Asian J. Exp. Sci., Vol. 22, No. 1, 2008; 13-24

Preparing for the Post-Industrial Age

John Cairns, Jr.
Department of Biological Sciences,
Virginia Polytechnic Institute and State University,
Blacksburg, Virginia 24061, USA

Abstract : The Industrial Age has been made possible by cheap, abundant fossil fuels, primarily petroleum and coal. The life expectancy of an industrial civilization is about 100 years. Some forecasts estimate the critical period of the current age to be from 1930 to approximately 2030. A key to this range is peak oil, which may occur in 2007. After peak oil, a terminal decline will occur in the industrial civilization because replacement or substitute energy sources are not as attractive as petroleum. Coal is a poor replacement for petroleum and produces twice as many greenhouse gases and also is finite in reserves. Nuclear energy poses formidable radioactive waste disposal problems, and, in France and Spain, nuclear power plants had to shut down when the cooling water became too warm. Biofuels have serious problems, the worst of which is reducing the food supply. Predictions that the human population will reach 9 billion in 2050 means less per capita energy even if energy availability does not diminish and much less per capita if it does diminish as peak oil models predict. The post-industrial age is almost certain to be an age of scarcity with painful contrasts to the cornucopian Industrial Age. Alternative energy sources such as wind and solar are essential, but will not replace the "fossil sunlight" of the Industrial Age.

Key words : Post-industrial age, Biofuels, Alternative energy, Coal/nuclear energy, Food supplies, Climate change

The nation that destroys its soil destroys itself.

Former US President Franklin D. Roosevelt

If a path to the better there be, it begins with a full look at the worst. **Thomas Hardy**

The human species may be seen as having evolved in the service of entropy, and it cannot be expected to outlast the dense accumulations of energy that have helped define its niche. Human beings like to believe they are in control of their destiny, but when the history of life on Earth is seen in perspective, the evolution of Homo sapiens is merely a transient episode that acts to redress the planet's energy balance.

David Price

Darwin's dice have rolled badly for Earth. The human species is, in a word, an environmental abnormality. Perhaps a law of evolution is that intelligence usually extinguishes itself. **E. O. Wilson**

If all mankind were to disappear, the world would regenerate back to the rich state of equilibrium that existed ten thousand years ago. If insects were to vanish, the environment would collapse into chaos. **E. O. Wilson**

Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist.

Economist Kenneth Boulding

This manuscript was inspired by an automobile bumper sticker that read: "Bring Ethanol to Blacksburg." I am confident that people whose bumpers had these stickers believed the sentiment was a "green" request that was good for the environment. However, as always, one cannot do merely one thing - consequently, the purpose of this discussion is to mention other events that will happen or have already happened that may,

at first, appear good for the environment. For example, Monbiot (2004) remarks that adoption of biofuels would be a humanitarian and environmental disaster and notes: "Those who have been promoting biofuels are well-intentioned, but wrong. They are wrong because the world is finite." In 1900, the global population was 1.6-1.7 billion. In 2007, it is 6,612,087 billion, nearly four times larger than in 1900. These people expect to be fed, but arable land is finite. Moreover, approximately 1,000 tons of water is needed to produce 1 ton of grain, and shortages of freshwater are being experienced worldwide. Crop wastes, such as wheat stubble and cornstalks, can be turned into ethanol, but solid information on the energy needed to collect and transport the stalks and process them is lacking (e.g., McKie, 2004). In addition, Friedman (2007) calls attention to adverse effects upon the soil caused by biomass removal. Italian pasta tastes good because it is made from durum wheat, which is now being converted to a biofuel (Willey, 2007). One of the consequences, state Italian pasta manufacturers, is that the price of pasta will rise 20% in fall 2007.

