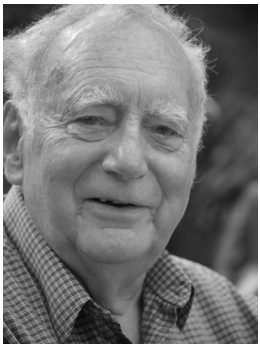
BRYAN FURNASS



PANDORA'S BOX CHALLENGES AND OPPORTUNITIES FOR HUMAN AND ENVIRONMENTAL HEALTH

An integrative approach

The most important cultural change of the last millennium has been the information explosion. When the Royal Society was founded in London in 1660, a small group of scientists knew most of what was known in their own discipline – in mathematics, physics, chemistry, geology, biology and astronomy. Since the information explosion following the industrial revolution, accompanied by massive technical and lifestyle changes, it has become impossible to know more than a small fraction of what is known in one's own field, let alone information outside it. In this paper I shall attempt to go backwards in time by taking an integrated philosophical and biohistorical approach to the impacts of civilization on the biosphere, culminating in the culture of democracy.

A basic philosophy of identity perception

In the 1890s, the French painter Paul Gaugin abandoned his family and prosperous stockbroking business in Paris to move to the South Seas, to experience the 'primitive nature of man', (including bedding some of the beautiful Tahitian women). When he was on his beam ends, unable to afford even a canvas, he produced a painting on jute entitled 'Qui venons nous; que sommes nous; qui allons nous?' where do we come from; what are we; where are we going? These questions are still pondered today by anyone who bothers to think.

Our place in the universe

The Horsehead nebula in the Constellation of Orion, with Orion's belt in the foreground is 1400 light years away from Earth, quite close in cosmic terms but a long way in our perception, since we are only eight light minutes away from our local star, the sun. There are 200 billion stars in the Milky Way, and an estimated 100 billion galaxies in the known universe. This answers the first two of Gaugin's questions. The first is that since every atom in our bodies is derived from stardust, we are children of the universe as well as of the biosphere. The second is that in astronomical/materialistic terms, the Earth and its inhabitants are totally insignificant. Perhaps we will only achieve significance when we realise our material insignificance?

Greek mythology

The culture of modern Western democracy is derived from the thinking of the ancient Greeks. Two and a half millennia ago they invented myths about gods who were said to exert control over humans. A dissenter from this control was Prometheus, who stole fire from the gods to help mortals. As punishment, Zeus (known in Roman mythology as Jupiter) chained Prometheus to a rock, where an eagle fed on his liver during the day, which was regenerated at night. Hericles (known to the Romans as Hercules) rescued him by cutting his chains and killing the eagle.

The most powerful of the Greek gods was Zeus, who ruled over heaven and earth from Mount Olympus. Zeus was clearly a grumpy old god, and a misogynist to boot, disliking humans in general. In revenge on Prometheus he also supposedly created the first mortal woman, called Pandora (meaning 'all gifts'). Together with Pandora came a box or jar, containing all the evils that beset humankind. When the jar was opened, all its demons flew out, and have multiplied since, threatening human wellbeing. (The moral of this story is that one should always look a gift horse in the mouth!) This mythology resembles that of Adam and Eve. At the bottom of Pandora's box remained Hope, which is currently under siege.

The evolution of our only home – the biosphere

The birth of the biosphere occurred about 3.7 billion years ago, with the appearance of the most important complex molecule on Earth, namely chlorophyll, contained in blue–green algae. Relics are fossilised as stromatolites, to be found in the Western Australian desert and off its coastline. Using the sun's energy, photosynthesis of glucose by chlorophyll gradually converted an atmosphere largely composed of carbon dioxide, nitrogen, methane, water vapour and zero oxygen into its present composition of approximately 21 per cent oxygen, 79 per cent nitrogen, variable quantities of water vapour and a tiny but important proportion of carbon dioxide, which has increased rapidly from 280 ppm in the pre–industrial era to over 387 ppm today. In parallel with these dramatic changes was the formation of an ozone layer (consisting of three atoms of oxygen), which protected the rapidly growing plant life on Earth from excessive solar radiation of ultraviolet light. Around 3–400 million years ago massive quantities of plant life and algae were buried and converted into coal, oil and methane representing stored solar energy capital as fossil fuels. Combustion of this non–renewable capital, which is becoming rapidly depleted, drives industrial civilization today.

