like, while the biosphere is pillaged because of consumerism and population growth. Humankind “talks the talk,” but does not “walk the walk.” Supply and demand are not in balance, but, if humankind does not get these two entities in balance, Mother Nature will.

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A Stitch in Time Saves Nine (American Proverb)

Kenneth E. Boulding's Dismal Theorems (Boulding 1971)

First Theorem: The Dismal Theorem

If the only ultimate check on the growth of population is misery, then the population will grow until it is miserable enough to stop its growth.

Second Theorem: The Utterly Dismal Theorem

Any technical improvement can only relieve for a while, for so long as misery is the only check on population, the improvement will enable population to grow, and will soon enable more people to live in misery than before. The final result of improvements, therefore, is to increase the equilibrium population which is to increase the total sum of human misery.

Third Theorem: The moderately cheerful form of the Dismal Theorem

Fortunately, it is not too difficult to restate the Dismal Theorem in a moderately cheerful form: if something else, other than misery and starvation, can be found which will keep a prosperous population in check, the population does not have to grow until it is miserable and starves, and it can be stably prosperous.

An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

Sir Isaac Newton's Law of Inertia

This chapter focuses on the global crisis of exponential human population growth. The fate of all humankind, if exponential growth continues, can be summarized by using Haiti as an example:

Haiti can never be self-sustaining without a huge reduction in population. I have been there and seen 9.2 million people jammed into an area half-mountainous, . . . (9,926 square miles) and the worst erosion I have ever seen . . . Haiti's population keeps growing, and is projected to be nearly 70% larger by 2050" (Youngquist 2010).

Achieving sustainability for Haiti is a formidable problem with no simple, palatable solution.

The Haitian problem and the planet wide problem can be stated simply. (1) The human population cannot grow exponentially on a finite planet. (2) The human population cannot grow beyond a nation's or Earth's carrying capacity. (3) Is humankind's goal to see how many humans the planet can support in misery or in a quality of life? (4) Most people would opt for a quality life, but that means stabilizing the human population within Earth's carrying capacity for them. (5) Climate change, loss of topsoil, turning the oceans acidic, and scarcity of freshwater are reducing food production and thus lowering Earth's carrying capacity for humans. (6) Discussion of population has been taboo for a variety of reasons but a discussion is essential in order to reach a compassionate, informed policy decision.

During the Great Depression in the United States, "a stitch in time saves nine" was frequently quoted and sometimes followed — the idea of taking action when needed saved making major actions later. Human society would have been spared much misery and mortality had the proverb been heeded, even as late as the beginning of the 21st century. Had a large-scale transition to non-carbon energy sources begun, then most of the glaciers might have been saved, hurricanes would have been less threatening, the severity of droughts and floods would have been diminished, and agricultural productivity would have been less threatened by climate changes.

Arguably, a major factor in the continuing damage of natural systems is the low level of scientific literacy globally and particularly in countries (e.g., the United States) with a very high per capita consumption of

resources. The oceans, which comprise about 70% of the planet's surface area, have been changed from mildly alkaline to mildly acidic. These changes profoundly and adversely affect marine ecosystems. Markedly reducing carbon dioxide emissions from fossil fuel emissions just a decade or two ago would have avoided this catastrophe.

Since a large number of species have become extinct, restoration of damaged ecosystems is problematic since species are the basic operational units of the biosphere. Ecosystems are self maintaining as long as biodiversity (i.e., replacement species) remains high and as long as change (e.g., global warming) remains within the normal range of variability. However, humankind is causing so many changes that the present era has been termed the Anthropocene. The climate changes that have already occurred make ecological restoration even more difficult. Of course, in evolutionary time (probably millions of years), biodiversity will doubtless be restored as it was following the five great extinctions that have already happened; however, this possibility is not comforting to most humans now alive. This situation markedly lowers carrying capacity has negative effects upon the economy due to a decrease in natural resources.

Failure to provide regular maintenance for societal infrastructures has markedly increased the risks for both human society and ecosystems. Ecosystems have been self maintaining for billions of years. They are dynamic (e.g., species successional processes), but they do maintain both structure and function unless placed in disequilibrium by some catastrophic event (e.g., the massive British Petroleum oil leak in the Gulf of Mexico in 2010)

Much of the infrastructure in the United States (e.g., bridges, roads, water delivery and sewage disposal systems, dams, buildings) is unsafe and badly needs repair or replacement. These factors are critical in determining carrying capacity. Surely *Homo sapiens* is capable of facing these problems head on. Common sense dictates that all human artifacts require continual maintenance to remain functional. Deterioration is usually so rapid that responsibility cannot be passed on to future generations as debt responsibilities are (e.g., the national debt).

" . . . political forces that resist attempts to regulate greenhouse gas emissions" lead to technological inertia that exacerbates the threat of climate change (Freedman 2010). Scientists have estimated "an 85% chance of population grinding to a halt by 2100, and a 60% chance that it will not exceed 10 billion" (Connor 2010). These estimates are not comforting since about 1 billion people go to bed hungry at present.

Some actions give reasons for hope. China has tried to limit couples to one child with some success. "Philippino President Benigno Aquino announced . . . [in October 2010] that his government will provide birth control to poor couples to help curb the country's high birth rate" (Reader Posted 2010). However, population growth will probably continue to be exponential and is only one of eight interactive global crises (Cairns 2010). The 21st century will be a rough era for humans because natural resources are declining and the population continues to grow.

Acknowledgments. I am indebted to Paul Ehrlich and Paula Kullberg for calling useful references to my attention.

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We never know the worth of water till the well is dry.

Thomas Fuller, Gnomologia

Although the oceans cover about 70% of Earth's surface, humankind is very dependent upon the tiny portion of water that is fresh. One billion people are already water stressed globally, and changing patterns of precipitation result in both droughts and floods.

Globally, rivers and streams are being drained due to human use and climate change. These and other human impacts alter the natural variability of river flows. Some impacted rivers have dried and no longer run, while others have actually seen increases in the variability of flows due to storm floods. The end result is that these two forces are conspiring to shorten flood chains, particularly by eliminating top predators like many large-bodied fish (Sabo et al. 2010).

In the United States, the mighty Colorado River, which carved the magnificent Grand Canyon, fails to reach the Pacific Ocean for much of the year. How could such a situation have happened?

Then, beginning in the 1920s, Western states began divvying up the Colorado's water, building dams and diverting the flow hundreds of miles, to Los Angeles, San Diego, Phoenix and other fast-growing cities. The river now serves 30 million people in seven U.S. states and Mexico, with 70 percent or more of its water siphoned off to irrigate 3.5 million acres of cropland (Zielinski 2010).

The human population is still growing, and little attention has been given to the ecological needs of the aquatic organisms that inhabit the river or the birds and other terrestrial animals and plants that depend upon it.

What humankind is ignoring is that the biota dependent upon the Colorado River is a component of the biospheric life support system that has maintained conditions favorable to *Homo sapiens* for the entire time the species has been on Earth. Of the five prior biospheres, none has resulted in conditions favorable to the genus *Homo*. The sixth biosphere is already in the midst of a great species extinction which, if continued, will almost certainly result in a seventh biosphere that is unlikely to produce conditions as favorable to humankind as the present biosphere. Why is nurturing the present biosphere so low on the list of political priorities?

Freshwater shortages are also worsened by events on land: "The soils in large areas of the Southern Hemisphere, including major portions of Australia, Africa and South America, have been drying up in the past decade, a group of researchers conclude in the first major study to ever examine 'evapotranspiration' on a global basis" (Jung et al. 2010). Since water in freshwater ecosystems comes mostly from land, this problem is serious.

Contamination of freshwater by runoff from land and industrial and municipal waste discharges is also a major problem. One recently discovered hazard is insecticides from genetically modified corn found in adjacent streams (Tank et al. 2010). Corn is engineered to release an insecticide that wards off the European corn borer, but these insecticidal proteins do not stay put, which puts more than the corn borer at risk. Almost certainly, insects will evolve immunity to this particular pesticide, but many long-life cycle organisms, including humans, will still be at risk. Preliminary scientific tests would have identified the probability of these pesticides leaching into the larger environment, and, if they did, more extensive confirmatory tests would be appropriate. Production of hazardous materials requires civic responsibility from both the producer and the regulatory agencies.

Most major resources upon which both humans and their economy depend are diminishing rapidly. A recent World Wildlife Report indicates that : "If business continues as usual, . . . humanity will be using resources and land at the rate of two planets each year by 2030, and just over 2.8 planets each year by 2050"

(Barringer 2010). How can a species designated wise (*sapiens*) perpetrate such action on populations of all species now alive and on posterity? I have yet to hear a satisfactory answer.

Acknowledgments. I am indebted to Paula Kullberg and Paul Ehrlich for calling useful references to my attention.

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England and America are two countries separated by a common language

George Bernard Shaw

Shaw intended a bit of whimsy when he noted the difference in language between America and England. However, different meanings and connotations for words have been turned into a weapon in the war against scientists and their science. Has ideology triumphed over humor? Read on — this is no “trick”!²

An American visiting Britain soon learns that different words refer to the same activity or item — for example, *football* is *soccer*, *subway* is *the tube*, *toilet* is *the loo*, and the *trunk* of an automobile is the *boot*. In addition, some American/British words have identical meanings but different spellings — behavior/behaviour, criticize/critise, plow/plough, program/programme, check/cheque, airplane/aeroplane.

More important in some misunderstandings is the difference in attitude between any two cultures — such as politicians and scientists. A member of the State of Virginia legislature has pre-filed a bill to classify natural gas (coal-bed methane especially) as a renewable energy source. Renewable resources are normally replenished through natural processes and are created as fast as they are consumed. However, the time factor — millions of years — must be considered in classifying natural gas as a renewable resource. The legislator should have consulted the Natural Renewable Resources Foundation or a natural renewable resource scientist in an academic institution — or a dictionary. Humankind is facing hard times that will surely worsen if politicians ignore definitions agreed upon by mainstream science and used by major dictionaries. In these dangerous times, the meaning of words cannot be distorted or used carelessly. Definitions do change, such as the definition of “middle-class” (Whitehead et al. 2010), but the new definitions will survive only if they are reached by consensus and are not used to placate a special interest group (Editorial 2010).³

Scientific publications are designed to minimize misunderstandings of words, but scientists may then be attacked for using “jargon.” Climategate is a superb example of an attempt to discredit scientists and their science. The controversy is based on

a set of over 1,000 private emails and many other documents that were stolen or leaked from the University of East Anglia’s . . . Climate Research Unit in November 2009. . . . Selected contents of the emails were used by some to suggest that scientists had been manipulating or hiding data, had been working together to frustrate people requesting access to the data and to prevent journal papers they disagreed with from appearing (Carrington 2010).

Extensive examination and analyses of the emails have comprehensively debunked the claims and accusations of the climate deniers. The detailed investigations showed no significant effect on the conclusions of mainstream science about human effects on Earth’s climate. Global climate change, if it continues at its present rate, is almost certain to produce climate changes so severe that humankind will probably be unable to cope with them effectively.

The total number of emails and other documents may have had four or five that looked suspicious/inappropriate/questionable. One involved the use of the word *trick*. British scientists used the word *trick* to denote an ingenious way of overcoming a problem. The climate change deniers interpreted the word as meaning either, at best, *mischievous* or, at worst, *deceptive*. Since Americans and British sometimes have different meanings for the same word, an objective, non-ideological analysis of the different meanings for the word *trick* was in order. Instead, a rush to judgment occurred. The qualified climate scientists had to spend inordinate amounts of time responding to accusations that lacked robust supporting scientific evidence. Climate change scientists should be able to devote all their time and energy to gathering and analyzing evidence on this

² *Trick* is used here as the word misinterpreted in Climategate.

³ I am indebted to Richard Rusk for calling this editorial to my attention

complex, multivariate problem, not explaining or justifying their word choices. In addition, climate scientists and those in related fields of science should be aware that their emails may be made public by illegal hackers and should be as vigilant in these exchanges as they are in articles in peer-reviewed, scientific journals.

Humankind cannot afford another "Climategate." A preliminary assessment of the dangers of a now probable global surface mean temperature of 4°C and beyond has recently been published (Tyndall Centre 2010). The dangers are many, and time to gather additional, relevant, scientific evidence is short. Above all, humankind should aspire to leave a habitable planet for future generations. The ideological attacks on scientists and their scientific research on global climate change are a major obstacle to achieving that compassionate goal!

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Prevention is better than cure

Erasmus

In the 21st century, statements such as “We cannot do anything to protect the environment (i.e., Biosphere) if it might endanger the economy” are frequent. However, prevention should always have the highest priority if human practices can push an ecosystem past a tipping point where change is irreversible (Solomon et al. 2009). The massive crude oil leak from British Petroleum in 2010 badly damaged the Gulf of Mexico and caused huge financial losses to the shrimp and fishing industries, tourism, and other types of recreation. Optimistic statements in the aftermath of this spill have announced diminished oil (probably because the toxic dispersants moved oil to the Gulf “floor”), but no statements are justified about the ecological condition. Another example of prevention not being heeded is the world’s oceans, which cover approximately 70% of Earth’s surface. They have changed from mildly alkaline to mildly acidic (carbon dioxide), which interferes with the use of calcium by marine organisms (among other effects). Once the oceans pass a major ecological tipping point, humankind will be in deep trouble. Marine fisheries are a major source of food for humankind, and prevention of irreversible change may not be possible if business as usual (i.e., unsustainable practices) continues.

Earth has run out of room to expand fisheries, . . . researchers have used a newly created measurement for the ecological footprint of fisheries that allows them to determine the combined impact on all marine fisheries and their rate of expansion. Known as SeafoodPrint, it quantifies the amount of “primary production” — the microscopic organisms and plants at the bottom of the marine food chain — required to produce any given amount of fish (University of British Columbia 2010).

In addition, since a “cure” for damaged wetlands is not well understood, prevention of change and damage to them makes sense. Earth’s wetlands occupy only a tiny percentage of the planet’s surface area, but are ecological “powerhouses” in terms of metabolic activity. Wetlands are critical in the recharge of underground aquifers, are nursery grounds for many species of fish, and are refuges for wildlife, especially migratory birds. Yet wetlands are drained for various types of development and are used to trap and transform hazardous materials. “Many coastal wetlands worldwide . . . may be more sensitive than previously thought to climate change and sea-level rise projections for the 21st century. . . . Accurate information about the adaptability of coastal wetlands to accelerations in sea-level rise . . . helps narrow the uncertainties associated with their disappearance” (USGS Report 2010).

The only biological system that can be touched by a human anywhere on Earth at any time is the Biosphere, which consists of a thin envelope of living species that covers Earth. The Biosphere cannot be seen around the circumference of the Earth from outer space.

The present Biosphere, the sixth, serves as a life support system for humankind and as a source of natural resources upon which the human economy depends. It has maintained conditions favorable to the human species for the thousands of years that the species has been on Earth. However, *Homo sapiens* has existed for only a tiny fraction of the time life has been on Earth (estimated to be 3.5 billion years). One assumption is that humans are apart from the Biosphere, not a part of it. This attitude is dangerous since it could be fatal to *Homo sapiens*. As a consequence, humankind fails to prevent actions that would slow the rate of climate change and is not disturbed by a 140% ecological overshoot (using resources faster than the biosphere can regenerate them) in 2010. Clearly, this lifestyle is unsustainable and can throw the current consumer society into disequilibrium. However, humankind continues to damage the Biosphere. What humankind should be doing is preventing further damage and repairing (curing) the damage it has already caused before the present Biosphere goes into disequilibrium and is replaced by a biosphere less favorable, even hostile, to *Homo sapiens*.

Why is humankind not protecting the Biosphere that is the foundation of the human economy? One reason may be a lack of knowledge of the critical role that the Biosphere plays in daily lives. Another strong probability is the fear that protecting the Biosphere (i.e., the environment) will require major adjustments in the growth economy.

Unfortunately, no "cure" for a damaged Biosphere exists except the evolution of a new Biosphere, which occurs over a considerable span of time. The new Biosphere will consist, if the five past major extinctions are reliable guides, of predominately new species. Another Biosphere will unlikely be as favorable to humans and their economy as the present Biosphere. The question becomes how to preserve a substantial portion of the species that still remain and the function of the system that supports the present life forms.

Science exists to prevent damage, but is not being used. Representatives from the world's sovereign nations gathered in Cancun, Mexico, in 2010 to attend the Conference of Parties of the United Nations Framework Convention on Climate change. Regrettably, no agreements were reached on hard numbers or dates to reduce anthropogenic discharges of greenhouse gases (Union of Concerned Scientists 2010). In short, agreements on goals (such as reducing greenhouse gas emissions) and conditions to protect Earth's climate so that catastrophes could be avoided (for which no "cure" exists) were not accomplished.