Problems of scale are almost always present, but they are extremely troublesome in the case of biofuels. Giampietro *et al*. (1997) focus on this issue: "Large-scale biofuel production is not an alternative to the current use of oil and is not even an advisable option to cover a significant fraction of it." Humankind is now using huge amounts of "fossil sunlight," as well as the energy that falls daily on the planet from the sun. Society is now at or near "peak oil," after which it will experience a precipitous decline in oil availability. Duncan (2007) remarks that "the high point of industrial civilization followed by its terminal decline will be a watershed of human history." His forecast for peak oil is 2007, and the life expectancy of an industrial civilization is about 100 years (e.g., 1930-2030). Duncan believes the terminal decline of industrial civilization will begin circa 2008-2012. Heinberg (2005, p. 1) is more blunt: ". . . industrial civilization is based on the consumption of energy resources that are inherently limited in quantity, and that are about to become scarce." Coyle (2007) reports on a United Nations Press Release of May 9, 2007, that acknowledges that biofuels are more carbon dioxide neutral than fossil fuels but warns that land use, food supply, and water supply issues need to be taken into account when planning for biofuels production. Arga (2007) reports on the burning of Indonesian forests to replace them with palm oil trees to produce a biofuel. These fires are a menace to citizens of Indonesia and the inhabitants of neighboring countries (e.g., Singapore and Malaysia). Indonesia has 91 million hectares of rainforest, or about 10% of the world's remaining tropical forest (www.rainforestweb.org). This area is not only a treasure trove of biodiversity but a substantial store of sequestered carbon.

End of Cheap Food

Cline (2007) finds that agricultural production in developing countries may fall by 20%, and, if global heating progresses at its current rate, India's agricultural capacity could fall as much as 40% by the end of the century. James E. Burke (personal communication) reports a conversation with a friend who had extensive commodities training experience. The friend proposed that

the world was running out of food - that, for the first time in decades, no surplus food is available in the markets and that his business was searching the world for surplus commodities when, in the past, it had always operated from the excesses of the United States. His professional opinion was that prices of food would increase substantially (3 to 5 times) in the coming years. How long is this scenario likely to continue? Of course, accurate prediction of climate change consequences is impossible, so quality estimates must be used. Collins *et al*. (2007) state: "Plants, animals and humans will be living with the consequences of climate change for at least the next thousand years." The "at least" is a shock, but not out of the question. An important point made by Collins *et al*. (2007) is

> *..that the removal of excess carbon dioxide from the atmosphere by natural processes on land and in the ocean will become less efficient as the planet warms. This change leads to a higher percentage of emitted carbon dioxide remaining in the atmosphere, which then further accelerates global warming.*

In the coming post peak oil era, liquid coal will almost certainly be used to partly replace petroleum. This approach would be a major mistake since liquid coal would produce roughly twice the global heating emissions of gasoline (Opinion 2007).

Comprehensive Energy Conservation Default Position

The eventual transition from a heavy dependence on fossil energy (e.g., oil and coal) to an ability to live on present solar energy will require major alteration in human lifestyles. Even if nuclear energy is used more extensively, despite the risks, to replace fossil energy, available energy per capita will still be less. In the United States, addiction to profligate energy use is still strong, despite former US Vice-President Al Gore's pleas for the United States to lead the world in reducing greenhouse gas emissions. The basic problem is simply stated - when fossil fuels are gone, humankind must live on solar energy as it is delivered by the sun (humankind may someday develop fusion power and/or safe disposal of nuclear wastes, but neither is available now). Plants could be used to capture sunlight, or it could be used directly. Patzek (2004) carries out both a traditional mass and energy balance based on the First Law of Thermodynamics, as well as an energy-based Second Law Analysis. He lists the following inputs in corn, one of the sources of ethanol, production:

- nitrogen fertilizers (all fossil energy)
- phosphate, potash, and lime (mostly fossil energy)
- herbicides and insecticides (all fossil energy)
- fossil fuels: diesel, gasoline, liquefied petroleum gas (LPG), and natural gas (NG)
- electricity (almost all fossil energy)
- transportation (all fossil energy)
- corn seeds and irrigation (mostly fossil energy)
- machinery, roads, silos, plants (mostly fossil energy)
- labor (mostly fossil energy)

In this era of droughts, reduced snow packs, and scarce freshwater, production of a ton of grain requires approximately 1,000 tons of water. If all this effort and resources are involved in capturing solar energy with

plants, why not capture it directly with solar panels or less directly with wind mills and tides? Of course, some means of storage (e.g., hydrogen, pumped storage, or batteries) is one of the major problems of solar and wind sources of energy since neither is constant. However, wind mills and solar panels will function in deserts and other areas not suitable for agriculture. This option would not deprive malnourished and/or starving people of food and is worth consideration despite the storage problems.