In relation to the biosphere, the human species is a very new kid on the block. Fossils of our remote ancestors date back to about 3 million years ago. Modern humans, *Homo sapiens,* appeared in the Rift Valley of East Africa around 200,000 years ago, as hunter–gatherers. Humans were unique in developing culture, thereby changing the face of our planet, particularly during the past half century (Fig 1).

Lifestyle	Time (years)	Generations
Hunter–Gatherers	> 200,000	> 8,000
Agriculture	> 10,000	> 400
Cities	> 5,000	> 200
Industry	250	10
Information Technology	50	2
Sustainability	25	1

Figure 1: A brief history of *Homo sapiens*

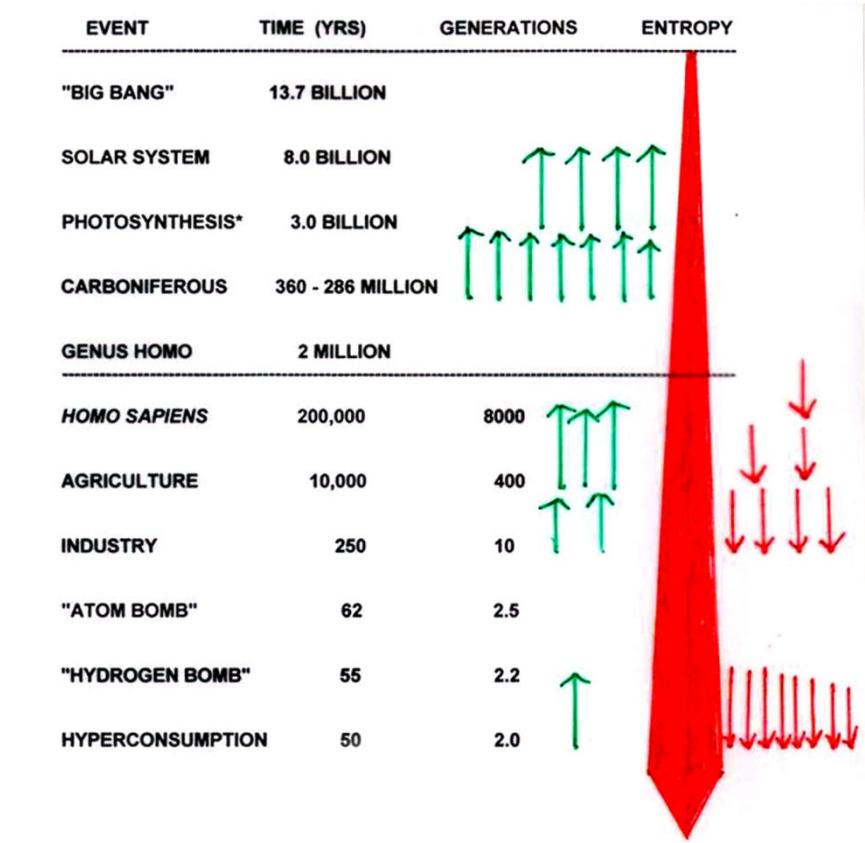


Figure 2: Entropy Roadmap

On a cosmic scale, entropy is a measure of the inevitable degradation or disorganisation of the universe (Fig 2). At the level of the Earth, the evolution of complex and biodiverse life forms through photosynthesis has tended to slow this entropic process (upwardly pointing arrows). Since the cultural shift to farming ten thousand years ago, in the Fertile Crescent of the Middle East, and particularly to fossil–fuelled industrialisation two and a half centuries ago, humans have enhanced the local entropic process (downwardly pointing arrows) by increasing land and biodiversity degradation and combusting prodigious amounts of fossil fuels.