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***The frog does not drink up the pond in which it lives*⁴**

Lakota
American Indian Tribe

In contemporary ecological terms, *the frog does not drink up the pond in which it lives* means that one does not reduce the carrying capacity of one's habitat. Carrying capacity is the number of individuals a region or nation can support in terms of its resources. One important issue is how humankind determines the actual number of people a region or nation will support.

Earth's carrying capacity for humans is difficult to discuss, even though discussing carrying capacity for other species has no hindrances. Ranchers pay a price for cattle on the US Bureau of Land Management grazing land based on numbers of cattle. Carrying capacity for fish is a major management tool for lakes and reservoirs with multiple species. In short, humankind will discuss and act upon carrying capacity for other species but not discuss or act upon its own. However, inaction can be cruel. Paul and Anne Ehrlich (personal communication) are still continuously criticized for having stated in 1968: "The battle to feed all of humanity is lost." But they were right; in 1968, approximately 500 million people went hungry; at present, the number is 1,000 million — billions more are likely to be added to the population in the next 40 years if present trends continue (<http://math.berkeley.edu/~galen/popclk.html>; <http://www.peterrussell.com/Odds/WorldClock.php>).

What about the global food supply to feed these new people? "Global grain production will tumble by 63 million metric tons this year [2010], or 2 percent over all, mainly because of weather-related calamities like the Russian heat wave [2010] and the floods in Pakistan [2010] . . . Roughly 7 percent of global yields of corn and other coarse grains are being used to make ethanol" (Rudolf 2010). In the present circumstances, should humankind be using food to produce automotive fuel?

Humankind must improve its relationship with natural systems, which result from the dictates of the universal laws of biology, chemistry, and physics. Humans are a part of natural systems, not apart from them. Technology enables humans to "bend" the universal laws a bit, but does not permit breaking them. Scientists are not being arrogant when they describe the potentially catastrophic effects of increasing anthropogenic (human caused) greenhouse gas emissions. They are merely drawing conclusions from the preponderance of scientific evidence upon which the scientific process is based. If others feel the evidence is incorrect, they should have the responsibility of providing evidence to support their conclusions.

Creatures, such as the frog, do not use the scientific process — they just become extinct if they violate the universal laws. Most species that once lived on Earth are now extinct. Many extinctions occur when a climate change is abrupt or due to a large object from outer space striking Earth. Others become extinct when slow change does not favor them. Finally, some species become extinct when another species completes more effectively for resources — for example, seven species of the genus *Homo* were simply out competed; i.e., of the seven species, only *Homo sapiens* (humans) remains. Perhaps humankind is being too arrogant in thinking that it is not affected by universal natural laws.

Scientists reach conclusions based on verified evidence in peer-reviewed literature. However, the most important aspect is that the universal laws of biology, chemistry, and physics are operational 100% of the time. Humankind cannot alter these universal laws nor can it negotiate "better" terms. Neither frogs nor humans can violate these laws without suffering severe consequences that could include extinction. Humans have a huge advantage that the frog does not — they have scientists conducting research and making information available. The Philosophical Transactions of the UK's Royal Society (which at 345 years is the oldest continuously published scientific journal) recently published an article on emission scenarios for a new world:

The analysis suggests that despite high-level statements to the contrary, there is now little to no chance of maintaining the global mean surface temperature at or below 2°C. Moreover, the impacts associated with 2°C have been revised upwards, sufficiently so that 2°C now more appropriately represents the threshold between 'dangerous' and 'extremely dangerous' climate change (Anderson and Bows 2011).

⁴I am indebted to Stefan Cairns for calling this quote to my attention.

Scientists find no joy in generating evidence regarded as “bad news,” but they have a responsibility to report it when it appears.

The issue can be simply stated — both the pond in the Lakota American Indian proverb and Earth are finite. The universal laws of biology, chemistry, and physics must be obeyed in both the pond and on Earth. Neither frogs nor humans can violate these laws without suffering severe penalties.

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The Iron Law of Climate Policy: when environmental and economic objectives are placed into opposition with one another in public or political forums, it is the economic goals which win out

Roger Pielke, Jr., *The Climate Fix*

Environmental protection that might endanger the economy is not generally acceptable. Political parties place the economy high, even highest, on priority lists, as does most of the citizenry of developed countries. The Biosphere (the environment) is the source of resources that fuel the economy; consequently, placing the success of the economy over the nurturing of the environment seems unreasonable.

The human economy has done serious, *perhaps irreversible*, harm to the Biosphere. Wilson (1984, p. 121) states:

. . .the worst thing that will probably happen—in fact is already well underway—is not energy depletion, economic collapse (emphasis mine), conventional war, or the expansion of totalitarian governments. As terrible as these catastrophes would be for us, they can be repaired in a few generations. The one process now going on that will take millions of years to correct is loss of genetic and species diversity by the destruction of natural habitats. This is the folly our descendants are least likely to forgive us.

Humankind is part of the Biosphere (living systems), although it sometimes forgets and becomes apart from the Biosphere. Four types of capital form the basis of the human economy (Hawken et al. 1999, p. 4):

- *human capital, in the form of labor and intelligence, culture, and organization*
- *financial capital, consisting of cash, investments, and monetary instruments*
- *manufactured capital, including infrastructure, machines, tools, and factories*
- *natural capital, made up of resources, living systems, and ecosystem services*

The Biosphere not only provides the resource base for the human economy but also maintains conditions that favor humankind. The human economy, therefore, is a subset of the Biosphere, so the Biosphere should be given the highest priority.

The view that human technology enables humans to control nature adds to the belief that the human economy should have a higher priority than the environment. This belief appears true in the short term; however, in the long term, the universal laws of physics, chemistry, and biology will prevail.

Biodiversity loss (species extinction) is a much discussed problem, even though no significant action has been undertaken to keep the loss at a normal rate. Species are the basic operational units of the biospheric life support system, which is essential to human well being and survival. An economic value cannot be placed on a life support system that is essential to the survival of *Homo sapiens*.

Biotic impoverishment occurs when populations of a species are reduced to such small numbers that they have little or no ecological significance. A critical number is necessary for adequate biospheric function (i.e., provision of ecosystem services). Even through the five great extinctions, the process of evolution has always restored biodiversity. Although the next Biosphere may produce conditions favorable to humankind, this phenomenon is not probable. Any attempts to place an economic value on ecosystem services and the biospheric life support system should keep this probability in mind. In addition, not much is known about biospheric tipping points (where irreversible change occurs). If biodiversity loss and biotic impoverishment continue, one or more tipping points will be passed. Since tipping points cannot be identified precisely until they occur, precautionary measures to avoid them are prudent, especially since the economic consequences will be severe.

If humankind nurtured the Biosphere, a reliable supply of resources would be available for the economic system. By damaging the Biosphere, humankind has already adversely affected agricultural productivity, food security, and freshwater supplies. "We are entering a new era, one of rapid and often unpredictable climate

change. In fact, the new climate norm is change. The 25 warmest years on record have come since 1980. And the 10 warmest years since global recordkeeping began in 1880 have come since 1998” (Brown 2010).

Meanwhile, the human economy, despite all the help it has received (e.g., bailouts) is not faring well and shows no sign of robust recovery. Could this possibly be because human society fails to recognize that the human economy is a subset of the Biosphere and nature’s economy is dominant?

Today we have a temporary aberration called ‘industrial capitalism’ which is inadvertently liquidating its two most important sources of capital . . . the natural world and properly functioning societies. No sensible capitalist would do that.

Amory Lovins

(http://www.woopidoo.com/business_quotes/authors/amory-lovins/index.htm)

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***All the world's a stage . . .*⁵**

William Shakespeare
As You Like It, Act 2, Scene 7

Since the time that the Kyoto Protocol was produced in 1997, humankind has waited for sovereign nations to take action in preventing dangerous levels of climate change. Any hope was crushed by the inaction at the 2009 Copenhagen Climate Conference, but slightly raised by the Cancun Climate Change Conference of December 2010. However, the acrimonious divide between nations still appears to be blocking any substantive, global, remedial action to prevent dangerous levels of climate change.

The analysis [of greenhouse gas emissions growth] suggests that despite high-level statements to the contrary, there is now little or no chance of maintaining the global mean surface temperature at or below 2°C. Moreover, the impacts associated with 2°C have been revised upwards, sufficiently so that 2°C now more appropriately represents the threshold between 'dangerous' and 'extremely dangerous' climate change (Anderson and Bows 2011).

Stated bluntly, humankind is seemingly unconcerned about the future and is rapidly moving from a dangerous to an extremely dangerous situation in climate change.

Fortunately, the Tyndall Centre of Climate Change Research (2011) has provided a list of “. . . challenges involved in avoiding high levels of warming, as well as the challenges of adaptation should society fail to do so.” These challenges indicate what must be done to leave a habitable planet for the next generation (and those after) and the adaptations all will be forced to make if humankind continues business as usual and the planet is pushed to four degrees and beyond current global temperatures. This report of the Tyndall Centre was intended to bring the latest climate change research to the UN Summit in Mexico in December 2010. Since that UN Summit appears to have failed to meet the challenge, humankind must prepare to adapt.

The following issues reported by the Tyndall Centre deserve serious attention.

(1) *On emissions scenarios — With high emissions and strong climate-carbon cycle feedbacks, 4 degrees global warming could be reached in the early 2060s (Betts et al. 2011).*

(2) *Water — With a 4 degrees warming, climate change is more important than population growth for determining whether a river basin suffers from water stress. If warming is limited to 2 degrees, the reverse is true (Fung et al. 2011).*

(3) *Industrialising economies — . . . cumulative emissions, split into richer and poorer nations, [can be used] to understand the implications of rapid emission growth in nations such as China and India, for global reduction rate (Anderson and Bows 2011).*

(4) *People — A greater temperature change might not only affect the magnitude of the associated population movements, but also – and above all – the characteristics of these movements, and therefore the policy responses that can address them. . . . policy evolutions [show what] . . . climate-induced displacements in a 4°C+ world would require (Gemenne 2011).*

(5) *Ecosystem interactions — Agriculture, plants, and animals would need to move large distances to stay cool or wet. Humans might be increasingly concentrated in places remaining sufficiently wet for economic prosperity. In a 2°C world, impacts would be roughly halved, many ecosystems like forests preserved, with much less need for movement (Warren 2011).*

(6) *Adaptation — Adapting to global warming of 4°C cannot be seen as a mere extrapolation of adaptation to 2°C; it will be a more substantial, continuous and transformative process. Decision-makers are likely to be paralysed by the complexity*

⁵I am indebted to Richard Rusk for reminding me of this quote when I told him about the tentative contents of this chapter.

of this problem, . . . (Stafford Smith et al. 2011).

(7) *Climate projections* — *The patterns of change in temperature and precipitation are similar for high-end and non high-end models but are amplified in the high-end models. The greatest warming occurs in the Arctic, where December, January and February temperatures increased by 12-16°C. Warming during June, July, August (6-8°C) occurred over many land areas, including the USA, Mediterranean Europe, much of Africa and northern Australia* (Sanderson et al. 2011).

(8) *Emissions targets* — . . . *if we met a cumulative emissions target, or a single budget between now and 2200, we would be more likely to limit global warming to two degrees than if we had used a 2020 or 2050 target* (Bowerman et al. 2011).

(9) *Food* — *In a four-plus degree world, food security will be more difficult to achieve because of commodity price increases and local production shortfalls* (Thornton et al. 2011).

(10) *Forests* — *Our results confirm some risk of forest retreat, (eastern Amazonia, Central America, parts of Africa), but also indicate a potential for expansion in other regions (Congo Basin). This potential increases if the positive impact of CO₂ is considered. Other, more uncertain, factors, notably higher temperature, may have a negative effect* (Zelazowski et al. 2011).

(11) *Sea-level rise* — *A pragmatic estimate of sea-level rise by 2100 for a temperature rise of 4°C or more over the same time frame is between 0.5m to 2m. Without adaptation, this may result in the forced displacement of up to 187 million people over the century (up to 2.4% of global population). Protection is costly with up to 0.02% of global domestic product needed* (Nicholls et al. 2011).

Astonishingly, despite the massive increase in scientific evidence, polls indicate that fewer people in 2010 than in 1997 believe that humans are a factor in global climate change. Humans are not directing the ecological “play” on the world stage in the evolutionary theater. The play has been in progress for approximately 3.5 billion years and is dominated by the universal laws of physics, chemistry, and biology. Most of the “actors” who have been “on stage” are now extinct, but the process of evolution has supplied new actors (i.e., species), even after five great extinctions.

The metaphor of an evolutionary stage with species as the actors suggests some important questions.

(1) How long does *Homo sapiens* have “on stage”?

(2) Why do some “actors” (species) remain on stage much longer than others?

(3) Does acting contrary to the universal laws of physics, chemistry, and biology markedly reduce an actor’s “time on stage”?

(4) Is it ethical/moral to pass on both a huge financial and ecological debt to future generations?

(5) At present, 1.2 billion humans go to bed hungry each night and over 2 billion are malnourished — how can they be shown compassion while trying to keep Earth’s human population within its carrying capacity?

(6) What should humankind’s relationship with other life forms be? Are they fellow actors on the stage, each with a different role to play or are they commodities for the human economic system?

(7) *Homo sapiens* has been on Earth for an estimated 160,000 – 200,000 years. Species are the actors in the evolutionary stage – not the individual. Should this knowledge influence the relationship between generations?

(8) What can humankind do to increase its time on stage?

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The environment is nice as long as it's free

Editorial (2010)^{6,7}

You walk through the cool woods taking deep, energizing breaths of fresh air. No charge! The trees or other photosynthetic organisms take your exhaled waste (carbon dioxide) and turn it into wood that can be used to build houses or make paper. No charge! For nearly 200,000 years, human wastes were just deposited in the environment and turned into less harmful materials. No charge! Small hunting and gathering tribes acquired their food from the environment. No charge!

However, at present, wastes from nearly 7 billion people on Earth and industrial and municipal wastes are more than the environment can handle. Some wastes are chemical substances that the environment cannot even use as raw materials. In addition, other types of wastes are discharged into the environment in quantities too large for the environment to assimilate.

Wastes also must be treated, not only to prevent harm to the environment but recycled or transformed into materials beneficial to the environment. Such procedures cost money — maintaining a functioning environment is no longer free, and some industries and some people find these circumstances disturbing. For most of the 200,000 years that *Homo sapiens* has been on Earth, the Biosphere (i.e., the environment) has provided both goods (e.g., natural resources) and services (e.g., maintaining the atmospheric gas balance) free. However, no action in natural systems is without consequences — some beneficial, some detrimental.

Humankind has made an irrational, unsustainable decision to maintain economic growth even though it has already damaged the biospheric life support system, probably beyond repair — once tipping points have been passed, the changes are irreversible. The morality of obtaining renewable resources at a rate beyond the Biosphere's ability to regenerate them will damage the natural system that provides the services. Using resources beyond their regeneration rate is ecological overshoot; in 2010, humans used 140% more resources than could be regenerated. August 21, 2010, was the day that the ecological budget was exhausted for the year — clearly an unsustainable situation. On December 26, 2010, humankind had used 154% of Earth's resources. Using a percentage beyond the resources available reduces natural capital, which is like using the capital in a bank account, i.e., the interest is reduced because of the decrease in capital available. In this example, natural capital is resources and interest is ecosystem services. As a result, each year of overshoot reduces the capital even more and, thus far, no effort has been made to replace it.

Retirement annuities and institutional retirement benefits are calculated on the basis of how long a person of a certain age is statistically likely to live and is based on a particular starting date. The goal is for the money to last as long as the individual. This practice assumes that the financial market will not collapse. The same procedure applies to the Biosphere, i.e., reserve resources for future use and do not deplete them or the structure will collapse. At least eight major global crises are interacting at present (Cairns 2010). Humankind can help the present Biosphere persist longer if it does not continue business as usual. Atmospheric carbon dioxide can be reduced by reducing anthropogenic (human-caused) greenhouse gas emissions, i.e., carbon dioxide can be markedly reduced by using non-carbon alternative energy sources (e.g., solar panels, windmills) to replace carbon rich fossil fuels (e.g., coal, petroleum). European countries have already begun the transition in a substantive way.

Many costs of climate change are just beginning to be discovered. For example, 30 new diseases have emerged in the last 20 years. In addition, a resurgence and a redistribution of old diseases have surfaced on a global scale (Epstein et al. 1998). A warmer world is producing a sicker world, as such diseases as malaria, heart ailments, and dengue fever (carried by mosquitoes whose numbers are increasing with warmer temperatures) are among those undergoing resurgence and redistribution (Associated Press 2006). In North America, the bark beetle is expanding its range already causing damage to forests. The global warming has enabled the beetle to expand its range. These costs and risks are yet to be adequately factored into estimating the full costs of climate change.