One renewable source of energy, palm oil, is responsible for much deforestation. In addition, every ton of palm oil generates 33 tons of carbon dioxide emissions - 10 times more than petroleum (Holt-Giménez, 2007). Holt-Giménez states:

> *Strong enforceable standards based on limiting land planted for biofuels are urgently needed, as are antitrust laws powerful enough to prevent the corporate concentration of market power in the industry. Sustainable benefits to the countryside will only accrue if biofuels are a complement to plans for sustainable rural development, not the centerpiece.*

Addiction to cheap, abundant energy based on a cornucopian view of the world is what keeps the biofuels "bandwagon" going. The concept of "clean" fuel and renewable abundance promote the concept almost to cult status. However, the detailed systems-level approach of Runge and Senauer (2007) soon puts an end to the cornucopian vision. They note that "The enormous volume of corn required by the ethanol industry is sending shock waves through the food system."

Population Crashes

Earth's human population has been estimated at 250 million in AD 950, 500 million in AD 1600, 1 billion in AD 1802, and 2 billion in AD 1928 (http://en.wikipedia.org/wiki/World_population). Only recently has the human population doubled in less than a single human lifetime. Other species may have similar population surges if food and habitat are plentiful and predators and diseases are few. Population crashes are also common, even for humans - for example, the Black Death is rarely discussed except in horror tales. However, at present, post peak oil is here or coming soon and will have a major effect on Earth's carrying capacity for humans. In addition, climate change is affecting food production; over half the human population lives in large cities; debilitating resource wars are in progress; and a post-industrial age is probable, not just possible, but humankind remains silent about these major issues. In the United States, the city of New Orleans and much of the Gulf Coast have not recovered from Hurricane Katrina, for which preplanning and post-hurricane remedial efforts have been tragically inadequate.

The three biggest threats to human security are (1) overpopulation, (2) global heating and other types of climate change, and (3) humankind's addiction to fossil energy. Few plans are actually in place to eliminate these concerns, so a "hard-landing" scenario is the most probable unless drastic corrective measures are in place soon. A hard landing could reduce human population size to 1 billion or less and would also markedly reduce the prospects for peace (Delpech, 2007). A "soft-landing" scenario is still possible, although not probable. A soft

landing would require maintaining production of foodstuffs close to present levels. Perhaps loss of human life might be kept to 1 billion or less. Rationing of petroleum products would be essential to the realization of a soft landing. The word *ration*, as a national requirement, has not been commonly used in the popular press. However, Mount (2007) reviews a book by David Kynaston on the subject and notes that the author misses the essential point: the era of rationing was a time of both austerity and hope - but hope can be dulled by sheer exhaustion. This situation would require a successful global effort to eliminate or markedly reduce the three biggest threats to human survival. In short, the inhabitants (*i.e.*, crew) of Spaceship Earth must act intelligently and vigorously to protect its function and integrity. Earth must become a viable habitat for all of humanity.

Cities and Urban Areas

Slightly over half of humanity now occupies cities and urban areas. A viable habitat must meet three basic human needs - food; shelter; and a viable, generally accepted social contract. Few people realize the incredible effort and amount of energy needed to cope with nature's assault on human artifacts. Weisman (2007, p. 15) provides a superb overview of this important topic: "Back when they told you what your house would cost, nobody mentioned what you'd also be paying so that nature wouldn't repossess it long before the bank." However, New York City's subway system (Weisman, 2007, p. 24) is the real shocker - every day, 13 million gallons of water must be removed to keep the water from overpowering the tunnels, which requires 753 pumps and incessantly vigilant subway crews. In addition, New York City's pavement is always at risk - repeated freezing and thawing make asphalt and cement split (Weisman, 2007, p. 26). After peak oil, asphalt will become increasingly scarce. In buildings with no heat (Weisman, 2007, p. 27), pipes would burst all over New York City, and water leaks in, bolts rust, and facings pop off and expose insulation.

As fossil energy declines in availability, cities and even suburbia will cease to be viable habitats. Environmental refugees from densely inhabited areas are likely to temporarily overwhelm food producing areas already in trouble from climate change and transition to low energy agriculture. One hopes that big government will be up to the challenge, but the evidence for this hope is not reassuring, especially since measures for reduced energy consumption per capital (e.g., efficient mass public transportation) and reduced greenhouse gas emissions have not been impressive. Under these circumstances, anarchy is probable, which will further exacerbate the food and energy allocation problem. If big government is to make effective resource allocations, rationing is arguably the only means of succeeding. However, this situation would require faith that the allocations would be both fair and equitable. Otherwise, local barter systems will prevail, especially if the nation's currency is debased.

