3RD Proof

Climate Change, Uranium, and the Safety of Life on Earth

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2006, 9

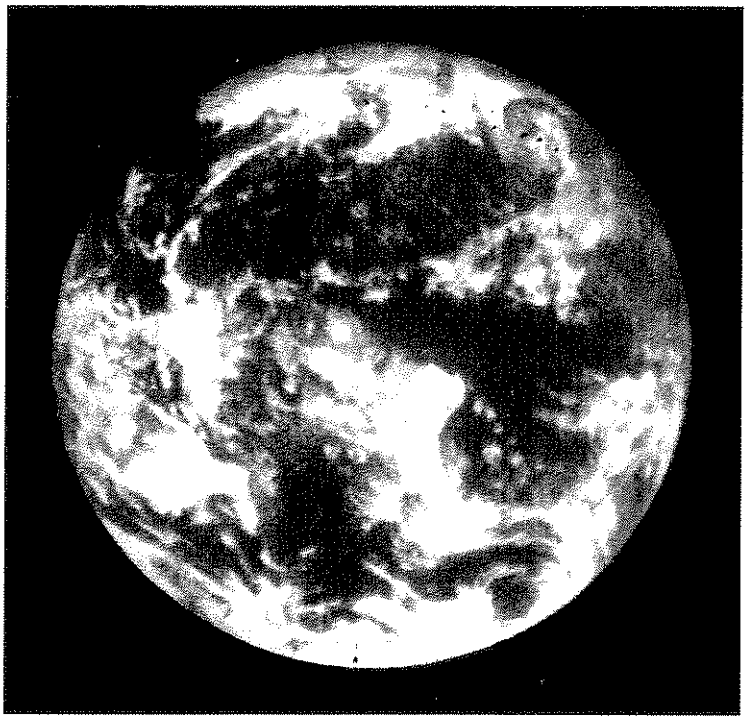
To Senate Committee on Climate Change.

Sorry this is so incomplete & messy but I think its main concerns are clear.

mb BSc Dip Ed PhD

A bug in a desktop computer in a nuisance, but in a missile-defense computer it could mean nuclear winter.

(Caldicott, 2002, p.106)



Reader's Digest, 1974, p. 36.

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INTRODUCTION

The Greek conception of the cosmos was animist; like an organism, it was responsive. The earth goddess, Gaea or Gaia was an agent of self-regulation. The metaphysical framework established in ancient times was replaced in the seventeenth and eighteenth centuries by a mechanistic or clockwork view of the universe. The animist view should have been promoted again in the nineteenth century with the Darwin-Wallace notion of natural selection as primarily a negative feedback control.

In 1875, the Swiss geographer, Edward Suess coined the term 'biosphere' for the layers of Gaia's land, sea and air in which life flourished. In 1937, Teilhard de Chardin claimed that "this animated covering of our planet may with advantage be called the biosphere". (1969, p.95) The emergence of life, he thought gave rise to the biosphere and we have, he asserts, a cosmic sense, an "affinity that binds us psychologically to the All which envelopes us". (Teilhard, p.82) We are drawn "powerfully towards nature". (Ibid., p.83) We can, should, and must love the universe. (Ibid.)

Systems theory or cybernetics was described in mathematical terms in the 1940s, but this was still seen by many as lying within the mechanistic framework. The Stern Review has now made clear the fact that levels of greenhouse gases must be stabilised. Their rate of production must not exceed the rate at which the earth's system can break them down. Negative feedback controls are the agents of stabilisation.

Those who live on the land have a much better understanding of the importance of the land and its water ways than many of their urban cousins, who buy milk, eggs and meat in cartons and seldom or never see cows, fowls or lambs. The urban sector is dependent on the rural sector.

Different areas of land have different values and the aborigines designated some areas as sacred or taboo. Radioactive isotopes such as uranium have since been found at some of these places. It is a pity they have not been left alone by Australians today.

Despite a number of Test Ban Treaties and Nuclear Disarmament programmes, new nuclear weaponry and new uses for radioactive wastes are part of the military and economic agenda of some nations. Doctor Helen Caldicott in her book The New Nuclear Danger tells us that "On October 2, 2001 - 21 days after September 11 - the Senate unanimously passed a massive 345 billion dollar Defense Appropriations bill, ..." (Caldicott, 2002, p.79). She claims that American children grow up believing that a war in space is inevitable.