⁶I hasten to emphasize that the editorial was criticizing an overzealous Commonwealth Attorney General of Virginia for investigating a well known climate scientist for possible misuse of Commonwealth funds. At this time, no evidence of misuse has been found.

⁷I am indebted to Richard Rusk for calling this editorial to my attention.

Humankind should be concerned for future generations as well as those now living. Every day humankind fails to increase its environmental literacy, live sustainably, stabilize its population within Earth's carrying capacity, and take effective remedial action on climate change.

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Exit the Cornucopian Era: Enter the Era of Scarcity

*The first lesson of economics is scarcity. There is never enough of anything to satisfy all those who want it.
The first lesson of politics is to disregard the first lesson of economics.*

Thomas Sowell

One of the consequences of such notions as “entitlements” is that people who have contributed nothing to society feel that society owes them something, apparently just for being nice enough to grace us with their presence.

Thomas Sowell

*Would you live with ease,
Do what you ought, and not what you please.*

Benjamin Franklin
Poor Richard's Almanac

Welcome to the world of scarcity! Humankind lives on a finite planet with nearly 7 billion people whose numbers are still increasing exponentially and whose ecological overshoot is approximately 150%. The human economy is dependent upon resources, particularly renewable resources, which are declining and will not increase as long as damage to the Biosphere continues.

Nature provides no entitlements, and humans cannot provide them if Earth's carrying capacity is exceeded. However, young people deserve entitlements such as health care and education. If parents and society cannot provide these, society will fail because a complex society needs healthy, well educated citizens. Entitlements will always decline in an era of scarcity, but education and health care must survive.

Using renewable resources more rapidly than Earth can regenerate them is, arguably, the ultimate unsustainable practice. Overuse now exceeds 150%, but overuse of resources has been advocated as the only way to maintain economic growth, which has already damaged the biospheric life support system (e.g., Cairns 2010). Nurturing the present biospheric life support system (which is the sixth one) might preserve the conditions that are so favorable to *Homo sapiens*. Even if nurturing were successful, many injustices (e.g., the growing disparity of wealth between the very rich and the very poor) would remain because nurturing the Biosphere after humankind has damaged it so badly will be difficult.

Rampant consumerism does not use resources wisely — for example, present use of fossil fuels, particularly coal, is changing Earth's climate in ways that threaten human society. Rampant consumerism has already damaged the Biosphere and may have pushed it close to an irreversible tipping point.

No amount of wealth will protect people from runaway climate change, which will occur if anthropogenic greenhouse gas emissions continue at the present or increased levels. The consequences of economic growth are being ignored because preventative measures for climate change might have adverse effects upon the human economy. However, the human economy is not more important than leaving a habitable planet for future generations.

Most citizens do not understand financial terminology well, such as the term *derivatives*. This illiteracy has cost them dearly, as has not understanding science and its terminology. However, economic growth is and has been a very high priority goal, so this illiteracy of economics is difficult to understand. Along the same lines, all parties need to understand the terminology when coping with global problems. Since the human economic system is a subset of the Biosphere, biospheric health is essential to the health of the economic system. Therefore, understanding terminology in the realm of science will aid the economic system.

On a finite planet with finite resources, humankind must arrange its priorities accordingly. Following is an illustrative accounting from 2010 of the general public's concerns.

50% unemployment and jobs
25% government deficit and spending
9% health care
7% war in Afghanistan
5% immigration
1% other
1% unsure

On the other hand, a global priority list corresponding to the major, global crises might include the following.

- (1) Protect and restore, as far as possible, the biospheric life support system.
- (2) Reduce Earth's human population to within Earth's carrying capacity for all humankind, which will require adjustment of many individual resource uses if the process is compassionate.
- (3) Eliminate ecological overshoot. Consuming resources at a rate beyond the biosphere's regenerative capacity is clearly not sustainable and is, therefore, both stupid and unsustainable.
- (4) Eliminate biodiversity loss and biotic impoverishment (i.e., reducing a species population size so that it is no longer of ecological significance).
- (5) Save some endangered, large carnivores and herbivores, regardless of their present numbers because they have major beneficial effects on the food web.
- (6) Treat corporations as artifacts created by humans, not as individuals. Their effects on the Biosphere must be regulated.
- (7) Develop a nurturing relationship with the Biosphere by having more association between humans and other life forms on Earth and become more literate about natural systems.

Giving priority to these goals will be an expensive undertaking, but the cost of doing nothing or doing too little, too late will almost certainly be far more expensive. Meeting these goals will require a diverse array of scientific information, and initially much of the evidence will not be pleasing or comforting. The scientific process has been exemplary in correcting errors for many years and must be left to credentialed scientists just as medical decisions are left to credentialed physicians. Harassment of scientists for political or ideological reasons markedly increases the risks for all society. The preponderance of evidence should be the basis for all policy decisions.

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The apple never falls far from the tree*

Proverb – probably European

The proverb, *The apple never falls far from the tree*, is usually interpreted to mean that a child's behavior is much like that of the parents who were, in turn, influenced by their culture. However, the proverb can also apply to civilization as a whole as it tends to maintain the status quo. The transition of *Homo sapiens* from hunter-gatherer tribes to agrarian societies about 10,000 years ago was an enormous change for the species. Then the Industrial Revolution was powered by cheap, abundant fossil fuel, and, in the 20th century, the cornucopian era was in full swing, accompanied by rampant consumerism (at least for the middle and, especially, the upper classes). The era beginning with the Industrial Revolution has been called the anthropocene, which was the beginning of consumerism, biodiversity loss and biotic impoverishment, increased anthropogenic greenhouse gas emissions, the automotive culture, the global economy, overfishing the oceans, increased destruction of old growth forests, and continued exponential human population growth. At present, about half Earth's human population is not well nourished, is poorly educated and housed, lacks adequate medical care, and does not have adequate, potable fresh water.

After a few centuries of the anthropocene era, talk began about unsustainable use of the planet, but humankind is far from living sustainably as 2011 begins. Being sustainable is like being pregnant – a woman either is or isn't. In ecological terms, if a single, crucial, limiting factor is depleted, then humankind may become extinct.

The proverb may also apply to nations as past behavior is a good indication of future behavior. International conferences such as the Cancun, Mexico, and Copenhagen, Denmark, climate conferences had a few forward looking statements of intent, but otherwise produced no hard, binding numbers on anthropogenic greenhouse gas emissions or firm commitments on dates for meeting reduction deadlines. Moreover, no "hard" targets were set for reduction of atmospheric concentrations of greenhouse gas emissions. Finally, no substantive discussions occurred on response measures in the event that positive feedback loops become more active. For example, vast amounts of frozen hydrated methane exist on the ocean floor and vast amounts of carbon dioxide are stored in permafrost soils. Increased temperatures are already causing some of this greenhouse gas release, and increased global temperatures will almost certainly increase release from storage. Perhaps such discussions will be avoided until multiple catastrophes occur that have a major impact on all nations with major anthropogenic greenhouse gas emissions.

The attacks on scientists and their evidence, which vary from nation to nation, are strong and well financed in more than one nation with major greenhouse gas emissions. Scientists rely on the universal laws of physics, chemistry, and biology. All human actions, goals, plans (including the human economy) must be congruent with these laws or the human actions will fail – usually catastrophically. All science is basically an endeavor to determine how these laws work. If a scientist manages to publish something that is not in context with the preponderance of scientific evidence about the laws, it is rejected by scientists using the scientific process. However, rejecting scientific evidence because it conflicts with ideology eventually ends in disaster. Denial of the preponderance of scientific evidence may be attractive in the short term, but is inevitably fatal in the long run.

Living with Respect for the Biosphere⁸

When we show our respect for other living things, they respond with respect for us. Arapaho

We will be known forever by the tracks we leave. Dakota

When a man moves away from nature his heart become hard. Lakota⁹

The North American Indian tribes shared a deep respect for natural systems. Although some less nomadic tribes eventually developed agriculture, much of their food was acquired by hunting and gathering. Even the tribes that were not nomadic obtained much of their food from ecosystems, as the shell mounds of coastal tribes show. The Plains Indians even used buffalo hides for both shelter and clothing. All Indian tribes had a close association with natural systems and realized their dependence upon them. Compared to present day, their populations were small and widely dispersed. In addition, they lacked the present day technology for doing extensive damage to the Biosphere upon which their continued existence depended. Most important, they did not use fossil fuels as do present day humans. Their primary fuels were wood and buffalo “chips.” They could alter natural systems, but they could not change the climate. Their respect for natural systems was inevitable.

In contrast, the majority of humans now living in North America exist in cities, towns, or suburbs around large cities. Most humans neither gather nor produce the food they eat, and their contact with natural systems is primarily recreational. Humankind has lost touch with the natural world, and the risks of doing so are enormous.

For decades, a massive body of scientific evidence has indicated that much damage has already been done to the Biosphere and that many of the changes are irreversible (Solomon et al. 2009). Moreover, the preponderance of scientific evidence indicates that human activities are making Earth less habitable for both humans and other species. Prestigious organizations such as the US National Academy of Sciences and the UK’s Royal Society have confirmed the validity of the scientific evidence and that human activities (e.g., anthropogenic greenhouse gas emissions) are a major factor. “No generation has faced a challenge with the complexity, scale, and urgency of the one we face” (Brown 2011, pp. xi).

The basic problem leading to this damage is that humankind does not acknowledge its dependence upon the Biosphere and is in denial about the magnitude, consequences, and the urgency of the problem and, in many cases, even that a problem exists. Consideration of certain issues could initiate both discussion and action on how to avoid tipping points for the Biosphere (all life forms and their habitats).

(1) Everyone needs to become environmentally literate. Define the following: (a) tipping point, (b) carrying capacity, (c) ecological overshoot, (d) biotic impoverishment, (e) ecological footprint, (f) carbon footprint, (g) greenhouse gases – name three or more, (h) positive feedback loop, (i) ecological disequilibrium, (j) biosphere, (k) endocrine disrupter, (l) invasive species, (m) methyl mercury, (n) synergistic interaction between toxicants, (o) bioaccumulation, (p) toxic threshold, (q) assimilative capacity, (r) biochemical oxygen demand, (s) ecological deficit, (t) albedo effect, (u) exponential growth, (v) linear growth, (w) sustainable use of the planet, (x) renewable resources.

Been there? Done that? Splendid! The environmentally literate have the civic responsibility to raise the environmental literacy of others! Of course, the above definitions are only the ABCs of environmental literacy. In comparison, the North American Indians were much more literate about their environment than the present generation. If these hunter-gatherers were not environmentally literate, they did not survive. They had to provide food but avoid toxic or unhealthy food, get clothing and shelter, know the habits of animals that were a major part of their economy, avoid dangerous situations, and pass knowledge and wisdom on to their children. Above all, they had a sense of community with other life forms and respect for them.

(2) Is the current generation of humans leaving Earth in a comparable or better shape than when it was born?

(3) Will the present Biosphere survive if humankind keeps damaging the habitat (e.g., the Gulf of Mexico) or other life forms and diminishes the resources available to them?

⁸I am indebted to Karen Cairns for suggesting this title.

⁹I am indebted to Stefan Cairns for calling this quote to my attention.

- (3) Will the present Biosphere survive if humankind keeps damaging the habitat (e.g., the Gulf of Mexico) or other life forms and diminishes the resources available to them?
- (4) Can humankind switch to non-carbon sources of energy in time to preserve the biospheric life support system and the conditions that make possible both the human economy and human survival?
- (5) When help is given to failed states (e.g., Haiti), should the donors insist that restrictions be made that will remove the nations from failed state status (e.g., population stabilization)?
- (6) Between early 2007 and 2008, world wheat, rice, corn, and soybean prices climbed to roughly triple their historic levels (Brown 2011, p. 59). What actions should be taken to address this problem? Is there a compassionate solution to this problem?
- (7) Is the United States becoming delusional about global warming in the same way that Japan was about victory at the end of World War II (e.g., Thomas 2006, pp. 336-338)? For example, on August 13, 1945, Just before Japan surrendered, Admiral Onishi cried: "If we are prepared to sacrifice 20,000,000 Japanese lives in a special attack, victory will be ours" (Thomas, p. 338). In the same vein, if the United States (and other nations that produce anthropogenic greenhouse gas emissions) continues business as usual, then hoping for no catastrophes is being delusional.
- (8) Are a significant amount of US citizens and politicians being delusional by calling scientists and their science a hoax, a deception, or a conspiracy when they have no verified different scientific evidence of their own? At least the deniers are a cut above ancient rulers who beheaded messengers who brought bad news. Scientists investigate the universal laws of physics, chemistry, and biology. The scientific evidence is neither good nor bad – these terms are "in the eyes of the beholder." Anyone who believes humans can ignore universal laws and achieve sustainable economic growth is delusional.

Humans will unlikely develop a respect and reverence for natural systems while intently focused on the present version of economic growth. Such a reverence is also unlikely to develop if damage to the present biospheric life support system continues much longer.

The tribal cultures of the planet are mostly gone, except in a few places that most humans could not survive (e.g., the Kalahari Desert). Humankind must acquire its knowledge of natural systems primarily from the people who study how the systems work – the world's scientists. However, society must not encourage "witch hunts" when scientists gather evidence that is displeasing or offensive to people with little or no scientific literacy. The news media must restrain itself when reporting attacks on scientists and their evidence just because it makes a "good story." Depicting science as a "hoax," especially in the case of no counter scientific evidence, is dangerous at best and fatal at worst. The world's temperatures vary significantly from one region of Earth to another, and seasonally as well. "Yes, global average warming is 'only' about a degree, but that is actually a lot. During the last major ice age, when New York, Minneapolis, and Seattle were under an ice sheet a mile thick, global average temperature was about 5 degrees colder than it is now. The last time Earth was 2 degrees warmer so much ice melted that the sea level was about twenty-five meters (eighty feet) higher than it is today" (Hansen 2010). Moral of the story – an unseasonable snowfall in Washington, DC, does not mean global warming is a hoax! People who are scientifically literate can identify the purveyors of doubt personally, even if the news media fails to do so – this course of action is 21st century individualism!

Acknowledgments. I am indebted to Larry Miller, who lent me the book *Sea of Thunder*.

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Frugal Living: Do We Have a Choice?

We say to humanity: the time has come when you must take the great step and rise out of a material existence into the higher, deeper and wider life towards which humanity moves. The problems which have troubled mankind can only be solved by conquering the kingdom within . . . Sri Aurobindo

Sri Aurobindo was an enlightened and progressive teacher in India who founded an ashram (a place for learning, meditation, and Integral Yoga) near Pondicherry, India, in 1926. Associated with the ashram is Auroville, an international community that promotes a sustainable lifestyle and compassion for all. The ashram's activities include free medical care and a publishing house, as well as support for cottage industries, such as growing spirulina (which is packaged and marketed), making non-polluting and healthy incense, and making a large line of handmade papers.¹⁰

This community is an example of frugal living, but what if humankind in general continues to do nothing about using more resources than Earth can regenerate? The default (failure to do that which is necessary) position will expose humans to the universal laws of biology, chemistry, and physics. The consequences of overuse of resources for all species are starvation, disease, and death.

In 2011, about 1 billion humans are water stressed (i.e., not enough, not potable), and agricultural productivity is declining in many areas of the world due to insufficient water for irrigation. About 1,000 tons of water is needed to produce 1 ton of corn. Approximately 1.2 billion humans went to bed hungry in 2010, and another 2 billion were malnourished and had inadequate medical care, poor housing, and inadequate education. The human population is nearing 7 billion in 2011 and may reach 9 billion in 2050. In short, resources (e.g., water) are declining and the human population is increasing.

The basic mistake people perpetuate in decision making is asking "Can I afford it?" instead of asking "Can Earth afford it?" An important component of the problem of living unsustainably is the present culture. Envy of another's possessions leads to spending more time and money trying to acquire them. In addition, footprint size is affected by the country of residence. For example, the highest rank in footprint size of countries is the United Arab Emirates at 15.99; next is the United States at 12.22; Germany is #14 at 6.31; China is #77 at 1.84; Bangladesh is #141 at 0.6. The weighted world average is 3.1 (http://www.nationmaster.com/graph/env_eco_foo-environment-ecological-footprint). Much can be learned from this simple list of footprint size; a few illustrative examples follow.

- (1) The US footprint size is approximately twice that of Germany. Is the quality of life in the United States twice as good as Germany's?
- (2) The footprint size of China is lower than the weighted world average. China is a growing economic power and is beginning to compete for both renewable and non-renewable resources in the global marketplace. China's footprint size will probably increase rapidly, which will increase the global ecological overshoot beyond the current (2011) 150%. Should nations with a large footprint size reduce it to prevent a major catastrophe?
- (3) Individuals should assess their footprint size and determine if they plan to reduce it.