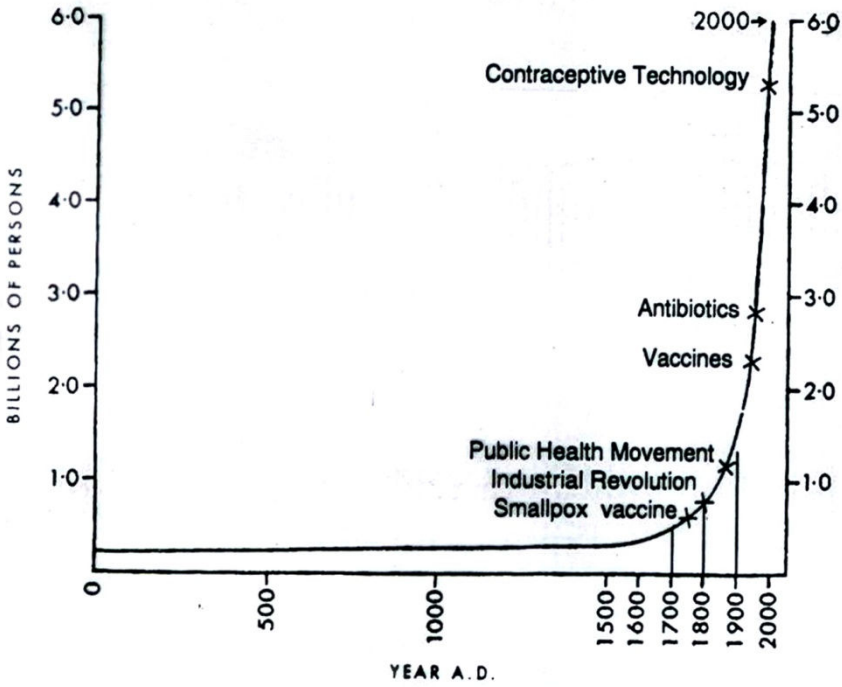


Figure 3: Human Population Growth

The emergence of democracy

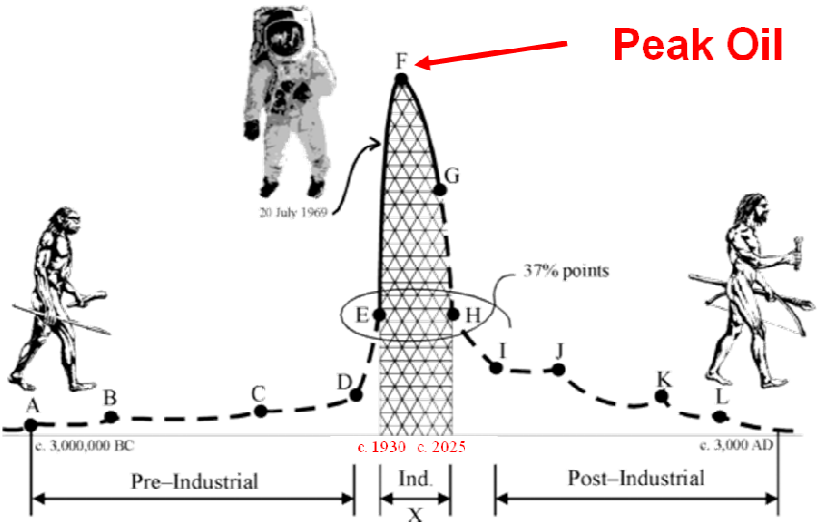
The emergence of democracy, which was first proposed but not implemented in ancient Greece, stresses the rights of individuals to have their say in the governance of the state. In modern times the ideals of democracy have degenerated into the assumed rights, and indeed encouragement, of individuals to consume and pollute at will, irrespective of environmental damage. This 'right' has become entrenched in post–Keynesian economics, in which 'progress' is defined as endless consumption and waste of non–renewable resources, represented as growth in GDP (which really means gross domestic profligacy). Environmental damage is conveniently relegated as an 'externality' not worth bothering about now, or indeed being permanently neglected, since repair is deemed to be 'too expensive'. Once a basic standard of living has been achieved, there is little

or no relationship between growth of GDP and human health and wellbeing. In the context of this conference, the growth of consumerism, depletion of non–renewable natural resources and pollution of lands, oceans and atmosphere, at the expense of environmental protection, represents major cultural conflict in our democracy.