Sea Level Rise

Sea level rise will not only ruin some areas that produce foodstuffs, but also produce millions of environmental refugees (e.g., the Bangladesh delta) and have a negative impact on nursery grounds for many marine organisms. Salt water intrusion will also contaminate many groundwater aquifers

in heavily settled coastal areas. These and other related problems (e.g., housing damaged by storms and floods) will exacerbate resource allocation problems. The comparatively wealthy countries may have the resources and technology to reduce these impacts (e.g., The Netherlands), but poorer countries (e.g., Bangladesh) will not. These global problems result from greenhouse gas emissions, so reducing them will help in the long term (*i.e.*, hundreds of years), but not in the short term (*i.e.*, decades) due to the long residence time of carbon dioxide in the atmosphere.

Agricultural Productivity

Production of foodstuffs will be, at least temporarily (*i.e.*, decades), adversely affected by both climate change and reduced amounts of fossil energy. With a human population increasing at 1.5 million each week and foodstuffs declining, a major loss of human life seems inevitable. The *New York Times* had a special op-ed series named "Worried about the Weather, and the Land" on 29 July 2007, which noted that summer has brought another rash of extreme weather around the world: relentless rain has caused flooding in Britain, India, and Texas, and record-breaking drought has led to wildfires in Greece and Utah - demonstrating, once again, how severe weather and climate change can quickly alter the landscape. Climate change is clearly visible in the shrinking of Swiss glaciers - some 100 of the nearly 2,000 glaciers have already disappeared, and researchers predict that most of the rest will have melted away by 2050 (Stamm, 2007). Stamm (2007) reports that the "radical" measures of reducing Swiss consumption of fuel and gasoline are not yet accepted by the general public. However, most shocking is his comment that

> *. . .a dangerous fatalism has spread among many Swiss. They are happy to see the water in the lakes getting warmer, and view the disappearance of glaciers as a sad but not necessarily bad development. They blithely forget that the ice is also our reserve supply of drinking water, and make light of the fact that the ground is thawing along with the glaciers, sending mud slides into the valley.*

Stamm (2007) remarks: "Heaven knows who will profit from the current climate changes. But chances are great that this time we will be among the losers."

Madison (2007) reports that the first year of a drought is good for farming in the Sacramento Valley of California. Much sunshine is available and good growing conditions exist if irrigation water is available. However, irrigation had to begin in January - ordinarily the rainiest month - and continue through spring and summer. Also in the first year of a drought, the lakes and reservoirs may have ample water from the previous year if rains were abundant. However, the second year of a drought is a worry, and the third year is a crisis. If electricity comes from hydropower, it is even worse. Although climate change models cannot yet predict local weather conditions, scientists would not be surprised if the American West had many more years of drought.

North (2007) is the chef and owner of a restaurant in Sydney, Australia, where a source of food, the Murray River cod, is disappearing in the wild, but previously was available from fish farms. However, Australia

is suffering from what may be the worst drought in 1,000 years. Scientists have linked the 6-year drought to the changing climate. The Murray-Darling river basin in southeastern Australia provides 40% of the country's food. Irrigation restrictions and the extreme heat that damages crops are resulting in price increases for food. North (2007) concludes that chefs around the world must consider sustainability when acquiring food to prepare. This undertaking is a major endeavor, but one admirably suited to a changing food supply.

Watzman (2007) discusses a global problem in a regional context using the Dead Sea as an example. Israel, Jordan, and Syria remove 95% of the water from the Jordan River for domestic use and irrigation. The World Bank asked for bids to study a high-tech solution - a 110-mile canal that would channel water from the Red Sea to the Dead Sea. The project cost is estimated at $5 billion and would have benefits (e.g., hydroelectricity) and probably unexpected deleterious ecological effects. The low-tech solution would be to restore the original system and allow freshwater to flow from the Jordan River into the Dead Sea. This approach would mean drastic alterations of the status quo on agriculture (e.g., lower water demand crops) and create a system of water salvage and reuse.

The Ogallala aquifer underlies the US Great Plains from South Dakota to Texas. In some areas of western Kansas and northern Texas, the water usable for irrigation is already gone (Blair, 2007). Blair (2007) notes that, although most of the water accumulated in the aquifer over 10,000 years ago, farmers needed only four decades to reduce the reserves under their irrigated fields by one-third. If pumping continues at the same rate (*i.e.*, drawing the water table down an average of 1 foot per year), farmers will only be able to continue present practices for approximately 60 more years. The primary crop in that area is corn, which requires more water than many other crops and is mainly used for livestock feed and ethanol (for automobile fuel).