At the beginning of 2011, predictions of major issues for the coming year gave little attention to factors such as: global climate change, exponential human population growth, ecological overshoot, resource depletion, biodiversity loss, diseases, increases in agricultural pests, and the malnourished people of the planet. These factors may have been mentioned, but people want optimistic news, despite the fact that ignoring bad news can be fatal. Of course, a gunman who shot 18 people and killed 6 at a political meeting received the usual, temporary, mass coverage in the news media. The US economy was the dominant motivator in this catastrophe, and some solutions for prevention of such an event in the future involved eliminating/reducing entitlements, reducing taxes, and making cuts in education funding. Certainly, humankind needs to re-examine its value system.

Human society is not even coming close to living sustainably and has a lifestyle that, if continued, will be catastrophic. In the United States and elsewhere, people had been optimistic until the global financial

¹⁰I am indebted to Karen Cairns, who has spent 2-3 months in India annually for many years, for this information.

meltdown occurred, leading to job losses, repossession of individual's possessions such as homes and automobiles, and termination of health insurance. In addition to this financial meltdown, Earth is in an ecological meltdown, which will worsen unless human society develops an "ecological civilization" (Magdoff 2011): "Given the overwhelming harm being done to the world's environment and to its people, it is essential today to consider how we might organize a truly ecological civilization – one that exists in harmony with natural systems – instead of trying to overwhelm and dominate nature."

All humankind is in these global crises together, and, if something is not done now, all humans will suffer, possibly die, together. The persistent attacks on scientists and their science by a handful of well financed deniers is more than a way for the news media to entertain viewers, listeners, and readers. The US National Academy of Sciences, the UK Royal Society, and their equivalents in other sovereign nations have confirmed that the preponderance of evidence in peer-reviewed, scientific journals shows that humans are a major factor in global climate change, including global warming. If humankind fails to reduce anthropogenic greenhouse gas emissions, ecological overshoot, and exceeding Earth's carrying capacity for humans, Mother Nature (i.e., the universal laws of biology, chemistry, and physics) will do so, and the consequences will be appalling. "Business as usual" is a dream world that is not good for either humankind or its posterity. The measures needed to reduce risk are known and could be put in place immediately. The consequences of inaction are so severe that precautionary measures are well justified.

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Searching for Truth Where You Live

If you cannot find the truth right where you are, where else do you expect to find it?

Dogen¹¹

When I mention the massive British Petroleum oil leak in the Gulf of Mexico in 2010 and the probably irreversible damage that has resulted, an all too common response is: “That’s far away; it has nothing to do with me.”

When I mention the heat wave in Russia, which has killed 50,000 people, the common response is: “That’s far away; it has nothing to do with me.”

When I mention the alien planet that humans are creating for future generations by continued ecological disasters, the common response is: “That’s far in the future; it has nothing to do with me.”

How can the eight interactive global crises, which could doom civilization and even eliminate *Homo sapiens*, be eliminated if action is delayed until everyone experiences a catastrophe personally? How has humankind lapsed into an ethical/spiritual/moral stupor and become obsessed with economic growth? A few relevant factors follow.

- (1) Substantive discussions/debates on life’s important values are nonexistent.
- (2) Literacy is essential to any informed discussion/debate.
- (3) The US Supreme Court has concluded that corporations, which are artifacts of the financial system, have many of the same rights as individuals.
- (4) Many people do not live in natural systems or have easy access to them. Even fewer people have the opportunity to experience a single system for many years. With nearly 7 billion people on the planet, such opportunities become rarer daily.
- (5) Despite massive scientific evidence that climate change is markedly affected by human activities (and more rapid than originally expected), significant remedial action has been blocked and has been delayed by public uncertainty, doubt, and denial of climate change. The small group of deniers, mostly untrained in science, has been extremely vocal and is well funded. Not surprisingly, the United States is poorly prepared to cope with the profound challenges that climate change will bring. Funds for prevention of further climate change are scarce and unlikely to increase in the present financial crisis.
- (6) All areas on the planet will suffer from climate change, although some will have greater problems than others. Only science can estimate the physical, chemical, and biological changes, and only empathy can help humankind develop compassion for other life forms and other distant members of its own species in space or time. Ethics and compassion should have a higher priority than economic growth.

However, the eight interactive global crises that are threats to the biospheric life support system cannot be addressed by information that is inadequate. For example, determining the global mean temperature requires planet-wide input. In addition, the same systems of measurement (e.g., the metric system) must be used. To make effective global policy, a global systems-level perspective is essential. An unseasonable snowfall in Washington, DC, does not mean that global warming is a hoax.

Global problems require an opportunity-cost perspective. Funds must be spent where they will get the “biggest bang for the buck.” This approach will probably be strongly resisted by special interest groups and their lobbyists. Local and regional interests are certainly important, but the Biosphere is a global system and all regional problems and opportunities must be considered in a global context.

For practically all of its existence on Earth, *Homo sapiens* has been a tribal species spread thinly over the planet. In many ways, humankind still thinks and acts like a small-group species — such as distrusting and fearing other tribes (i.e., cultures). Language differences make communication difficult and sometimes lead to dangerous misunderstandings. Many people have a tendency to dwell upon and emphasize differences between cultures rather than commonalities. Finally, climate change events are moving much more rapidly than anyone expected. Social changes are slow and major adjustments must be made in decades rather than centuries.

¹¹I am indebted to Karen Cairns for calling this Zen quote to my attention.

The climate changes that humankind is almost certain to face (e.g., rising sea levels) require rapid, congruent, social evolution at a global level. As an essential beginning, humankind must co-evolve in ways that nurture the biospheric life support system, which means dramatic alteration of the present perpetual economic growth system with excessive use of natural resources that damages the Biosphere. Human society will have to live sustainably, not just talk about doing so.

Should humankind not choose to live sustainably, the universal laws of biology, chemistry, and physics will cull the human population. "Cull" is just a way of stating that some members of the human population will be incapable of adapting and will perish. Culling will occur not only by the universal laws mentioned but by humankind's (especially Western and affluent humans) refusal to change and its denial of responsibility. Humans are already responsible for the culling of poorer populations that are dying from the effects of climate change and who are becoming environmental refugees in increasing numbers. By this level of denial, humankind is now (although this situation is unacknowledged) deciding that other humans are "not worth saving" (Karen Cairns, draft manuscript). The worst case scenario is that too few individuals will adapt and the human gene pool will be so reduced that *Homo sapiens* will join the huge number of extinct species.

Much of humankind is in denial that extinction could happen, but seven species once existed in the genus *Homo* and only one remains. The "Black Death" caused population declines of 30% or more, depending on the area. The result was more renewable resources (e.g., fruit from trees) per capita. After a significant lapse of time, the result was the Renaissance — a period when the arts and sciences flourished. However, exponential population growth made the "Black Death" a minor, downward blip in the upward population growth curve. Renewable resources are again becoming scarce, and, as petroleum supplies for mega-agriculture decline, the production of food will suffer. The pressures to ignore and even become hostile to exponential population growth were simply too great to stabilize the human population and more misery was the result.

Truth can be found where one is: (1) if sufficient imagination can determine how the changes based on predications derived from evidence produced by credentialed scientists and published in peer-reviewed, scientific journals will affect the area right where one is and (2) if trust is placed in evidence produced by the scientific process and human society acts accordingly.

"The U.S. Energy Information Administration (EIA) has projected that the United States will lead the world into catastrophic global warming over the next twenty five years. In its 2011 Annual Energy Outlook, EIA predicts that energy-related CO₂ emissions will 'grow 16 percent from 2009 to 2035,' reaching 6.3 billion metric tons of carbon dioxide equivalent" (Johnson 2010). All but approximately 10% of the carbon dioxide will come from fossil fuel combustion.

The climate changes that have already occurred due to global warming have made conditions less favorable to humankind than they were. Evidence provided by climate scientists indicates future climate changes will be catastrophic. Human society must become more literate about the scientific process in order to put the attacks on it by special interest groups in perspective. The deniers of global warming have not published any robust scientific evidence that negates the preponderance of present scientific evidence.

Informed individuals can still do quite a bit in their local or regional areas and keep it congruent with global crises. However, everyone must be vigilant to identify misinformation and/or statements that attempt to discredit credentialed scientists without evidence from a peer-reviewed, scientific journal. Humankind got into these global crises because it forgot that all species, without exception, are affected by the universal laws of biology, chemistry, and physics. Actions not within the context of these laws are usually fatal. Humans must live with integrity, keeping in mind both local and global perspectives if *Homo sapiens* is to survive.

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Surviving Nature's Dark Side

*When ocean-clouds over inland hills
Sweep storming in late autumn brown,
And horror the sodden valley fills,
And the spire falls crashing in the town,
I muse upon my country's ills –
The tempest bursting from the waste of Time
On the world's fairest hope linked within man's foulest crime.
Nature's dark side is heeded now . . .*

Herman Melville, 1860, "Misgivings"¹²

Humankind has flaunted Nature's laws and now the rampant consumerism party is over. Growth has limits, and the penalties for exceeding them are appalling. Nature's dark side is starvation, disease, tornados, drought, and death. Discussing, or even mentioning, the extinction of *Homo sapiens* may be politically incorrect, but no "correctness" will keep it from happening. Deniers, politicians, lobbyists, corporate executives, billionaires, and the very poor will all suffer together — the universal laws of biology, chemistry, and physics apply equally to all. Global warming is not a hoax — it, like gravity, is a consequence of these universal laws, which are not a delusion. Pretending that humans need not obey these laws is the delusion.

Why is humankind clinging to an economic system that is destroying Earth's biospheric life support system?

We need an economy for the twenty-first century, one that is in sync with the earth and its natural support systems, not one that is destroying them. The fossil-fuel based, automobile-centered, throwaway economy that evolved in western industrial societies is no longer a viable model — not for the countries that shaped it or for those that are emulating them. In short, we need to build a new economy, one powered with carbon-free sources of energy — wind, solar, and geothermal — one that has a diversified transport system and that reuses and recycles everything. We can change course and move onto a path of sustainable progress, but it will take a massive mobilization — at wartime speed (Brown 2011).

In his State of the Union Address on January 6, 1942, one month after the attack on Pearl Harbor, US President Franklin D. Roosevelt expressed his intent to change the US economy from consumer orientation to wartime orientation at once. He did not set a goal of change for a given year, but NOW. Energy and food were rationed, young men were drafted, and the entire country was expected to make personal sacrifices. Most did. A change, just as vital, needs to be made NOW in current unsustainable lifestyles and the economy so that *Homo sapiens* has a future.

What would motivate humans to make an all-out commitment to carbon-free, alternative energy sources and move to a path of sustainable use of the planet? Again, Roosevelt asked for an all-out mobilization of US industries and citizens after the attack on Pearl Harbor, which resulted in a military victory in 3½ years. The United States, which had resisted involvement in World War II (WWII), swiftly became united in a common cause. Even though this example shows that all-out commitment can be achieved, some important differences exist between War World II dynamics and the necessity of a carbon-free, alternative energy source and sustainable living.

(1) After the attack on Pearl Harbor, the United States was strongly united and had a common goal. (2) During WWII, US cities and infrastructures were not devastated by bombing, shelling, and occupation by foreign military forces (as were Paris and Leningrad).

¹²I am indebted to Karen Cairns for calling this poem to my attention.

- (3) Although WWII started badly for the United States, the Battle of Midway on 4-7 June 1942 caused a huge loss of aircraft carriers for the Japanese, and the Battle of Guadalcanal, which began on 7 August 1942 and lasted six months, marked the first recapture of territory in the Pacific from the Japanese. Less than a year after the war began, a steady series of victories began for the United States.
- (4) In short, after less a year, the United States clearly was winning, and with less percentage loss in military casualties than expected.
- (5) A draft during WWII registered 6,000,000 US citizens. Many more people enlisted before they were drafted, which made the forces a truly citizens military. People feel differently about a war when their children's futures are at risk.
- (6) In addition to their taxes, citizens bought war bonds to finance the war.
- (7) The wealthy people did not flaunt their wealth and political leaders and their families served in combat units (e.g., President Roosevelt had four sons in the military).
- (8) Even so, after two years of war, some citizens were becoming restless and tired of war.

In 2011, the situation is dramatically different when the call is being made to think about future generations by living sustainably.

- (1) Even with a strong citizen commitment, which does not yet exist, to non-carbon sources of energy and sustainability, the effort will probably take half a century or more. The United States is highly polarized by conflicting ideologies.
- (2) Many citizens and their political representatives are hostile to scientists and their evidence on global crises (e.g., global warming).
- (3) A strong, well financed campaign is being waged against scientists and their science (e.g., Oreskes and Conway 2011).
- (4) Because most natural systems are non-linear, events typically move much faster than expected (Ritter and Hanly 2011). As a consequence, humankind fails to take precautionary measures in time.
- (5) The public is continually told something is "safe" (e.g., nuclear power) when it is highly risky because of "unexpected events." Life in general is risky and the better policy is to state the risks rather than indicate no risk — i.e., "safe."

Nature does indeed have a "dark side," but it is only displayed when the habitat of a species or biotic community changes so that it is no longer suitable for the present species that could not adapt to the new circumstances. The new conditions are the result of the universal laws of biology, chemistry, and physics. The failure to adapt may merely be the result of the rate of change, appearance of a more competitive species or biotic system, or a variety of other factors, many of which are yet to be discovered by science.

Humankind is totally dependent upon nature (the Biosphere) for resources that run the human economy and make survival possible. Humans cannot eliminate seeing nature's dark side, but can substantially reduce risks by using effectively the information provided by science. However, science cannot flourish in a hostile environment.

. . . a committee of the US Congress was poised to pass legislation that would overturn a scientific finding on the dangers of global warming. . . [the] bill is intended to prevent the US Environmental Protection Agency (EPA) from regulating greenhouse-gas emissions, which the agency declared a threat to public welfare in 2009. That assessment serves as the EPA's legal basis for regulation, so repealing the 'endangerment finding' would eliminate its authority over greenhouse gases. That this finding is scientifically sound had no bearing on the decision to push the legislation and . . . [the] energy and commerce committee have [has] made clear their disdain for climate science. . . anger and distrust were directed at scientists and respected scientific societies. Misinformation was presented as fact, truth was twisted and nobody showed any inclination to listen to scientists, let alone learn from them. It has been an embarrassing display . . . the legislation is fundamentally anti-science, just as the rhetoric that supports it is grounded in willful ignorance" (Editorial 2011).

Such actions are a perfect recipe for ensuring that humans see the dark side of nature, which can be accomplished by denigrating both scientists and their evidence, willfully ignoring the universal laws of science,

and using rhetoric and legislation in a useless attempt to avoid the consequences of humankind's actions. This very short-term, inappropriate "solution" will result in long-term catastrophe.

Acknowledgments. I am indebted to Paul Ehrlich and Paula Kullberg for calling useful references to my attention.

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Should I Become a Scientist?

“ . . . Science has much to say.

Science has much to say to the Islamist zealots who preach an intolerant doctrine.

It has much to say to young democrats enamored of the new technologies.

It has much to say to those who yearn for a better economic future.

And more importantly, it has much to say about the kind of values that we must adopt if our societies are to be truly open and democratic, for these are the values of science.

Dr. Ismail Serageldin
Founding Director of the New Library of Alexandria, Egypt

It's not denial. I am just selective about the reality I accept.

Bill Watterson
Calvin and Hobbes cartoonist

If they can't swallow facts, let them eat fiction.

Rain Bojangles

Why waste time learning, when ignorance is instantaneous?

Bill Watterson
Calvin and Hobbes cartoonist

Shutting off the thought process is not rejuvenating; the mind is like a car battery – it recharges by running.

Bill Watterson
Calvin and Hobbes cartoonist

The opportunities for science to make critical differences and influence policymaking in the 21st century are unprecedented in human history. Most, possibly all, global systems have, or might soon, cross tipping points that result in irreversible change. Human activities are influencing evolutionary processes. Some illustrative opportunities for science to make a difference follow.

The threat of global warming releasing huge amounts of stored carbon into the atmosphere is rapidly increasing. “An increasing share of global emissions [greenhouse gas] is from the production of internationally traded goods and services . . .” (ScienceDaily 2011a). “Cities worldwide are failing to take necessary steps to protect residents from the likely impacts of climate change, even though billions of urban dwellers are vulnerable to heat waves, sea level rise and other changes associated with warming temperatures” (ScienceDaily 2011b). The world's human population may reach 10.1 billion by 2100 (Gillis and Dugger 2011), even though global food shortages exist in 2011 with nearly 7 billion people on the planet. Agricultural productivity is down, and the overuse “of pesticides in Asia is raising the spectre of ‘pest storms’” (Abbugao 2011). “. . . the Fukushima meltdown [has been raised] to level 7, the highest category on the International Nuclear Event Scale” (Global Research 2011).