One cannot talk sensibly about impacts of humans on the biosphere without considering human population growth, in both its quantitative and qualitative aspects. At the beginning of the industrial revolution, population was around one billion, rising exponentially to almost seven billion today (Fig 3). Much of this growth distribution is caused by migration of rural workers from the countryside into mega cities (over ten million population), which carries the risk of epidemics of infectious disease, local heating stress and degradation of the surrounding countryside, with threats to food security.

There are gross disparities in resource use within and between nations. Thus, per capita use of non–renewable resources, including fossil fuels, may be up to 100 times greater by many citizens of Australia and the United States than by the average citizen of the Republic of India. It has been calculated that if the world's present population were to achieve the same material standards of living as affluent societies, we would require at least three additional fertile and richly resourced planets to accommodate them.

Some astrophysicists are pressing for funds to discover other potentially habitable planets in the cosmos. In my opinion, this quest is grossly anthropocentric and quixotic, and the enormous funds required would be better devoted to solving the problems of peak oil, climate change and restoration of the biosphere – our only home. There should also be international pressures to reduce resource inequalities and invest heavily in the education of girls and women, which has been shown to improve life expectancy and to reduce the rate population growth in developing countries. Japan and some European nations fear an ageing population and postponement of retirement, neglecting the fact that this could improve the quanta of wisdom and experience in the world, to help build a more sustainable planet.



Pre-Industrial Phase [c. 3,000,000 BC to 1765]
A = Tool making begins (c. 3,000,000 BC)
B = Fire use begins (c. 1,000,000 BC)
C = Neolithic Agricultural Revolution (c. 8,000 BC)
D = Watt's steam engine, 1765
Interval D-E is a transition period.

Figure 4: The Olduvai Theory of Industrial Civilisation

Olduvai theory of industrial civilization

Figure 4 is a gloomy cartoon of the Olduvai theory, representing the march of industrial civilization towards catastrophe, from the present era of peak oil, which would appeal to doomsayers. In my increasingly fewer optimistic moments, I feel that, in the unlikely event of achieving the requisite political and social will, there are still adequate resources and scientific brainpower available to abseil down rather than fall off the cliff, to modify the impending disaster and move towards a sustainable future. What is lacking is the awareness of the depth of the environmental crisis which we now confront, and how to respond to it in an urgent way.

For example, given a 30 per cent improvement in energy efficiency, replacing the combustion of ancient solar capital by the infinite availability

of clean solar currency (directly and indirectly), and the progressive long–term replacement of nuclear fission by nuclear fusion would solve the energy supply problem. This would entail a much fairer distribution of resources, trimming the sails of obscenely wealthy individuals, corporations and countries, to achieve a much lower but more sustainable material (and perhaps more creative and spiritual) standard of living for them. Hence, the harnessing of social and political commitment will is extremely difficult, despite the fact that 'business as usual' puts the planet in a similar position to that of the voyage of the Titanic.

Global population growth and fossil energy use have followed an upwards exponential curve, compounded by increase in numbers of people and national energy consumption, although there are large difference in energy use within and between countries.