The Global Perspective

Global metrics (http://www.worldometers.info) shows numbers that increase and spin rapidly and induce barely controlled panic. Some numbers of concern from 29 July 2007 are: 6,520,780 hectares of forest lost this year; 3,622,663 hectares of productive land lost to soil erosion this year; 8,513,295 acres of desert land formed this year due to mismanagement. Jackson (2007) notes that the Container Recycling Institute states that overall beverage container recycling has dropped from 53.5% in 1992 to 33.5% in 2004. The Institute calculates that, if a national campaign could increase beverage container recycling to 80%, the savings in greenhouse gas production would be the equivalent of taking 2.4 million cars off the road for a year. If the recycling content of plastic beverage bottles was 25%, enough crude oil would be saved to electrify 680,000 American homes for a year.

World figures on plastic recycling are hard to obtain; however, Weisman (2007) discusses how much is in the world's oceans, how long it will persist, and the ecological harm it does. Much of the bottled water comes in bottles (polyethylene terephthalate) made from petroleum.

Is Humankind Exempt from the Laws of Nature?

Present actions indicate that humankind thinks it is exempt from the laws of nature, which is why it is plunging into the post-industrial era instead of making a more systematic and orderly transition. In just two centuries, humans have drastically altered the biospheric life support system. Worse yet, humankind does not even know if the planet has passed major ecological and societal tipping points, beyond which return to predisturbance conditions is problematic. The global human population has quadrupled in just one century, an unprecedented event in human history. As a consequence of human actions, the biota has been impoverished (*i.e.*, loss of biodiversity); global heating and other types of climate change are adversely affecting global food production; the era of declining availability of fossil energy (e.g., petroleum) is here or will be here shortly; the amount of arable land is decreasing while births exceed deaths by 1.5 million weekly; hazardous, persistent substances (e.g., chemicals and radioactive wastes) are increasing globally; humans have exceeded Earth's carrying capacity, as evidenced by a 24%+ ecological overshoot; the hydrologic cycle has been drastically altered; the oceans are becoming more acidic; drug-resistant diseases make a pandemic disease increasingly probable; scientific evidence is all too often either ignored or attacked by persons (e.g., politicians) with few or no scientific credentials; the length of time that favorable environmental conditions for *Homo sapiens* will last is difficult to determine; continuing exponential growth rather than preserving conditions favorable to the human species is still the dominant forcing factor worldwide.

How can humans possibly believe the laws of nature apply to other species but not to them? Weisman (2007, p. 3) asks: ". . . at what point would things have gone so far that, for all our vaunted superior intelligence, we're not among the survivors?" He answers his own question:

> *The truth is, we don't know. Any conjecture gets muddled by our obstinate reluctance to accept that the worst might actually occur. We may be undermined by our survival instinct, honed over eons to help us deny, defy, or ignore catastrophic portents lest they paralyze us with fright.*

In the United States, Presidential Signing Statements (e.g., Dean 2006, p. 14) have become common:

> *Rather than veto laws passed by Congress, Bush is using his signing statements to effectively nullify them as they relate to the executive branch. These statements, for him, function as directives to executive branch departments and agencies as to how they are to implement the relevant law.*

As Savage (2006) notes, President Bush has quietly claimed the authority to disobey more than 750 laws enacted since he took office, asserting that he has the power to set aside any statute passed by Congress when it conflicts with his interpretation of the US Constitution. However, human law is quite different from the laws of nature. The latter is vastly older than human law (*i.e.*, billions of years compared to a few thousand years). The

laws of nature apply to 30+ million species, including *Homo sapiens*, while human law applies to only one and varies from nation to nation and through time. Still, humankind exhibits a sense of entitlement that condones ignoring the laws of nature.

Eisler (2007, p. 4) provides a redefinition of productive work appropriate for the post-industrial economy, where the most important capital is what economists like to call human capital. She notes (Eisler, 2007, p. 9) that, without caring and care giving, no humans would be here - no households, no workforce, no economy, nothing. However, she remarks that most current economic discussions do not even mention caring and care giving. Eisler (2007, p. 16) notes that, in current economic theory, what is valued is a matter of supply and demand, with scarce goods and services more valued than abundant ones. She believes that a much more sensible, and realistic, standard for what is given economic value is what supports and advances human survival and human development. Eisler (2007, p. 17) also notes that the new view of economics takes into account the long-term costs of uncaring environmental policies as compared to the short-term profits they may yield.