The realm of science has a superb quality control system for potential students that begins with a rigorous series of requirements for obtaining a degree in any field of science, including required courses and qualifying examinations. Most graduate degrees require a thesis or dissertation. In many fields of science, a post-doctoral position is often a requirement before employment in a prestigious research institution. In short, a research career as a principal investigator requires an investment of time from one's life, even though many positions in science may require significantly less of an investment of time. A principal research investigator has much responsibility and a considerable amount of insecurity.

In addition to studying and investing a great deal of time, research in science generally requires a considerable amount of extramural funding. Competition for research funding is rigorous, and funding for a

particular grant proposal is not assured. From 1948 to 1966, I worked for the Limnology Department of the Academy of Natural Sciences in Philadelphia, PA — all salaries at all departmental levels depended entirely on extramural funding. Not a single employee missed a salary payment during that entire period — most assuredly due to the tenacity of Director Ruth Patrick. However, a life dependent on obtaining needed funding in order to do research is not for everyone. In considering a scientific research career, one should search out the pros and cons of the field from a research scientist. At the very least, attending the annual meeting of a state academy of sciences would be enlightening. Such meetings usually provide opportunities for high school students in a junior academy.

Teaching can be combined with a research career or be one's primary focus as a scientist. I had the good fortune to do my undergraduate work at Swarthmore College in Pennsylvania. Teaching is extremely important there, but most of the faculty are also involved in research.

Some of my colleagues over the years have told me that they knew what they wanted to do as adults while they were still children. A research career for myself never entered my thoughts at that age. Not until I reached Swarthmore College after World War II was I exposed to wondering why some aspect of nature was "the way it was." Professor Robert Enders skillfully steered me in that direction. Only a little of his time was needed to entice me because he intrigued me with such questions as "How can freshwater sharks exist in Guatemala?" When I speculated on an answer, he then asked "How would you verify that hypothesis?"

When I was admitted to the zoology department at the University of Pennsylvania, my major professor David Wenrich prepared me for research with freshwater protozoans by seeing that I knew how to identify them. When he was asked to recommend someone for summer work to identify protozoans on one of two river survey teams being assembled by Dr. Ruth Patrick of the Academy of Natural Sciences, he suggested me, even though I had only one year of acquiring some basic skills. Dr. Mary Gojdics was the protozoologist on the other team. She had publications, including a book on euglenoids, and was very helpful to a novice. Basically, each research scientist is primarily self taught, but the nudges from mentors keep one on the track and focused. When summer was over, I was given a position on the permanent survey team; Mary returned to teaching but did serve on the Academy team for several summers. In short, in the early stages of their careers, research scientists must be nurtured, which is primarily done by individuals rather than institutions.

Becoming a scientist takes a substantial amount of time in the long term. The good news is that a number of options, each with a different level of commitment, lead to a reasonable level of satisfaction. I have carried out research since 1948, and it still gives me joy even though I can no longer do field work or laboratory studies. However, I have never taken a year-long sabbatical even though I have been entitled to it for many years. I knew that research programs could not be turned on and off like a light bulb. When students and technicians are involved, cash flow cannot be interrupted because the researcher is not actively seeking grant funds. If summers are spent teaching and carrying out research, contact with a variety of research investigators is invigorating, and spouses and children usually enjoy the atmosphere at field stations.

A career in science may also provide an opportunity to be of service to both humankind and the other life forms with which humans share the planet. Climate change, exponential human population growth, and natural resource depletion need to be explained to non-scientists, as do many other issues such as sources of energy and the risks and benefits of each source. An important responsibility for present day scientists is to communicate the steadily increasing risks to humanity from rapid climate change, hazardous materials, and so on (e.g., Ehrlich and Ornstein 2010, Brown 2011).

On the "downside" of a scientific career is the chilling effect of political controversy on both scientific teaching and research as ". . . political controversies can shape what scientists choose to study" (Kempner 2008). "There is a tendency to think of scientists . . . as members of an intellectual community guided by norms of openness and transparency and committed to critique, organized skepticism, and the production of objective knowledge" (Kempner 2008). However, scientists are also spouses and parents who are highly focused on research and teaching, devoted to civility, and apprehensive about tenure and promotion. Few could deal with the assaults that some scientists have endured and are not emotionally equipped to cope with the controversies of the 21st century. For example, some scientific research will inevitably be perceived as a threat to special interest groups. In addition, public funds are often used to fund grant proposals for research that often sound weird to laypersons, even though the information would have scientific value. Many grant applications are not funded because too many requests are made for available resources. Proposals with titles that impress non-scientists will have a disturbing effect on science.

The last half of the 20th century and the early part of the 21st century has witnessed a well financed, concerted effort by a small group of scientists who did almost no original research on issues ranging from tobacco smoke to global warming and have cast doubt on the robust, scientific evidence (Oreskes and Conway 2010).

Why would scientists dedicated to uncovering the truth about the natural world deliberately misrepresent the work of their own colleagues? Why would they spread accusations with no basis? Why would they refuse to correct their arguments once they had been shown to be incorrect? And why did the press continue to quote them, year after year, even as their claims were shown, one after another, to be false? . . . a group of scientists . . . fought the scientific evidence and spread confusion on many of the most important issues of our time. . . . a pattern that continues today . . . about fighting facts and merchandising doubt (Oreskes and Conway 2010, pp. 8-9).

Nature will confirm that the robust evidence gathered by credentialed scientists is correct, and science will triumph over ignorance as it has always done in the past. The people who accept the misrepresentations of science will pay a terrible price. The “merchants of doubt” have effectively delayed action on climate change and other global crises so that some of the changes that have already occurred (e.g., changing ocean water from slightly alkaline to slightly acidic) are irreversible in human time frames. Other crises now occurring (e.g., melting of the planet’s glaciers) will probably continue and result in many irreversible changes (e.g., sea level rise). The human population is still growing exponentially. As a consequence, resources per capita are likely to decline substantially. Science has flourished in times of plenty and survived in times of scarcity; however, in the future, resources for science, education, the arts, and so on will be less abundant.

Science is basically an attempt to determine how the universal laws of biology, chemistry, and physics work and interact. A career in science is a never ending journey full of excitement and challenge. Data gathering seems boring to many people because they lack the vision to see the goal — discovery of new information. Earth’s biosphere is a dynamic system that may never be fully understood. Much remains to learn and discover, so science is a lifetime process that can be quite stimulating. A tremendous satisfaction can also be gained by accepting individuals as students, having them leave as colleagues, and watching their careers flourish. Fulfillment also comes from collaborating with scientists in other disciplines to explore transdisciplinary research. In short, exploring new areas of science with my students and colleagues has been incredibly stimulating. I cannot visualize being in a non-science career as my career in science has brought me great joy.

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You Can't Stop Progress!

*Development will conquer the diseases of the poor,
By spraying all the houses and by putting in the sewer,
And we'll know we have success in our developmental pitch,
When everybody dies from the diseases of the rich.*

Economist Kenneth E. Boulding
(1969, p. 3)

Be Content with what you have; rejoice in the way things are. When you realize there is nothing lacking, the whole world belongs to you.

Lao Tzu

There are three kinds of men: The ones that learn by reading. The few who learn by observation. The rest of them have to pee on the electric fence and find out for themselves.

Will Rogers

All the invited participants for the week-long conference on “The Careless Technology” in 1969 were seated in alphabetical order in a large circle for the entire week. As a result, I had the great pleasure of sitting on Ken Boulding’s right hand while he composed the entire “Ballad of Ecological Awareness.” It is a masterpiece and was used as the conference summary. I first realized what Ken was doing when he asked me: “What rhymes with schistosomiasis?” Ken had a superb sense of humor.

Ken’s rhyme above on the diseases of the rich is still valid over 40 years later.

As is common with many countries as they industrialize, the usual plaques of poverty – infectious diseases and high infant mortality – have given way to diseases more often associated with affluence, such as heart disease, stroke, and cancer. . . . Lung cancer is the most common cancer in China. Deaths from this typically fatal disease have shot up nearly fivefold since the 1970s. In China’s rapidly growing cities, like Shanghai and Beijing, where particulates in the air are often four times higher than in New York City, nearly 30 percent of cancer deaths are from lung cancer. . . . Coal burning is also a major emitter of carcinogens and mercury, a potent neurotoxin. Coal ash, which contains radioactive material and heavy metals, including chromium, arsenic, lead, cadmium, and mercury, is China’s number one source of solid industrial waste (Larsen 2011).

Humankind should reexamine the human cost of economic growth. Despite the misleading publicity, “clean coal” is not yet available, even though, in the United States, a significant number of people still believe it exists. If “clean coal” ever becomes a reality, it will be expensive, and the trapped high risk components will still have to be located somewhere – in “someone’s backyard.” The desire for cheap energy or corporate profits places future generations at serious risk.

Burning fossil fuel, such as coal, produces an enormous amount of carbon dioxide. As the amount of carbon dioxide continues to rise, so does ocean acidification. Marine ecosystems are at risk globally from “impairing the ability of organisms to form shells or skeletons” (Kelly et al. 2011). Coping with oceanic acidification at a global scale is a daunting challenge, but dealing with acidification of coastal areas locally may be obtainable (Kelly et al. 2011). Coastal communities will also have to cope with sea level rise caused by climate change from carbon dioxide and other greenhouse gases.

Alternative sources of energy to coal exist. Policymakers often tout a mix of sources including nuclear, wind, solar, and geothermal. However, events at the Fukushima nuclear power plant in Japan have raised many practical considerations about the risks of nuclear power. One of the problems is that people pay little or

no attention to what has happened in other countries or even parts of their own country, and no substantive discussion occurs in the media of experiences with uranium mining elsewhere. “Tailings,” waste material after processing uranium, can be huge in volume and are not without risk. Late in the 20th century, many tailings piles were transported from areas where they posed a significant risk to areas where they were buried underground, decreasing human exposure to radiation and preventing redistribution by strong winds. Relocating tailings is an expensive process and involves a significant degree of risk since small particles of radioactive dust can be blown away if the tailings are not covered.

In humanity’s quest for “progress,” ecological tragedies, such as the British Petroleum massive oil leak in the Gulf of Mexico in April 2010, have a tendency to be discounted. Hasty responses to ecological disasters usually involve statements that ecosystems are tough, not fragile, because some species have either recolonized the damaged area or some individuals of some species managed to survive. These responses indicate why a distinction must be made between loss of biodiversity and biotic impoverishment. Reports began to appear after the catastrophic explosion at the Chernobyl nuclear power plant in 1996 that a dead zone was “. . . no longer a wasteland . . . but rather a lush wildlife refuge . . .” (Featherstone 2011). However, no robust evidence indicates as yet that this situation was due to radiation. The area around the Chernobyl reactor itself remains an “exclusion zone,” and humanity is creating zones of alienation on a regular basis (Featherstone 2011). Each represents loss both to the Biosphere and to humankind. How many more of these losses can humankind afford? How many more can the Biosphere afford?

The Fukushima nuclear catastrophe in Japan was first graded 5 and then was raised to 7 on the international scale of nuclear catastrophes, making it comparable to Chernobyl. The scale is based on the estimated total amount of radiation released and the estimated human health and environmental impacts (Featherstone 2011). However, like Chernobyl, the initial estimates will probably be too conservative. Even so, the Fukushima events have resulted in a shift in public sentiment worldwide against nuclear power plants, and “The crisis at Fukushima Daiichi and government pledges to rethink energy policy from a ‘blank slate’ have sparked widespread speculation that Japan will abandon plans for new reactors, spelling the eventual end of an atomic sector that until this year accounted for nearly 30 per cent of electricity generation” (Dickie 2011). In contrast, “Germany announced . . . it would become the biggest industrial power to completely give up nuclear energy following the crisis at the Fukushima plant in Japan, saying that all nuclear reactors would be shut by 2022” (Politi 2011).

The major, unaddressed issue on nuclear power plants is that nuclear catastrophes are global problems that are still being addressed nation by nation. The Chernobyl catastrophe spread radiation to practically all of Europe, and, since a major portion of the Fukushima radiation is draining into the Pacific Ocean, it will almost certainly have a wide distribution in both marine and terrestrial systems. “A study has found that radiation from the plant [Fukushima] has spread over 230 square miles, . . . suggesting that there could be a Chernobyl-like ‘dead zone’ if the government doesn’t act quickly to decontaminate soil” (Politi 2011).

As the climate situation worsens, such as the still increasing anthropogenic greenhouse gas emissions (BBC News 2011), more curious “solutions” will emerge from non-scientists — Representative Dana Rohrabacher, a Republican from California, has suggested during a Congressional hearing “. . . that clear-cutting the world’s rain forests might eliminate the production of greenhouse gases responsible for climate change Forestry experts were dumfounded by Mr. Rohrabacher’s line of questioning, noting that the world’s forests currently absorb far more carbon dioxide than they emit — capturing one-third of all man-made emissions and helping mitigate climate change” (Rudolf 2011). Despite this obvious lack of knowledge of the world’s forests, no outright expression of outrage has been voiced by the general public.

“You can’t stop progress!” is a badly outmoded viewpoint left over from the days when cheap, abundant energy provided the illusion that humans had conquered nature — which was never true and never will be! Mother Nature, i.e., the universal laws of physics, chemistry, and biology, will always prevail. Life on Earth has had five mass extinctions of species and has always rebounded with a huge number of new, quite different species. Nature can “afford” huge losses of species and individuals and life goes on by replacing the losses in evolutionary time. In the sixth great extinction, now in progress, many species have already become extinct, and the end is not yet in sight. *Homo sapiens* might yet survive since it is the major factor in the sixth great extinction.

Survival might be accomplished by redefining progress as living sustainably in harmony with the present Biosphere by not violating the universal laws of biology, chemistry, and physics. A good start would be to cease “. . . the war on climate science and scientists that’s going on now” (Kerr and Kintisch 2010). Civilization cannot reject science and survive. Science is based on peer-reviewed evidence — facts to use for quality living and survival. Science is a process, not a specified discipline, and science must be accepted as such. No amount of money, disinformation campaigns, or vocal merchants of doubt can suppress the universal laws. Billions of

dollars cannot protect an individual, a nation, or a special interest group. If humankind continues “business as usual,” it will experience the “dark side of nature” (pages 141-143 in this volume)!

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“SEE YOU LATER, ALLIGATOR. AFTER A WHILE CROCODILE”

Lyrics by Bill Haley

Research on exposure effects on female alligators from agricultural chemicals “showed signs of ovarian failure and infertility, essentially giving what would be a human woman in her 20s or 30s the body of a 50-year-old” (Kropf 2011). This finding brings the Bill Haley lyrics of the 1950s to mind. “Ancestors of the American alligator appeared 200 million years ago” (Louisiana Alligator Advisory Council, <http://www.alligatorfur.com/alligator/alligator.htm>), and soon Americans may not be able to “See you later, alligator.” “The alligators of South Carolina are the latest ‘canary in the coal mine’ species. They are animal-sentinels that will help tell whether and how far along the flood of pollutants, toxins and agricultural runoff in state water are on their way toward adversely affecting humans” (Knopf 2011). However, very few people seem to be noticing, which is astounding since humans have much in common physiologically with the other species with whom they share the planet. Humans are not paying attention and are driving many species to extinction. A probable answer is that most humans do not perceive themselves as part of the Biosphere, although all life forms on Earth are.

One assumption could be made that global warming could benefit the American alligator because increased temperatures should enable it to expand its range northward. Furthermore, melting glaciers and ice packs will result in sea level rise, enabling the alligator to occupy low elevation coastal areas that were previously not available. Hazardous chemicals affecting the alligator’s reproductive ability and health might well negate the “advantages” of temperature increase and the availability of new habitat. Any estimates of risk should involve all major factors or the environment will be saying “farewell” to many species instead of “see you later.”

Humankind’s obsession with economic growth has diverted attention from two high risk practices.

- (1) Nothing should be manufactured that cannot be beneficially reintroduced into the biospheric life support system upon which all species and the economy depend. One example is plastic — ubiquitous in the 21st century, but, once used by humans, it should not be reintroduced in the biospheric life support system (e.g., Freinkel 2011). For most of the 3½ billion years that life has existed on Earth, the waste (output) of one species could be used as a resource (input) for one or more other species. However, plastic is not only useless to the biospheric life support system but is harmful both physically and toxically. Turtles can be caught in plastic mesh, and many other creatures have been injured in various ways.
- (2) No manufactured products or waste products should be released into the environment in quantities that the biospheric life support system cannot beneficially assimilate. One toxic effect of plastics comes from phthalates.