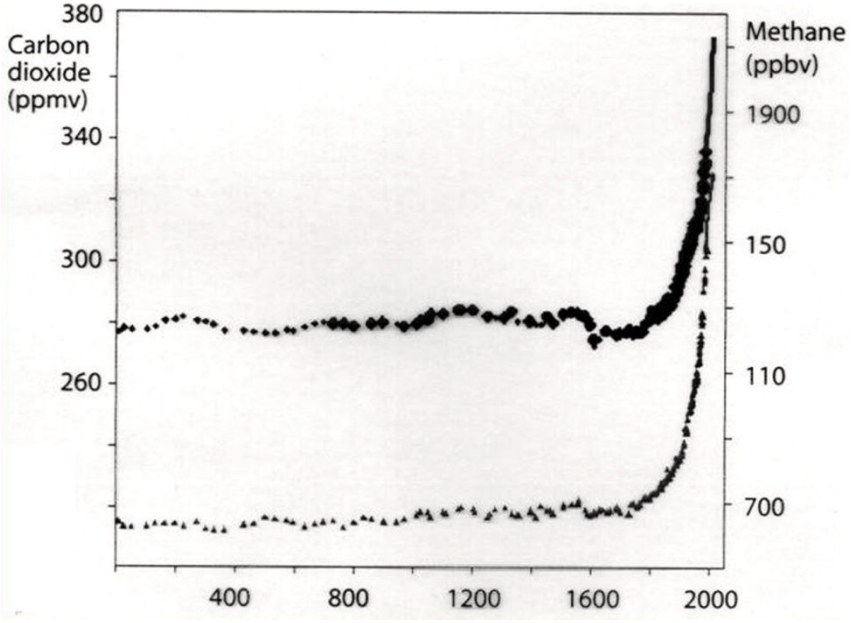


Figure 5: Greenhouse Gas Concentrations
Source: Intergovernmental Panel on Climate Change

Greenhouse gas concentrations and global 'sinks'

Figure 5 shows a steeply rising curve of concentrations of the greenhouse gases carbon dioxide (CO2) in parts per million by volume (ppmv) and methane in parts per billion by volume (ppvb) over two centuries, reinforced by their feedback release from oceans, ice and tundra due to global warming and acidification. Water vapour is the most powerful greenhouse gas, itself related in a complex way to feedback from global warming, but too variable to be measured in isolation. Climate change denialists (many of whom have large investments in fossil fuels) who claim that these dramatic changes are not anthropogenic should be reminded that the last time that CO2 rose so significantly was three million years ago.

The greatest storehouses of carbon lie in oceans, icecaps and soils, CO2 and methane being released into the atmosphere as feedback from global warming, perhaps at a greater rate than from fossil fuel combustion. Global warming has already led to the demise of many animal and plant species, since according to the veteran ecologist Barry Commoner, 'everything is connected to everything else' in the web of life.

A recent disturbing finding is that the biomass of marine phytoplankton, which lies at the bottom of the ocean's food chain, has diminished by 40 per cent since 1950. Linked to this is the worrying observation that during the (northern) summer of 2010, shoals of dead fish have been washed up on the East coast beaches of Delaware in the Eastern United States, raising a stink and threatening employment in local fisheries. The cause of death has been identified as anoxia, oxygen being less soluble in warm than in cold water. Without wishing to be unduly alarmist, I think that climatologists should focus closely on levels of oxygen in soils, oceans and the atmosphere, since its progressive decline holds potentially catastrophic consequences to all living organisms, including humans.

Mean global temperatures

Despite annual variations related to changing solar radiation and el Niño effects, mean global temperatures, particularly over the past century, have demonstrated an inexorable rise of around 0.8C (Fig 6). Warming has

particularly affected polar regions, which have experienced record rates of melting ice (Fig 7). The last decade has been the hottest ever, and the months of April to June 2010 have broken highest temperatures recorded by nine countries (Fig 8).

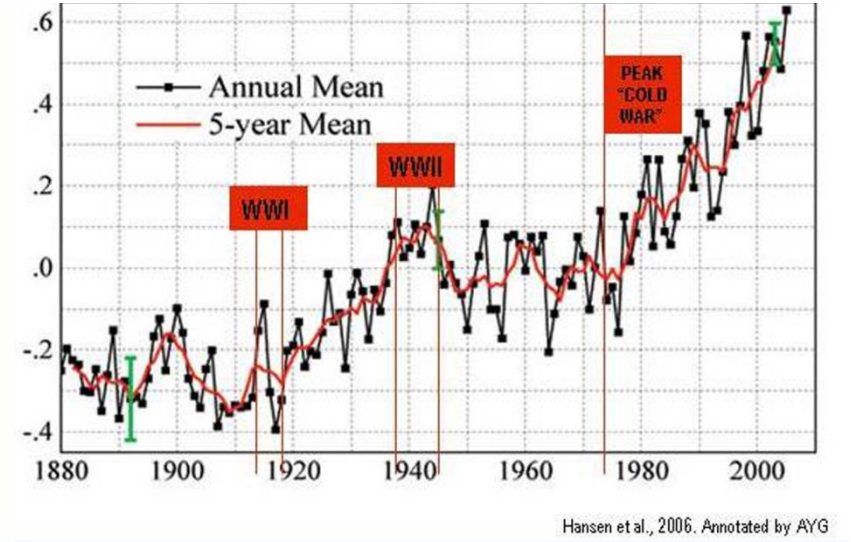


Figure 6: Mean global land–ocean temperature anomalies (°C)