Rockets launched through earth's atmosphere destroy ozone in the stratosphere. Ozone depletion adds to global warming.

When uranium is mined, there are two uranium isotopes present: U-238 and U-235. It is U-235 that is used in nuclear reactors, but it has to be enriched from 0.7% to 3%. This process uses lots of energy. There must therefore, be an energy input before there can be any energy output. "Uranium 238, the unfissionable isotope remaining after enrichment is dubbed depleted uranium, or DU." (Ibid.) DU has left a legacy of radioactive waste on the battlefields of Iraq, Bosnia and Lebanon, and is being used in military exercises in Australia.

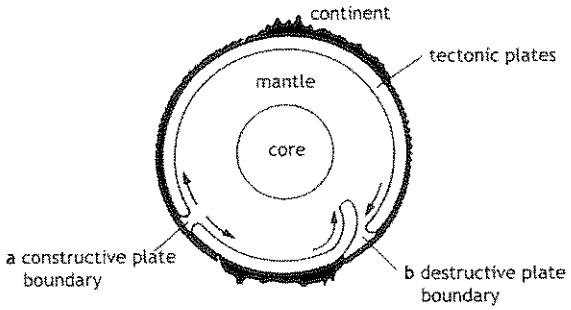
Runoff from uranium and military sites where depleted uranium is used, threatens our waterways.

> When uranium 235 is fissioned in a nuclear reactor, over 200 new radioactive elements are created, and the uranium, when mixed with its fission products becomes 1 million times more radioactive than in its natural state. (Ibid., p.148)

Uranium decays at a minimum rate when left undisturbed, but even then it is highly radioactive. "In 1 gram of uranium 238, 12,400 atomic transformations occur each second, and each throws off an alpha particle ..." (Ibid., p.149). Each alpha particle creates a path of ionisation – a path of broken molecules.

If we are to keep our land, waterways and air safe from additional radioactive products, we should work to ensure that uranium remains unmined. It should be left alone. There is natural radiation with which we and the rest of life evolved, but we are not adapted to the higher levels and new kinds that are being created by humans.

Radiation is at a minimum when radioisotopes are left alone – when taboo – and the safety of life is then maximised.



The Earth's structure (Bennett, 2005, p.115)

The earth's inner heat is due to radioactive decay and when radioactivity is created by humans extra heat is added to the system. "At a depth of 4.6 km the temperature reaches 145 degrees Centigrade, where oil is cracked into natural gas." (Cawthorne, 2004, p.165)

Jeanne Guillemin, who was part of a team who recently investigated an outbreak of anthrax in the USSR, which occurred in 1979, expresses her concerns:

> Military technology also imposes risks for the environment, in its manufacture, in its potential deployment, and above all in its technological development. Behind us lies a century devoted to using modern scientific achievements to develop weapons of mass destruction, the ultimate risks. Out of physics came nuclear weapons, which were produced in such quantities in the second half of the twentieth century that it will take centuries to rid the planet of their noxious products. Out of chemistry came nerve gases, cheaper to make and use than nuclear weapons, but hard to control. And then, out of biology, the science of life and healing, have come weapons that can turn the worst of nature's devices against humans. Advances in molecular and cellular biology threaten new products and technologies that may not simply kill or wound, but manipulate our bodies and our minds, including the way our species reproduces, who lives and who dies, and all the life processes that govern our survival. (Guillemin, 2001, p.228)

Out of chemistry came also fossil fuel products such as petrol, oil and industrial products, including plastics, dyes and thousands of synthetic chemicals. Out of biology came also a recognition that the physiological process of our body are controlled by feedback systems. The temperature of our body is held constant; sugar levels are held constant; the rate at which new cells grow equals the rate at which old cells die in the tissues of our bodies. Similarly, the temperature of the earth was held constant; oxygen, nitrogen and carbon dioxide levels were held within a limited range, and the rates at which elements and molecules were released equalled the rates at which they were lost or destroyed. Stability was maintained by natural selection of Gaia.

The Stern Review now argues that it will be most efficient, from an economic perspective, to stabilise the level of greenhouse gases at a level as low as is feasible. Their levels are already far above normal, so we must stabilise them at the lowest possible high level.