Phthalates are a class of chemicals added to a number of common consumer products. In 1994, close to 87% of all phthalates in the United States were used as plasticizers, or softening agents, in vinyl products. . . . Eating, breathing and skin contact, as well as blood transfusion, are all ways, either together or alone, that phthalates make their way into our bodies. . . . eating is probably the main route by which humans are contaminated with diethylhexyl phthalate (DEHP), the most widely used phthalate plasticizer. DEHP migrates into food from certain foodwraps during storage. Similarly, we are also contaminated with other commonly used phthalates such as diisononyl phthalate (DINP) (Coming Clean 2001).

Clearly, estimating the assimilative capacity for phthalates of the biospheric life support system is a difficult task since many routes can take them into the human body. Phthalates in plastic are accumulating in the environment, so the risk of further contamination in the bodies of humans and other life forms will continue to increase.

The Risk of Mass Extinction

Paleontologists have identified five global mass extinctions over the past 540 million years in which the number of species declined by over 75% in massive biotic turnovers in a geologically brief interval (<http://bolpark.physics.umd.edu/WN11/wn030411.html>). Recovery from each mass extinction took millions of years. Persuasive evidence indicates that mass extinction six is already under way. Since a huge number of species on Earth have yet to be identified or studied, estimating the rate of loss is difficult, but it is clearly higher than replacement rate. The sixth mass extinction differs from the first five because it is the result of human

activities, although the first and second mass extinctions were the result of global climate change (Eldredge 2001). The sixth mass extinction may also be different because of the rate of change.

Alligator mississippiensis (the American alligator) is at increased risk because of toxins and agricultural runoff produced by another species – *Homo sapiens* – which could, if continued, hasten its extinction. Species extinction is a continual event. “Surprisingly, mass extinctions probably account for the disappearance of less than 5% of all extinct species — 95% of species extinctions occur between mass extinctions” (Cairns 2009). In short, all species are vulnerable to extinction at any time (Erwin 2008). In fact, *Homo sapiens* could be just another transient species (Cairns 2007).

The fact that extinction is the norm — a process that is inevitable, such as aging and death — is not exactly comforting. In some cultures, elders receive great respect — after all, great luck and stamina helped them achieve old age and, along the way, some wisdom. Sustainable use of the planet, if practiced and achieved, might actually increase the time that *Homo sapiens* has on the ecological stage of the evolutionary theater. However, what humankind could do to achieve sustainability and what it is doing are far apart. If humans were working to achieve sustainability, the eight global crises (Cairns 2010) would not have all worsened, but they have. “In all previous ages . . . Asian and European civilization [read “Western culture”] had shared the same basic values. Quite recently, though, a Europe infected with a despiritualized hypermaterialism had whirled off on its own destructive tangent, imperiling human dignity and even survival” (Gandhi in Paine 1998, p. 238).

Ecological Footprints by Nation

A vast difference exists in the size of the ecological footprint of each nation (<http://www.footprintnetwork.org/en/php/GEN/page/footprint>). Information on ecological footprints leads to some important questions: How much more of Earth’s resources can *Homo sapiens* take for itself without causing biospheric collapse and mass extinction? In short, what is the tipping point due to biospheric lack of adequate resources that will cause biospheric collapse? How many resources will be available per capita when the human population reaches 10 billion?

Conclusions

The same chemicals that adversely affect the alligator also affect humans adversely. At the global level, what is bad for the biosphere is also bad for its component species, including humans. Humankind cannot protect only those parts of the biosphere perceived to be beneficial to humans — it must protect the entire system. Each individual must act in a way that, if everybody on the planet acted in a similar fashion, life on Earth would not be threatened. To accomplish this goal, humans must share the same values. Given the present state of the world, such an achievement is difficult to visualize — as difficult as visualizing extinction. Life existed on Earth for approximately 3½ billion years without humans. The planet needs the Biosphere and its huge array of species, but it does not need *Homo sapiens*.

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THE VISION THING¹³

Where there is no vision, the people perish.
29:18, Bible

Proverbs

Great leadership does not mean running away from reality. Sometimes the hard truths might just demoralize the company, but at other times sharing difficulties can inspire people to take action that will make the situation better.

John Kotte

Vision without action is a dream. Action without vision is simply passing the time. Action with vision is making a positive difference.

Joel Barker

Knowledge is love and light and vision.

Helen Keller

No one is less ready for tomorrow than the person who holds the most rigid beliefs about what tomorrow will contain.

Winston Churchill

We can chart our future clearly and wisely only when we know the path which has led to the present.

Adlai E. Stevenson

The Biosphere is being badly damaged, and most of the general public and its political representatives have failed to express any dismay or even concern about these events. No vision exists for what the Biosphere would be like if humanity nurtured it or what it could become if humankind continues business as usual. In addition, scientists and the evidence they produce are being denigrated or worse (e.g., science is a hoax, a conspiracy, mere money grabbing) by a handful of individuals, only a few of whom are credentialed scientists with climate change research experience. The media continues to present both sides of the issue of climate change even though a huge number of mainstream scientists represent one side and a handful of credentialed scientists the other. However, the preponderance of scientific evidence confirms that anthropogenic greenhouse gases are causing global climate change. The scientific results are in, and the scientific debate has moved from the big picture to small but important details. However, the major missing component is vision. Humanity badly needs leaders with broad vision because, without renewable resources from the Biosphere, jobs and the financial economy will disappear.

Manus (1992) defines *vision* as a “. . . realistic, credible, attractive future for your organization.” The words *realistic* and *credible* are extremely appropriate in considering solutions for global problems, although their real meanings may not be attractive in the near term to citizens, politicians, and economists. A short-term sacrifice will be necessary to attain an attractive future, which requires both knowledge and wisdom. The world’s great philosophers have included all aspects of the human condition — compassion, empathy,

¹³Attributed to US President George Herbert Walker Bush. Currently used as a description “for any politician’s failure to incorporate a greater vision in a campaign, and has often been applied in the media to other politicians or public figures” (http://en.wikipedia.org/wiki/Vision_thing).

community, civility, common spirit, responsibility to the larger whole, values, justice, honesty, love, hope, and so on — in the words *vision* and *wisdom*, whose spirit is essential for the survival of civilization.

The thin layer of living material that surrounds Earth is the Biosphere. The sixth and present one is the environment in which *Homo sapiens* evolved and, at times, flourished. The five previous biospheres operated on conditions that were not favorable, even hostile, to humans. Consequently, the present Biosphere should be protected and nurtured for humanity's survival. This Biosphere maintains conditions favorable to humans, is the source of renewable resources essential to the human economy, and functions as an interactive system (e.g., Lovelock 1988) that is more than a collection of plants and animals. However, similar to all complex systems, the Biosphere has tipping points beyond which irreversible change occurs. The biggest threat to humanity is neither terrorists nor a recession, but the collapse of the present Biosphere. Because of the short life span of individuals, they assume that the present Biosphere will always exist; however, the collapse of the previous five biospheres before humans evolved should indicate this belief is unjustified. Scientists are continually learning more about the Biosphere, but the fact that it is humankind's life support system and the source of renewable resources critical to the human economy should be sufficient reason to protect and nurture it.

Although scientists have generated much evidence on human effects on climate change, the treatment of scientists increasingly lacks civility. The citizens of the United States and the politicians elected to represent them have an unwritten social contract to live and work with one another with civility and responsibility. Past generations had a high regard for compassion, empathy, and reason (Connelly 2011). In their place, current generations now have a growing "civility deficit" (Connelly 2011). In order to survive, *Homo sapiens* must strengthen its social bond and restore respect for civility, compassion, science, and reason. When humanity consisted of small tribes, as it did for most of the time that *Homo sapiens* has been on the planet, mutualistic, cooperative behavior for survival was the norm — now it is not.

At the very least, humankind needs a global vision of the planet that future generations will inhabit. Economic growth, the present "vision," has not worked because billions of humans are hungry or malnourished and have little or no financial security. Humankind has yet to acknowledge that it inhabits a finite planet with finite resources, i.e., the carrying capacity for humans on the planet is finite. Limits exist to growth! A humane vision must include many generations of *Homo sapiens* and the 30+ million other species with which humans share the planet. Sustainable use of the planet is by far the optimal choice for a global system, but humankind is far from achieving this vision. A global vision must be centered on the Biosphere that is shaped by the universal laws of biology, chemistry, and physics, as were all the preceding biospheres. Consequently, the global vision must be congruent with these natural laws as they are presently understood.

The loss of the present Biosphere is an existential risk, i.e., one that *Homo sapiens* has not faced during the 200,000 years the species has been on Earth. Both the oceanic and terrestrial portions of the Biosphere are in peril and are a cause for deep concern. Ironically, at the same time that rapid Biosphere decline is in progress, both regulations to protect the environment and the agencies that enforce them are being eliminated or have had significant cuts in funding.

Above all, the biophysical reality must be accepted – a finite planet with finite resources that has limits to growth. Exceeding Earth's carrying capacity for any species, including humans, has severe consequences. Economic growth, as presently practiced, will deplete renewable resources more rapidly than they can be regenerated. Any achievable vision must recognize this reality. Life is exceedingly rare! It only exists on Earth in this solar system, and, even in the galaxy of which Earth is a part, no robust evidence exists to show life except on Earth. Life probably does exist somewhere in the universe, and, even if it does, life is still both rare and precious. So why did the US Supreme Court give corporations more protection from risk than is given to living creatures? (Hartmann 2011). "Corporations are neither physical nor metaphysical phenomena. They are socioeconomic ploys — legally enacted game-playing — agreed upon only between overwhelmingly powerful socioeconomic individuals and by them imposed upon human society and its all unwitting members" (Buckminster Fuller 1983, p. 25). Corporations are now destroying Earth's life support system in the name of economic growth.

Globalizing the Consumption Model

Some developing countries, such as China, can now afford increased consumption of coal, paper, grain, and oil. Why should China's citizens not enjoy these commodities? Even though they can now afford to purchase biospheric resources beyond regenerative capacity does not mean they should do so. Many individuals may now be able to afford such consumption, but the Biosphere cannot afford to have high resource consuming individuals and nations. Humankind's vision must be one that nurtures the Biosphere rather than a high consumption vision that destroys it.

Brown (2011) gives a concrete statement of the future if business as usual continues: "For almost as long as I can remember we have been saying that the United States, with 5 percent of the world's people, consumes a third or more of the earth's resources. That was true. It is no longer true. Today China consumes more basic resources than the United States does."

A Viable Vision

Living in harmony with the present Biosphere is a viable vision since *Homo sapiens* did so for approximately 200,000 years. Ecological overshoot/debt began in December 1987 and with it came damage to natural capital and the present Biosphere. Perpetual economic growth on a finite planet is not a viable vision because it is damaging Earth's life support system and, if continued, will result in the collapse of the present Biosphere. Humankind must have a vision of living within the resource limits of a finite planet, which requires living within Earth's carrying capacity for humans. Some means other than misery, starvation, disease, and death must be found to stop exponential population growth. A vision of growth in knowledge and wisdom is compatible with the vision of sustainable use of the planet. The view of other life forms (i.e., species) must be replaced by a vision of life as a rare and precious entity that occurs only on Earth. Above all, a vision of civility is badly needed — effective solutions to global problems require civility.

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TOUGH DECISION VS DENIAL

Real vision demands that we make tough choices.

Michael F. Easley

Nobody ever did, or ever will, escape the consequences of his choices.

Alfred A. Montapert

One reason we resist making deliberate choices is that choice equals change and most of us, feeling the world is unpredictable enough, try to minimise the trauma of change in our personal lives.

Hugh Mackay

We're going to have to make tough choices and we're going to have to make them together.

Bill Clinton 42nd US President

Quick decisions are unsafe decisions.

Sophocles

The food and water crises, which are closely linked since agriculture is a major consumer of water, have been developing for well over a decade. “. . . food scarcity will be the defining issue of the new era now unfolding, much as ideological conflict was the defining issue of the historical era that recently ended. Even more fundamentally, . . . rising food prices will be the first major economic indicator to show that the world economy is on an environmentally unsustainable path” (Brown 1996).

Another major issue is the disparity in food consumption. “While nearly one billion people worldwide are overweight or obese, the same number of people – one in every seven of us – can’t get enough to eat” (Roberts 2008, flyleaf). “After decades of hearing that our food system is the best, it almost seemed as if a curtain had been drawn back and we’d been allowed a glimpse of the shadowy structure behind the food system – the huge networks of production and distribution and retailing that deliver millions of tons of food to the hundreds of million of consumers – only to find those structures broken or derailed” (Roberts 2008, p. xi). “On nearly every level, we are reaching the end of what may one day be called the ‘golden age’ of food, a brief near-miraculous period during which the things we ate seemed to grow only more plentiful, more secure, more nutritious, and simply *better* with each passing year” (Roberts 2008, p. xii).

Efforts to anticipate how climate change will affect future food availability can benefit from understanding the impacts of changes to date. . . . in the cropping regions and growing seasons of most countries, with the important exception of the United States, temperature trends from 1980-2008 exceeded one standard deviation of historic year-to-year variability. Models that link yields of the four largest commodity crops to weather indicate that global maize and wheat production declined by 3.8% and 5.5% respectively, compared to a counterfactual without climate trends. For soybeans and rice, winners and losers largely balanced out. Climate trends were large enough in some countries to offset a significant portion of the increases in average yields that arose from technology, CO₂ fertilization, and other factors (Lobell et al. 2011).

In short, the “golden age” of food is over, and prospects will probably worsen if anthropogenic greenhouse gas emissions are not markedly reduced very rapidly. Even though many calculations and trends relating to food productivity are available, the major issue is the tough choices that must be made if humankind continues to deny reality. Some illustrative examples follow.

(1) A total of 60 failed states were identified in 2011. Somalia is at the top of list, closely followed by Chad and Sudan (Failed States Index, http://www.foreignpolicy.com/articles/2011/06/17/2011_failed_states_index_interactive_map_and_rankings). Somalia has many serious problems: “Beyond freelance gunmen, Islamist militants, cholera, malaria, measles, and the staggering needs of hundreds of thousands of starving children; aid agencies scrambling to address Somalia’s famine now may have another problem to reckon with: the wholesale theft of food aid” (Gettleman 2011). Approximately 2.26 non-failed states (136 out of 196) exist for each failed state (<http://geography.about.com/cs/countries/a/number%20countries.htm>). Even if the 136 non-failed states agreed to provide long-term, significant assistance to the 60 failed states, they could not be certain of the aid being received by the needy people. In addition, these non-failed states might stipulate certain conditions (e.g., population control) be enforced in return for the aid.

(2) Some non-failed states have been proponents of the unfettered economic free market. Should economics or values/ethics/morality determine who receives access to the global food supply?

(3) Every choice or decision has a default position. If the choice is no action, then the universal laws of biology, chemistry, and physics will be operative, and the human population will be culled by starvation, disease, and death until it is at or below Earth’s carrying capacity for humans. This inability to make tough choices carries a terrible price tag. Tough choices require facing reality, which includes such issues as limits to growth and population stabilization.

(4) For most all of the 200,000 years that *Homo sapiens* has existed, resources were gathered by individuals in small tribal groups that were spread thinly over the planet. Humans are the only species with such a vast range of access to resources. Money as a means of access to resources was not important – individual fitness was. At present, vast wealth for less than 1% of the human population provides essentially unlimited access to resources while approximately 1 billion humans are starving. Some obvious questions are related to this inequitable access to resources: (a) is it compassionate/ethical to live in luxury when one person in seven globally is starving? (b) does it make any difference where the starving people are located? (c) if the starving people are given food, will they still produce large numbers of children?

(5) Tough choices are required to optimize the quality of life of the current human population and the 3 billion expected in the 21st century. How will these additional people be fed, provided with potable water, acquire shelter, be educated, and have access to health care? If starvation and misery are the probable future of these additional people, do those people presently alive have any responsibility for individuals yet to come? Should starvation, disease, and death be the primary means of population control? If not, how should the human population be kept within Earth’s carrying capacity? The essential first step is to acknowledge that a finite planet has limits to growth. The unwritten taboo on discussion of maintaining the human population within Earth’s carrying capacity must be transcended. Denial of limits to growth can be a very strong negative force; however, it should not be allowed to cause billions of people to live in misery, threaten the stability of social systems, and serve no useful purpose whatsoever. Humankind has lived in denial of the downside of overpopulation and must make the tough choices necessary to at least reduce misery.