Humankind's Fatal Addiction to Growth

You've all admitted that the system failed, none of you feel personally responsible. Somebody should be responsible.

US Congressman Henry A. Waxman, speaking to former Defense Secretary Donald H. Rumsfeld and three current and former high-ranking generals on the handling of the friendly-fire death of Corporal Pat Tillman

In 2007, more people on the planet were without adequate nutrition, housing, and health care than the total world population in 1900 (United Nations estimate for 1900, 1.65 billion). Who is responsible for this situation? The simple answer is "everyone," but this answer is inadequate. In the United States, 28% of total net worth is held by the richest 2% of the families. Even so, Latin America is the region of the world with the greatest income disparity. The WorldWatch Institute (2003) notes that the global economy has grown sevenfold since 1950. However, the disparity in per capita gross domestic product difference between the 20 richest and 20 poorest nations more than doubled between 1960 and 1995. Globalization has long been portrayed as "the rising tide that lifts all boats." Roach (2007) notes: "Only the elite at the upper end of the occupational hierarchy have been spared the pressures of an increasingly brutal wage compression." He further remarks:

> *As different as the problems are in the U.S. and China, there is no economic issue in either country that hits the political hot button like income disparities. And with both countries suffering from relatively high degrees of inequality, neither can be expected to backtrack insofar as the political response is concerned.*

Roach (2007) concludes: "Inequalities of the distribution of income have long been the Achilles' heel of economic growth and development." Hulbert (2006) notes that, despite its economic success, Asia remains home to two-thirds of the world's poorest, who live on less than US$1 per day. William Morris has stated: "A society based on cash and self-interest is not a society at all, but a

state of war." US presidential candidate Senator Chris Dodd puts the issue as:

> *When you consume less, your lifestyle improves. This is not going to be a hair shirt you've got to wear. The hair shirt is the one you're wearing today where you place your children in jeopardy, your climate, your planet. We're destroying our lifestyle as a result of our continued dependency on these polluting technologies and fuels, and what I'm offering is a way for us to escape.*

Conclusions

Fossil sunlight made the Industrial Age possible. As fossil sunlight's availability decreases with a concomitant increase in cost, humankind must inevitably turn to real sunlight as it arrives on the planet. Sunlight can be acquired directly with solar panels or indirectly with windmills. A practical technology may even be developed for tidal energy. Nuclear fusion is still an unproven source of energy, although research may someday make it feasible. Fission nuclear power technology is available, but safe disposal of spent fuel poses some formidable long-term risks. Plants can also be used to accumulate sunlight's energy. This approach requires arable land; abundant water; use of energy for plowing, harvesting, and transportation to the processing plant; and retail outlets. The energy input/output ratio is often unfavorable. Since the human population is still increasing, weekly by 1.5 million, and the sunlight arriving on Earth is limited, less energy per capita will be available until the human population is stabilized or reduced.

As the Industrial Age developed, lifestyle changes were so rapid that few life experiences would be usefully passed on to new generations. However, the post-industrial era will have per capita energy that is not dissimilar to that between 1900 and World War II. Except for the very wealthy, material possessions will not be as numerous as at the height of the Industrial Era. People who lived between 1900 and World War II did not feel deprived because the Industrial Era abundance was then unimaginable. The post-industrial generations need to be told these details by people who have experienced them.

The Industrial Era has been very damaging to the environment and would not have been sustainable due to ecological overshoot, global heating, and other types of climate change, even had cheap, abundant fossil energy remained available. The Industrial Era has been a brief (approximately 100 years) period in human history, which is unlikely to be repeated. If *Homo sapiens* is truly an adaptive species, a transition to the new circumstances should be possible. If not, it is worth remembering that other species have also been transient.

Acknowledgements

I am indebted to Darla Donald for transferring the handwritten draft to the word processor and for editorial assistance. Walter Youngquist, Alvin Lucier, Paul R. Ehrlich, and Paula Kullberg brought useful references to my attention.

References

Arga A. (2007) : Palm oil firms burning Indonesia forests. Reuters 12July http://www.reuters.com/article/environmentNews/idUSJAK2342920070712?pageNumber=1.

Blair J. (2007) : High plains water crisis will force farmers to think like

environmentalists. AlterNet 30July http://www.alternet.org/environment/58244//.