In Russia, burning tundra has affected human respiratory systems and led to the destruction of wheat crops to the extent of an embargo being placed on wheat exports, placing nutritional needs of many countries at risk. The highest temperature recorded was in Pakistan (54C) which has resulted in massive evaporation of water, leading to cloudbursts and widespread flooding, displacing 21 million people from their homes. Around the world, including Australia, despite preceding droughts, atypical flooding has caused much damage to crops and homes.

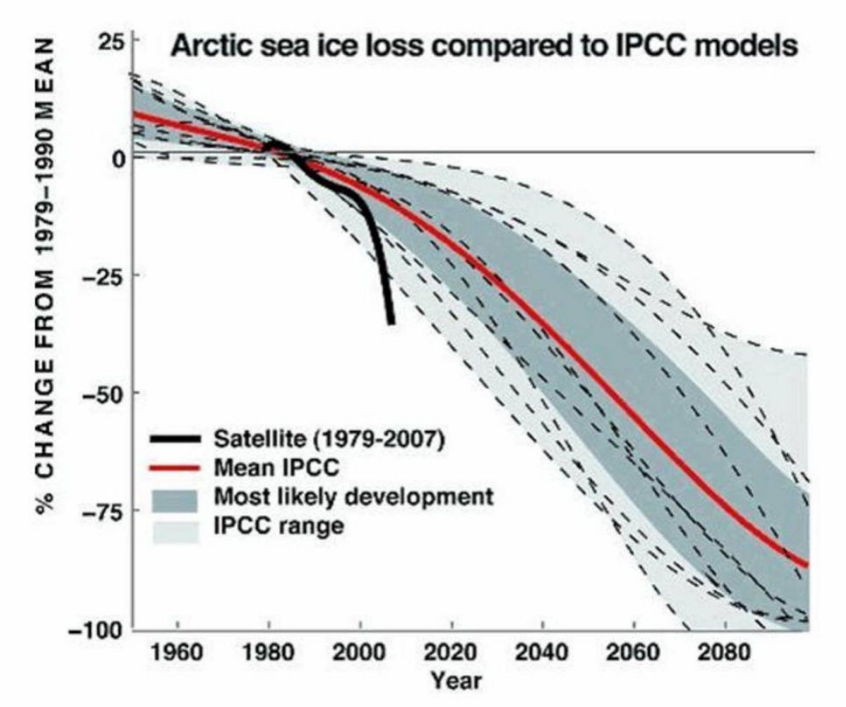


Figure 7: Arctic sea ice loss compared to IPCC models

Record Maximum Temperatures April–June 2010
• Russia 44C • Niger 48C • Sudan 49C • Saudi Arabia and Iraq 52C • Pakistan 54C

Figure 8: Record Maximum Temperatures
Source: Intergovernmental Panel on Climate Change

Effects of climate change on human health and wellbeing

Figure 9 summarises some of the effects of climate change on health. It seems likely that the effects of global warming will collectively outstrip all

other causes of human death and health impairment in the 21st century. So far, forward planning to adapt to these disasters is close to zero.

Health Hazards of Climate Change
• Habitat loss (flood, fire, storm) • Loss of terrestrial and marine biodiversity • Heatwaves (frequency, intensity) • Threats to water, food, security • Infectious disease (malaria, dengue) • Mental stress, social insecurity • Warfare for resources

Figure 9: Health Hazards of Climate Change

The benefits of industrial civilization on human health are well recognised. They include reduced mortality and increased life expectancy for the minority of the world's population living in affluent countries. Adverse health impacts on humans include a rising tide of obesity, with associated Type 2 diabetes and cardiovascular disease, malignancy and impairment of mental health. Environmental impacts may be summarised as the four 'Ps' – namely Population, Poverty, Pollution and Preparation for war.