(6) Climate change is having major impacts on marine ecosystems, which cover approximately 71% of Earth’s surface and are being badly damaged. Can issues of national sovereignty be adjusted to protect this major component of Earth’s Biosphere? Humankind’s actions display little concern for the Biosphere since “the environment” is usually last, or not far from last, on the policy priority list and the human economy is almost always first. However, the Biosphere is both the planet’s life support system and the source of renewable resources, without which the human economy would not function. Perhaps the view of the Biosphere as a miscellaneous collection of plants and animals (i.e., commodities and pests) is at fault; however, not acknowledging humankind’s dependence on the Biosphere is suicidal. The reality of this tough choice is that it weakens humankind’s sense of superiority over the planet’s other life forms.

Conclusion

Since most of the global crises have been caused by aggregate individual decisions, a tough choice is to acknowledge that each person is responsible for the current problems. *Homo sapiens* will not be able to address global problems effectively unless a civil global discourse takes place. Since the future of the current

and next generations of humans requires that discussion and action occur, humankind must have the faith that they can!

Acknowledgment. I am indebted to Paula Kullberg for calling a useful reference to my attention.

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THE MONKEY TRAP

Place a large, attractive nut inside a glass container with an opening just large enough for a monkey to insert a paw. The paw goes in easily and the monkey grasps the nut, but cannot withdraw the paw while grasping the nut. The monkey is trapped while grasping the nut, but could easily escape by letting go of the nut. However, the monkey wants the nut and refuses to let go; consequently, he remains trapped. The original metaphor uses a box and bananas, but I have chosen to depict the metaphor by using a glass jar and a nut because the monkey could see the problem and still would not let go.

The “monkey trap” is a superb metaphor for humanity’s present addiction to fossil fuel and consumption of material goods far beyond the basic needs for food, clothing, and shelter. Humans know that finite amounts of fossil fuel exist on a finite planet and that all the easy sources have been tapped. The remaining sources of fossil fuel are hard to obtain and involve ever increasing risk and danger. However, humanity refuses to transition to non-carbon energy alternatives (e.g., solar, wind, geothermal). Much opposition and much support are voiced for the Keystone XL pipeline from the tar sand deposits in Canada to refineries in Texas, USA. Tar sands are a dangerous source of energy and the long pipeline would damage both ecological and societal areas. Some considerations follow.

- (1) *Homo sapiens* is facing the most serious crises it has ever faced. Although these crises were identified decades ago, humankind has failed to respond — when will *Homo sapiens* let go of the nut?
- (2) No politically acceptable solutions have been found for any of the interactive global crises, so the crises continue to worsen — when will humanity let go of the nut?
- (3) The fossil fuel era is ending because the supply is finite — when will humanity let go of the nut?
- (4) Robust evidence confirms that carbon, sequestered by natural laws for millions of years, cannot be extracted and burned at present rates without altering Earth’s climate — when will humanity let go of the nut?
- (5) Since the 1880s, carbon dioxide has been identified as a greenhouse gas that changes the climate — when will humanity let go of the nut?
- (6) The human population cannot expand exponentially without creating a food crisis — when will humanity let go of the nut?
- (7) No resource on Earth is infinite, but perpetual economic growth supporters act as if resources upon which economic growth depends are infinite — when will humanity let go of the nut?
- (8) The universal laws of biology, chemistry, and physics are preeminent and nonnegotiable, but humanity either ignores them or believes technology can transcend them — when will humanity let go of the nut?
- (9) The assaults on scientists who provide evidence on the functioning of universal laws will not change the functioning of these laws — when will humanity let go of the nut?

THE PERIL OF REPLACING SCIENCE WITH IDEOLOGY

Ideologies do not map the complete living processes of a World.

William Irwin Thompson

*When you were born, you cried and the world rejoiced,
Live your life so that when you die,
The world cries and you rejoice.*

White Elk, Native American

*When all the trees have been cut down,
When all the animals have been hunted,
When all the waters are polluted,
When all the air is unsafe to breathe,
Only then will you discover you cannot eat money.*

Cree Prophecy

Ideology — *shared ideas or beliefs which serve to justify and support the interests of a particular group or organizations* (<http://sociology.socialsciencedictionary.com/Sociology-Dictionary/IDEOLOGY>)

Ideology is not evidence based, as is science, but vigorously excludes contrary beliefs and even punishes persons espousing them. In the United States, the climate wars have reached the stage where denial of global warming has resulted in a tragic situation. For example, “for more than two decades, in their efforts to inform the public about climate change and its potentially disastrous consequences, scientists have run up against powerful vested interests who either deny that such change is occurring or, if it is, that human activity plays much if any role in it” (Mann 2012, p. xii).

The Commodity Trap

A *commodity* is an economic good or an article of commerce (*Merriam-Webster Dictionary* online). The view of Earth as a collection of components that can be turned into commodities for economic advantage masks the reality that the Biosphere is an interactive system with both living and non-living components that evolved over billions of years. Economists divide these components into renewable and non-renewable resources, both of which are essential to the human economy. Most important, the human economy has produced a large number of politically powerful groups that espouse the same ideology and can spend huge sums of money to defend their exploitation of the planet’s resources, even if the acquisition and use (e.g., fossil fuels) damage the Biosphere that functions as Earth’s life support system and the source of renewable resources. Humankind has known for centuries that damaging the environment (i.e., the Biosphere) can cause the collapse of civilizations (e.g., Diamond 2005), but society (or at least its elected officials) invariably chooses to protect special interests and ideologies rather than pay attention to a mass of scientific evidence. In fact, in the United States and some other developed countries, attempts are being made, often successfully, to limit the authority of regulatory agencies established to protect the environment. In a very real sense, the economic profits from damaging the Biosphere are used to suppress scientific evidence that confirms this damage. The preponderance of evidence demonstrates that anthropogenic greenhouse gases are changing the climate. In addition, strong evidence shows that the process of evolution has produced the great biodiversity of life observed over the ages. However, persistent attempts continue to offer alternative viewpoints to those based on scientific evidence (e.g., Kaufman 2012).

Anti Enlightenment

The Enlightenment, a philosophical movement of the 18th century, was based on a belief that reason, national discourse, and a reverence for knowledge were critical components of an enlightened society — hence,

the name. Leaders of the forming nation, the United States, such as Thomas Jefferson and Benjamin Franklin were inspired by this concept, and its tenets are evident in both the US Constitution and the Declaration of Independence. Evidence, not ideology, was a core of the Enlightenment. In the last part of the 20th century and the beginning of the 21st century, science in the United States was derided as being uncertain, disregarding that all life is characterized by uncertainty, including politics, sports, the stock market, the financial system, the prospects of a quality retirement, and job security and opportunity. In reality, science is a probabilistic determination based on evidence. Judgments are made on the basis of the preponderance of evidence, which is gathered in a process that uses peer-review before publication and confirmation by qualified scientists after publication. The word *theory*, much denigrated by critics of science, is not a guess but rather a carefully constructed testable hypothesis to be tested and either confirmed or rejected by robust evidence. If the preponderance of scientific evidence confirms the hypothesis, it is accepted by mainstream science, but any new contrary scientific evidence will result in reconsideration of the hypothesis.

Humanity has been well served by the research carried out by scientists. Longevity has been increased dramatically, and every day the technology based on scientific evidence is used and taken for granted. The quality control system developed for scientific information has worked remarkably well despite the vast increase in quantity as a consequence of the increased number of credentialed scientists. Qualified scientists are the best means of determining how the universal laws of physics, chemistry, and biology work, and, arguably, the only way since robust scientific evidence is essential. Scientists publish the results of their investigations without labeling them “good news” (i.e., news corporations and the general public like) or “bad news” (news regarded as a threat by corporations, ideologies, and religions). In ancient times, bearers of “bad news” were often punished (e.g., killed). In the 20th and 21st centuries, scientists produced evidence (e.g., global warming) that human activities were altering the global climate. As the evidence supporting this crisis increased, so did the assault on scientists (e.g., conspiracy, hoax) and their evidence (e.g., manipulated, uncertain). No “hoaxers” were identified; no contrary evidence was produced; and the crises worsened.

In the coming decades, science — and a respect for science — will prove crucial to confronting our greatest global challenges, whether that means reducing our carbon footprint to combat climate change, finding new treatments and new cures for diseases that ail us, or developing innovations that can lift hundreds of millions out of poverty. We cannot afford to ignore the power of science or the problems we will need it to solve. Nor can we afford to make decisions about our economy, and our future, without reason or sound evidence (vanden Heuvel 2012).

Where to Now?

How did humanity get trapped in this high risk situation? — by rejecting scientific evidence in favor of ideology. However, without scientific evidence, *Homo sapiens* is not likely to cope successfully with the new risks in a rapidly changing world. The common ideology is that technology will always provide more food for more people. Scientific evidence has shown that meeting continually increasing demands is not possible on a finite planet. “More” food and water for everybody is no longer achievable. Human population has dramatically outstripped biospheric resources. Regional examples of shortages have been occurring for centuries, but globalization has increased the risks for the entire planet. Approximately 1,000 tons of water are needed to produce a ton of grain. For example, net grain imports to the Arab Middle East have increased from a few million tons in 1960 to approximately 70 million tons in 2010 — a lot of water that is not included directly in the price of the grain (Rasmussen 2012).

Is US Science Education the Problem?

Replacing science with ideology is leaving human society in hazardous conditions. Undoing the harm done by the assault on science and scientists can be accelerated by increased environmental literacy, which must come from education and the clarification of the place of science in describing and understanding the physical world. Ideology based on special interests cannot be the foundation of dealing with the environment.

(1) Fifteen-year-olds in the U.S. ranked 25th among peers from 34 countries on a math test and scored in the middle in science and reading, while China’s Shanghai topped the charts, raising concern that the U.S. isn’t prepared to succeed in the global economy.

(2) The Paris-based Organization for Economic Cooperation & Development, which represents 34 countries, today released the 2009 Program for International Student

Assessment. For the first time, the test broke out the performance of China's Shanghai region, which topped every country in all academic categories. The U.S. government considers the test one of the most comprehensive measures of international achievement.

(3) The average U.S. science score of 502 ranks 17th in the OECD nations, which were led by Finland, Japan and South Korea. Twelve scores were statistically better, the [U.S.] Education Department said. Shanghai students scored 575. The U.S., which scored 489 in 2006, ranked 21st among 30 OECD countries that year (Hechinger 2010).

I find it ironic that Hechinger's article appeared on December 7, the same day the devastating attack on Pearl Harbor occurred, which served as a wakeup call for the United States. Citizens made sacrifices at that time on their own initiative. Their children and/or a friend's/relative's children were at risk. The same thing is true now, but no bombs are involved. However, if students cannot compete academically, they will face a life of frustration, humility, and scorn, except for the 1% with very wealthy parents. Denial of verifiable scientific facts is not a good approach in educating the young. In the long term, science triumphs somewhere on the planet — ideology loses after much misery and death.

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THE CONSEQUENCES OF GLOBAL HUMAN DOMINANCE

The world in general seems to be gradually awakening to a realization that our long evolutionary story is, through our actions but not our intentions, coming to a turning point. A product of evolution ourselves, shaped by the environments of our past, we have attained dominance by increasing our numbers, divesting resources, and reshaping the world's environments to sustain our huge, still growing population. That dominance has now led to a progressive destabilization of the global systems that sustain us.

Ehrlich and Ehrlich (2008, p. 364)

Humans have only recently been a dominant animal. For most of the 4 million years that the genus *Homo* existed and the 200,000 years that the species *Homo sapiens* has been on Earth, humans did not dominate nature. Just a few thousand years ago, only approximately 150 million humans were on the entire planet (Tanton 1995). In contrast, "World population is believed to have been fairly stable at about 300 million people from the birth of Jesus to the year 1000 A.D." (United Nations Population Division 1999). Whatever the actual global human population total was just over 2,000 years ago, it was tiny compared to the 7 billion people existing in 2012.

Just over 10,000 years ago, the Agricultural Revolution began and humans displaced natural systems to develop agriculture and to raise domesticated animals. Between 1750 and 1850, human society became engulfed in changing from rural to predominately urban lifestyles. The Industrial Revolution was possible because humans had developed technologies using fossil fuel (e.g., coal) that gave them more energy per capita than any other species (e.g., the Iron Bridge 2012).

Appropriation of Biospheric Space

The Agricultural Revolution was really the appropriation of space from the Biosphere to devote to cultivating species of interest to a single species — *Homo sapiens*. The Biosphere had high biodiversity up to that point, but the cultivated tracts that were initiated by humans were dedicated to only a few species. The Biosphere was self maintaining — the cultivated areas were not. The Biosphere provided a variety of ecosystem services — the cultivated areas produced primarily food.

The present Biosphere is a complex, multivariate system that consists of many regional components. However, many of these components are being lost or damaged by human artifacts such as shopping malls, road systems, housing developments, factories, surface mining, and removal of resources (e.g., fisheries, forests).

Not only has land been usurped, but the oceans are suffering changes that may not be conducive to the many species living there. The oceans, which represent about 71% of the global surface area, have changed from slightly alkaline to slightly acidic and, if "business as usual" continues, may become corrosive in some areas. Acidification has many deleterious effects upon marine organisms. At certain concentrations, many (arguably all) chemical substances produce observable, deleterious effects on global flora and fauna. Even more alarming, endocrine disrupters may have deleterious effects at very low concentrations.

Incremental Reductions of Biosphere

People often tend to discount biospheric catastrophes, such as the one at the Fukushima nuclear facility in Japan or the British Petroleum oil spill in the Gulf of Mexico, because they are remote and out of sight. However, even tiny, incremental loses can be significant over time. For example,

In March [2012], Nepal welcomed home an exhibition of plant and animal paintings drawn in the Kathmandu Valley over 200 years ago . . . Many of the plants pictured were once common in the Kathmandu valley but are now hardly seen at all. Some

have declined due to habitat destruction and deforestation, but many, especially the orchids, have suffered greatly from over-collection for trade in ornamental or medicinal plants (Pulse 2012).

Humanity cannot continue to trash components of the Biosphere as if they were throwaway artifacts.

Short-term Memory Loss

Even in something of great interest to the general public, such as the financial meltdown of 2008, public outrage directed at the big banks faded quickly (e.g., Huffington 2012). Complex, long-term global crises will never be resolved with humanity's short-term memory and world view. Sustainable use of the planet requires holistic reasoning, scientific evidence, and a laser sharp focus on the common good. In addition, sustainability requires recognition that dominance and technology do not provide immunity from the universal laws of biology, chemistry, and physics. Also, dominance without humility can be fatal.

Resisting Scientific Evidence and the Consequences of Denial

Hamilton (2010) sums up the problem of resistance and rejection of scientific evidence as follows.

Let me begin with a pregnant fact about United States' voters. In 1997 there was virtually no difference between Democratic and Republican voters in their view on global warming, with around half saying warming had begun. In 2008, reflecting the accumulation and dissemination of scientific evidence, the proportion of Democratic voters taking this view had risen from 52 to 76 per cent. But the proportion of Republican voters fell from 48 per cent to 42 per cent — a four percent gap had become a 34 per cent gap. What had happened?

The opening of the gulf was due to the fact that Republican Party activists, in collaboration with fossil fuel interests and conservative think tanks, had successfully associated acceptance of global warming science with 'liberal' views. In other words, they had activated the human predisposition to adopt views that cement one's connections with cultural groups that strengthen ones' definition of self. In the 1990's views on global warming were influenced mostly by attentiveness to the science; now one can make a good guess at an American's opinion on global warming by identifying their view on abortion, same-sex marriage and gun-control.

In 1948, when I acquired my first professional position, I believed that if I acquainted people with the evidence on pollution that they would come to conclusions identical or similar to mine. I soon realized that denial of pollution was not due primarily to a lack of evidence but rather due to their cultural beliefs. However, *Homo sapiens* did not become dominant by ignoring or attacking science. Dominance, coupled with ignorance about science and the scientific process, is very dangerous for the species *Homo sapiens*, the current civilization, and Earth's Biosphere.

Rejection of science and scientific evidence has long-term deleterious consequences, although denial of scientific evidence may have short-term political advantages, especially when people are told what they want to hear. Nature does not confer "rights" on any species. All species are subject to natural selection, which results in evolutionary processes. Humans can have conferences and set goals, but, if they are not congruent with the universal laws of nature, they will fail. The universal laws result in an "order" that is wildly different from human society's concept of "order." A paradigm is a body of scientific laws within which scientists work; however, periodically a paradigm shift becomes essential. Humanity will face paradigm shifts in the 21st century that will determine the future of civilization and the survival of *Homo sapiens*.

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KING CANUTE AND THE UNIVERSAL LAWS OF PHYSICS, CHEMISTRY, AND BIOLOGY

King Canute was a Danish king of England who died November 12, 1035. “. . . *Canute's courtiers flattered him into believing that his word was so powerful that even the tide would recede at his command*” (Ward's Book of Days 2006). The tide did not recede — King Canute had encountered one of the universal laws of physics before the laws were well understood, but, even then, individuals should have known that many natural processes are beyond humankind's dominance.