Cline W. R. (2007) : Global Warming and Agriculture: Impact Estimates by Country. (Washington, DC: Peterson Institute for International Economics).

Collins W., Colman R., Haywood J., Manning M. R., Mote P. (2007) : The physical science behind climate change. *Scientific American*, **297(2)**, 64-71.

Coyle,P. J. (2007) : Potential biofuel problems. Suite 101 22June http://un-environmental-initiatives.suite101.com/article.cfm/potential_biofuel_ problems.

Dean J. W. (2006) : The problem with Presidential Signing Statements: Their use and misuse by the Bush administration. Find Law: Legal News and Commentary 13Jan http://writ.news.findlaw.com/dean/20060113.html.

Delpech T. (2007) : Savage Century: Back to Barbarism. (Washington, DC: Carnegie Endowment for International Peace).

Duncan R. C. (2007) : The Olduvai theory: Terminal decline imminent. *The Social Contract*, **XVII(3)**,141-151.

Eisler R. (2007) : The Real Wealth of Nations. (San Francisco, CA: Berrett-Koehler Publishers).

Friedmann A. (2007) : Peak soil: Why cellulosic ethanol, biofuels are unsustainable and a threat to America. Culture Change 10Apr http://www.culturechange.org/cms/index.php?option=com_content&task=view&id=107&Itemid=1.

Giampietro M., Ulgiati S., Pimentel D. (1997): Feasibility of large-scale biofuel production. *BioScience*, **47(9)**, 587-600.

Heinberg R. (2005) : The Party's Over: Oil, War and the Fate of Industrial Societies, 2nd ed. (British Columbia, Canada: New society Publishers).

Holt-Giménez E. (2007) : The biofuels myth. International Herald Tribune 10July http://www.iht.com/articles/2007/07/10/opinion/edholt.php.

Hulbert M. (2006) : Asia – a vision for 2015. The Globalist 19May http://www.theglobalist.com/StoryId.aspx?StoryId=5278.

Jackson D. Z. (2007) : Tapped out. Boston Globe Online 25July http://www.boston.com/news/globe/editorial_opinion/oped/articles/2007/07/25/tapped_out/.

Madison M. (2007) : Sunny California. *New York Times*, 29July Late Edition - Final, Section WK, p. 1.

McKie R. (2004) : Forget the tiger. Put some mushrooms in your tank. The Observer 21Nov http://observer.guardian.co.uk/uk_news/story/0,6903,1356121,00.html.

Monbiot G. (2004) : Feeding cars, not people. The Guardian 22Nov http://www.monbiot.com/archives/2004/11/23/feeding-cars-not-people/.

Mount F. (2007) : Review of *Austerity Britain 1945-51*. *The Times Literary Supplement*, **5437(15June)**, 7-8.

North J. (2007) : Dining in a drought in Australia. *New York Times*, 29July Late Edition - Final, Section WK, p. 11.

Opinion (2007) : Worse than gasoline. *Scientific American*, **297(2)**, 32.

Patzek T. (2004) : Thermodynamics of the corn-ethanol fuel cycle. *Critical Reviews in Plant Sciences*, **23(6)**, 519-567.

Roach S. (2007) : Globalization's new underclass. Asian Times 2Aug

(Republished with permission from Japan Focus) http://www.atimes.com/atimes/Global_Economy/HD26Dj01.html.

Runge C. F., Senauer B. (2007) : How biofuels could starve the poor. *Foreign Affairs*, **May/June**, 41-53.

Savage C. (2006) : Bush challenges hundreds of laws: President cites powers of his office. Boston Globe 20Apr http://www.boston.com/news/nation/articles/2006/04/30/bush_challenges_hundreds_of_laws/.

Stamm P. (2007) : The great Swiss meltdown. *New York Times*, 29July Late Edition - Final, Section WK, p. 11.

Watzman H. (2007) : Israel's incredible shrinking sea. *New York Times*, 29July Late Edition - Final, Section WK, p. 11.

Weisman A. (2007) : The World Without Us. (New York, NY: St. Martin's Press).

Willey D. (2007) : Italians facing pasta price rise. BBC New 10July http://news.bbc.co.uk/2/hi/europe/6287850.stm.

WorldWatch Institute. (2003) : Rich-poor gap widening. WorldWatch Institute 12Oct http://www.worldwatch.org/node/82.