Controlling cultural change apart from individual behaviour, we should look more closely at the distribution of economic, political and social power which underpins so–called democratic societies (Fig 10). When discussing the appropriate colour background for this slide of Pandora's demons (as shown in the conference presentation) my young neighbour suggested pink, since Pandora was a women. What he naively failed to recognise was that the power of Pandora's demons was mainly held by persons possessing Y chromosomes, exerting their influence through testosterone. The good news is that women's influence on our planet is generally more creative, socially responsible, more sensible, less destructive and less egocentric than men's. Women are slowly climbing up the corridors of power, sometimes vigorously opposed by fundamentalist religious, and economic vested interests in the maintenance of the 'business as usual' scenario which scientific evidence suggests is potentially disastrous.

Some of the consequences of Pandora's 'gifts'
• Corporations • Military-industrial complex • Hyperconsumption • Widening inequalities • Corrupt politicians • Scientific illiteracy • Terrorism and warfare • Loss of biodiversity

Figure 10: Pandora's 'Gifts'

A positive if utopian spin on a sustainable future for humanity and the biosphere

I'd like to conclude by discussing an optimistic attitude towards a sustainable future by advocating a radical cultural change through the application of the four 'Es' – Enlightenment, Ecology, Education and Ethics – and by a philosophical approach to the ABC of enlightenment – Awe, Beauty and Caritas (care and active responsibility, for people and nature). This is in line with the view that humans must learn to co–operate rather than compete with the natural world, echoed by Stephen Boyden of Nature and Society Forum through its Biosensitive Futures program (www.biosensitivefutures.org.au).

In the 19th century poets of the Romantic era wrote about living in harmony with the natural world, and some classical composers wrote inspirational music, such as Beethoven in his sixth (Pastoral) symphony. Half a century later Albert Schweitzer advocated the widespread adoption of a reverence for life. The scientific journal *Nature* previously included on its front page a quote from William Wordsworth: 'In the solid ground of Nature trusts the Mind that builds for aye'. This quote was later abandoned, probably because it carried religious overtones which were incompatible with the scientific culture of the day.

In my view, as presently constructed, democracy has little chance of dealing with the environmental crisis which we now confront, since it incorporates, especially in the United States, the rights of individuals and corporations to consume and pollute as they wish. Yet the alternative

autocratic communist regime of China, which flouts human rights, and the authoritarian government of Singapore hold little appeal to most Westerners. Yet despite their construction of a great number of coal–fired power stations, the Chinese investment in solar technologies (often the result of Australian brainpower) is double that of the US, and growing rapidly.

In the USA, attempts to reduce consumption is met with dogged opposition, being lost amongst endless Senate committees, resulting in 'business as usual' or tiny cosmetic adjustments. In Australia, efforts towards sustainability are met with unedifying squabbles in the Australian Parliament and the media by politicians of both the main political parties who are ideologically committed to competition rather than co–operation. Indeed being 'uncompetitive' is regarded as a crime. Perhaps when the Greens gain the balance of power in July 2011, some sanity will be introduced into politics.

I'd like to suggest a compromise solution of a mixture of benign autocracy and democracy, based on my own experience of wartime Britain. When faced with the alternatives of invasion or starvation, Winston Churchill selected his coalition war cabinet from men and women of proven ability, irrespective of political allegiance, if any. Despite much grumbling and flourishing of the black market, the population generally accepted the need for rationing – of food, fuel and clothing. Food was more fairly distributed amongst the population and much repair and recycling of clothing and mechanical gadgets became essential. Particularly successful was the 'Dig for Victory' campaign, where people grew household vegetables, fruit and chickens in allotments and back yards as valuable food supplements. Obesity was rarely observed, and cardiovascular and mental health improved as a result of the additional exercise. The nutritional health of children was preserved by issuing free milk, orange juice and cod liver oil, and many of them were healthier than before or since.

The bottom line for Hope remaining in Pandora's box is the collective harnessing of the potential of the human brain, which contains vastly more inter–neural connections than there are atoms in the Milky Way, always

remembering that we are children of the universe as well as of the biosphere.

In the final analysis, the main conflict facing our so–called democracy is between ecology and economics as presently constructed – both words being derived from the Greek *oikos*, meaning house. We must set our house in order.

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