In the comparatively enlightened 21st century, ridiculing King Canute's naiveté is tempting, but humanity is still trying to circumvent the universal laws. For example, “*The state [of North Carolina] General Assembly's Replacement House Bill 819 would rule that scientists are not allowed to accurately predict sea-level rise*” (Zimmerman 2012). In addition, “. . . *North Carolina legislators are now tossing around bills that not only protect themselves from concepts that make them uncomfortable, they're DETERMINING HOW WE MEASURE REALITY*” (Huller 2012).

“*Denial is probably one of the best known defense mechanisms, used often to describe situations in which people seem unable to face reality or admit an obvious truth (i.e., “He's in denial.”). Denial is an outright refusal to admit or recognize that something has occurred or is currently occurring. Drug addicts or alcoholics often deny that they have a problem, while victims of traumatic events may deny that the event ever occurred*” (Cherry, undated).

The denial of sea-level rise would be distressing even if only the legislature of North Carolina was taking actions, but “*Like-minded legislators and state officials in Texas, Virginia . . . [have made it] illegal for state planners and zoning officials to refer to nettlesome scientific findings that might hurt coastal property values*” (Grimm 2012). The inland states have similar concerns about global climate change.

Denial is not all bad. “*The closer you look, the more clearly you see that denial is part of the uneasy bargain we strike to be social creatures*” (Michael McCullough as quoted in Cary 2007). Still, a high price will be paid for denying global warming and other types of climate change. One might also question the value of denying the Apollo man landings (Launius, undated) and other well documented events.

King Canute's naiveté a thousand years ago is unbelievable, but, in an age of robust science, humanity is still attempting to ignore or control the universal laws of physics, chemistry, and biology. Scientists in the United States are being accused of perpetuating a hoax and engaging in a conspiracy about global warming. However, no hoaxers have been named and no conspirators have been charged. Scientists are not responsible for the consequences of the universal laws — they just provide evidence on how they function.

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WHY HUMANKIND IS NOT LIVING SUSTAINABLY

"All my means are sane, my motives and my object mad"

Captain Ahab in *Moby Dick*

"We have involved ourselves in a colossal muddle, having blundered in the control of a delicate machine, the working of which we do not understand."

John Maynard Keynes
(although written about the economy,
these prophetic words apply equally well to the threats to the Biosphere)

"All my means are sane, my motives and my object mad" is a relevant statement of many goals of the 21st century human lifestyle that are damaging the Biosphere and keeping sustainable living at bay. Illustrative causes and needed responses follow.

- (1) Biospheric natural resources are being consumed at a rate beyond regeneration, causing a dangerous ecological overshoot that began in 1987.
- (2) The planet's oceans are being altered from mildly alkaline to acidic by the greenhouse gas carbon dioxide, for which anthropogenic emissions are still rising. Because solubility of carbon dioxide increases in cold water, the acidic condition may become corrosive in the Polar Regions if increased emissions continue.
- (3) *"Global climate change is a reality that is rendering the concept of 'background conditions' meaningless. We can no longer attempt to maintain the environmental status quo. What we can do is to attempt to maintain ecosystem services despite climate-driven environmental change"* (Chapman 2012).
- (4) Retaining ecosystem services, including regeneration of renewable resources, may require more work than reducing anthropogenic greenhouse gas emissions, and this situation occurs when the old adage "A stitch in time saves nine" is forgotten or ignored.
- (5) The political system (in the United States) is sluggish in controlling anthropogenic greenhouse gas emissions and making a prompt transition to non-carbon (solar, wind, geothermal) energy sources.
- (6) *". . . the global food demand is rising as many millions of people in developing countries acquire the means to eat rich diets. That alone would be expected to drive food prices higher, but . . . calculations suggest that climate change will greatly compound the problem"* (Gillis 2012). Surely food insecurity should be easily understood, even by persons without much environmental literacy. Humanity inhabits a finite planet with finite arable land, and global climate change is diminishing food and water security.
- (7) Humanity is acting as if it has the remainder of the 21st century to do something substantive about global climate change, but persuasive evidence indicates this hope is unlikely to be correct (ScienceDaily 2012).
- (8) Exponential human population growth is now a major crisis, but a very effective taboo quiets any discourse about it. Some people and organizations are even opposed to contraception to control population growth for ideological reasons. The daily population growth for the entire world is 230,970 persons per day (Population Reference Bureau 2012).
- (9) Fragmenting ecosystems is reducing biodiversity and accelerating biotic impoverishment. For example, scattered remaining patches of ecosystems *". . . are not providing many important species the protection they need to survive*

...” (Slivka 2012).

(10) Many of the world’s forests have survived because they are on mountains unsuitable for either agriculture or development. However, this situation is changing: “. . . forests in the region [Los Alamos, New Mexico, USA] have not been regenerating after the vast wildfires that have been raging for the last decade and a half. . . . Ecosystems are already resetting themselves in ways big and small, . . . The challenge for managing these ecosystems is to help them adapt. Seeking to preserve existing systems is futile . . .” (Rosner 2012).

(11) A major problem in public acceptance of reality is the false perception of “balance” in the United States news media. “From climate change to voter fraud, [the news media is] a reflection on ‘false balance,’ in which reporters are accused of giving equal credence to arguments on both sides of an issue regardless of the preponderance of evidence” (New York Times).

(12) The response to scientific evidence is much worse than most of us who believe in evidence and reason thought. “It is well known that when like-minded people get together, they tend to end up thinking a more extreme version of what they thought before they started to talk. . . . [a] kind of echo-chamber effect . . .” (Sunstein 2012). Although “people tend to dismiss information that would falsify their convictions . . . they may reconsider if the information comes from a source they cannot dismiss. People are most likely to find a source credible if they closely identify with it or begin in essential agreement with it” (Sunstein 2012).

In many cultures, science has been a credible source of information; however, in the United States, the merchants of doubt (Oreskes and Conway 2010) have been successful in casting doubt on scientific evidence and conclusions. Despite their small numbers, they have had a major impact because they were heavily funded and the news media typically gave them equal space and time with the scientists in the interest of “balance.”

The present throw-away economy uses renewable resources at an unsustainable rate as evidenced by ecological overshoot. When humanity pushes economic growth, it is simultaneously deleting the future of its descendants and millions of other species that depend upon the present Biosphere.

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COMPASSION VS RESOURCE SCARCITY

Truth crushed to earth will rise again.

William Cullen Bryant
as quoted by The Reverend Martin Luther King, Jr.

By showing hunger, deprivation, starvation and brutality, as well as endurance and nobility, documentaries inform, prod our memoires, even stir us to action. Such films do battle for our very soul.

Theodore Bikel

. . . the planet is robust, economic freedom is fragile.

Fred Smith, Competitive Enterprise Institute
(as quoted by Carl Pope 2012)

Conservation can no longer conserve, because any conservative who tried would not be funded.

John Grey, British Traditionalist
(as quoted by Carl Pope 2012)

If global warming is a serious problem requiring effective action, its solutions are governmental, global and majoritarian — and conservation exists to oppose those outcomes.

Jerry Taylor, the Cato Institute
(as quoted by Carl Pope 2012)

Compassion is easily expressed for an individual who is starving that one has been in contact with for a short time. One can also be persuaded by news stories, television or even books to become involved in situations of the disadvantaged. However, compassion is less easily fueled for posterity (i.e., individuals not yet born), even though intergenerational ethics requires humanity do so. Leaving a habitable planet for future generations will require great sacrifice in an era of dwindling resources per capita. Unfortunately, convincing people in developed and developing countries will not be easy, even though the beneficiaries will be their own descendants. The above quotes are selected from two, now opposed, viewpoints.

“The German Advisory Council on Global Change (WBGU) . . . had advised against subsidizing biofuels in developed countries, since this could not be justified from the point of view of sustainability” (Press Release 2012). *“World grain prices have risen so high that families in poorer countries are being forced to schedule ‘food-free days’ each week, according to one of the leading experts on global agriculture”* (McCarthy 2012).

Ethical issues must be considered when humanity converts food (e.g., corn) into automotive fuel (e.g., ethanol) (Cairns 2007). Basically, biofuels involve transforming the sun’s energy into living material that can be converted into alcohol. If corn is the material used, approximately 1,000 tons of water are needed to produce a ton of grain. Arable land must be used to produce the corn, and much energy is used for cultivating and harvesting the corn. Energy is then expended, converting part of the plant into ethanol. Why not collect the sun’s energy directly with solar panels? Why not use the government subsidy for ethanol production to encourage the production of solar panels? Some solar panel production plants have failed in the United States, even with government subsidies. However, production and use of solar panels has flourished in other nations, so the basic concept is sound.

However, the basic dilemma is an ethical/moral lack of compassion for the very poor. "In a world hungry for biofuels, food security must come first. . . . US ethanol policies have increased the food bills of poor food-importing countries by more than \$9 bh [US\$] since 2006. . . . With or without biofuels, many regions are, and will remain, highly reliant on imports to feed their citizens" (de Schutter 2012).

The basic ethical/moral question centers on which should have the highest priority: food security or energy security? ". . . a new planetary boundary, terrestrial net primary (plant) production (NPP), that may be as compelling conceptually, integrates many of the currently defined variables [as proposed by Rockstrom et al. 2009], and is supported by an existing global data set for defining variables" (Running 2012). Compassion for the 30+ million species with which *Homo sapiens* shares the planet requires a deep respect for planetary boundaries. Compassion for the very poor of the human species requires serious attention to global food prices that are on the rise (Nixon 2012). Compassion for all planetary life forms requires that nuclear meltdowns be prevented. "The utility that owns the Fukushima nuclear power plant has admitted that it failed to take proper safety measures . . ." (Halper 2012).

Two major problems, both suppressing scientific information and delaying the transition to non-carbon energy sources, are the result of "A dearth of competition in major U.S. industries and a government with policy making that has been severely corrupted by moneyed interests have led to depressed wages and stifled innovation . . ." (Worthington 2012).

Compassion for both humans and other life forms often declines during crises (e.g., potable water), which is likely to increase substantially if the nine interactive crises (Cairns 2010, 2012) continue to worsen. For example, if positive feedback loops accelerate, especially of the greenhouse gases methane and carbon dioxide, they will markedly hasten climate change. Temperature changes in ". . . the Gulf Stream are rapidly destabilizing methane hydrate along a broad swathe of the North American margin" (Phrampus and Hornbach 2012).

A perpetual global food crisis is a distinct possibility, especially in an era of extreme weather. "World grain reserves are so dangerously low that severe weather in the United States or other food-exporting countries could trigger a major hunger crisis next year, . . ." (Lacey 2012).

The global reduction in renewable resources per capita is already underway. During World War II, most countries rationed scarce resources, such as food and fuel, although most also had a "black market" for scarce resources as well as an unregulated barter system. In the era of perceived resource abundance and financial globalization, resources were moved rather freely about the planet, but now the reality of resource scarcity and resource export is being banned by some nations (such as the Ukraine) (Reuters 2012). The United States discourages food export bans (Moffett 2011); the Economic Union has condemned the Ukraine for banning wheat exports; and India is rethinking its frequent ban" on the export of food grains and other farm commodities (Sen 2012).

Obviously, poor, developing countries with a major dependence on imported food (e.g., Egypt) would be seriously affected by export bans on food and agricultural commodities. A major consideration is exponential human population growth congruent with food insecurity. An equally important consideration is protecting the integrity and health of the present Biosphere, which must not be threatened by short-term efforts to resolve the global food crisis. The long-term common good of humanity requires nurturing the present Biosphere. Compassion may suffer during long-term resource scarcity, but it should not disappear.

Acknowledgment. I am indebted to Paul Ehrlich and Paul Kullberg for calling useful references to my attention.

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THE GREATEST EXPERIMENT IN HUMAN HISTORY: WHY IS IT BEING IGNORED?

When the last individual for a race of living things breathes no more, another heaven and another earth must pass before such a one can be again. William Beebe

Nature does nothing uselessly. Aristotle

Nature is trying hard to make us succeed; but nature does not depend on us. We are not the only experiment. Buckminster Fuller

The greatest experiment in human history will determine how many years perpetual human population and economic growth can continue before causing a state shift in Earth's present Biosphere. A state shift is irreversible and will involve many new conditions that could be fatal to civilization and even drive *Homo sapiens* to extinction.

The greatest experiment is global and is vastly important because it consists of damage to the present Biosphere, which serves as Earth's life support system and the source of renewable resources that are the foundation of the human economy. The present Biosphere is the first that will probably collapse because of human activities; the primary threats are all caused by human activities (Cairns 2010, 2012). A biospheric collapse would result in mass extinction of species, which occurred in the five previous collapses that were not caused by humans. At present, a state shift of the Biosphere is the worst case scenario, and the destruction of human civilization but the survival of *Homo sapiens* is the probable best case scenario. A sobering observation is that *"more than 99 percent of all species that have lived on Earth are now extinct"* (<http://dsc.discovery.com>).

For a few weeks, the attention of citizens of the United States and a significant portion of the rest of the world was understandably focused on Superstorm Sandy and its impact on the human condition. Preliminary estimates of costs are US \$32 billion for New York State alone – the total cost of the storm could exceed \$100 billion. Superstorm Sandy was just a component of the social cost of carbon emissions in the United States (Johnson and Hope 2012).

Those Catastrophic Externalities

"Corporate profits can be increased by keeping wages low and real social, environmental, and economic costs externalized, borne by society at large and not by the firm. Today's corporations have been called 'externalizing machines' because they are so committed to keeping much of the real costs of their activities off their books. One can get some measure of these external costs from a recent analysis of three thousand of the world's biggest companies; it concluded that paying for just their external environmental costs would erase a third of their profits at least" (Speth 2012, p. 5). Externalities may be "external" to corporate profits, but they are not external to humankind when they badly damage the biospheric life support system. This experiment cannot long continue without serious, probably fatal, damage to human civilization.

Developing an Actively Caring Worldview

"The large-scale, long-term health, safety, and welfare of people require us to routinely go beyond the call of duty on behalf of others. We call this actively caring for people or AC4P. . ." (Geller 2013, p. 5). Of course, the most obvious response in actively caring is to help individuals in need. However, all humanity evolved and, at times, flourished in the present Biosphere. If it collapses, which seems increasingly probable, all humanity will suffer.

Framing a New Worldview

"The technical term for understanding within the cognitive sciences is "framing." [Humans] think, mostly unconsciously, in terms of systems of structure called "frames" . . . the frame circuitry in our brains doesn't change overnight" (Lakoff 2009).

Perpetual economic growth on a finite planet with finite resources has been a catastrophic failure. Although the scientific evidence is massive, many people cling to the practices that cause catastrophes, such as greenhouse gas-emitting fossil fuels when non-carbon energy sources are readily available (e.g., solar, wind geothermal). A new worldview centered on non-carbon energy sources is essential.

Lack of Urgency

The "Greenland glacier is melting 5 times faster than it was in the 1990s" (McDiarmid 2012), yet humankind still shows no urgency about approaching irreversible global tipping points. When irreversible changes occur, humanity will be strongly tempted to approve the use of inadequately tested "hail Mary" geoengineering techniques. Even now, inadequately tested large-scale geoengineering experiments are being given more serious attention. For example — "Last July, a freelance geoengineer [Russ George] — some called him rogue — dumped 100 tons of iron sulfate into the Canadian Pacific, the largest deliberate ocean fertilization ever. A plankton bloom covering thousands of square miles of ocean resulted" (Carroll 2012). And then what happened? No robust evidence is available of the probable extent of unintended secondary effects.

Denial of Climate Change Continues

During the 2012 presidential candidate debates, global climate change, overpopulation, rising sea levels, and food security were barely mentioned or not mentioned at all. Superstorm Sandy, which occurred during the end of the election period, had little or no effect on the presidential debates. However, coverage of Sandy focused almost entirely on its effects on humans and property. Some forceful attempts were made to focus on causes — "It's Global Warming, Stupid," blasted from the cover to *Bloomberg Businessweek* (Carroll 2012).

Illustrative Questions to Initiate Discussion

During a global biospheric shift,

- (1) how can biological forecasting of global state shifts be developed?
- (2) what does equal opportunity mean?
- (3) can humanity be persuaded to accept that the universal laws of physics, chemistry, and biology cannot be ignored or denied?
- (4) how can policymakers be persuaded to focus on root causes of change rather than symptoms (i.e., effects)?
- (5) what is meant by the words "bounce back" in the context of planetary state shifts?
- (6) what does individual freedom mean?

Acknowledgment. I am indebted to Paul Ehrlich and Paula Kullberg for calling useful references to my attention.

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