Carbon dioxide (CO_2) is the best known greenhouse gas, but there are many others, some natural and some artificial. Each gas has its own

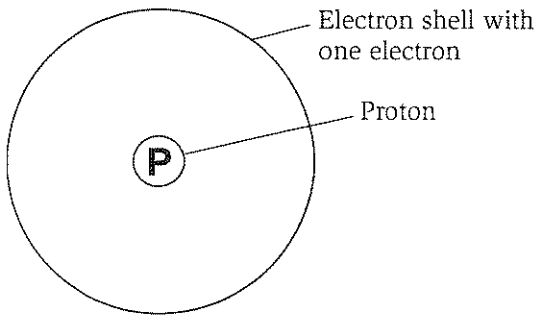
individual heat holding capacity and this is measured against the heat holding capacity of CO_2. At present, the level of CO_2 is 380 ppm, but the level of all greenhouse gases or their CO_2 equivalent (CO_2e) is, according to the Stern Review, 430 ppm. As greenhouse gases accumulate, more heat can be held. Since the level of these gases is perhaps double their natural level, the level, at which stabilisation can be achieved, will be high also. To stabilise them at 450 ppm would be difficult, but a level of 550 ppm should be considered an upper limit target.

The greenhouse problem, the nuclear problem, and many others have arisen due to the failure of the economic system to pass true costs to those who incur them.

HYDROGEN

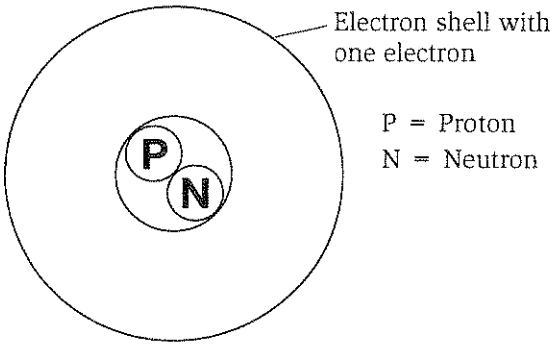
Hydrogen occurs in water. The atmosphere contains only about 10^{16} kg of water; 97% or 10^{21} kg is in the oceans, 3×10^{19} kg is in icecaps and glaciers; 10^{15} kg is in rivers; 2×10^{17} kg is in lakes and inland seas, and 8×10^{19} kg is in groundwater above 4000 metres in depth. The amount of hydrogen as a component in the earth system is so small that it is included in 'other' - 0.6%. Some is included in the earth's crust but to an extent of less than 1%. Hydrogen is the most abundant element in the universe, but most of the earth's hydrogen is in the oceans. Neither hydrogen no helium are held by the earth's gravitational field.

Hydrogen is the lightest and simplest element~~; also the most abundant~~. Its atom is made up of one proton in the nucleus and one electron in the electron shell surrounding the nucleus.



Hydrogen atom – isotope H-1 – stable

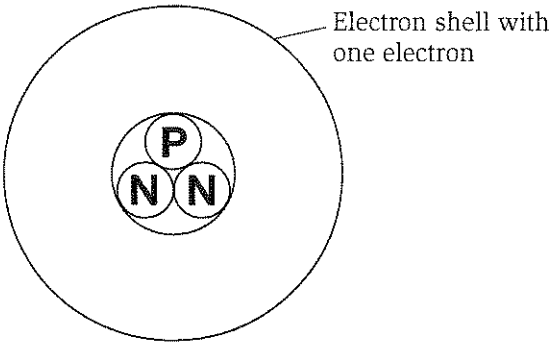
The proton has a positive charge and the electron has an equal negative charge.



Deuterium atom – isotope H-2 – stable

Deuterium is an isotope of hydrogen, designated H-2. It has the same structure as hydrogen except that is has a neutron added to its nucleus.

Deuterium is almost twice as heavy as hydrogen. Deuterium dioxide, for this reason, is know as heavy water. Neither deuterium not its compounds are radioactive; its nucleus is stable, but deuterium dioxide is not suited to most forms of life. One of the most basic similarities between cells from all branches of the evolutionary tree is their inbuilt 'clock mechanism'. Every cell and every organism has evolved with the day/night rhythm of our planet and this is built into the basic cell structure. If deuterium oxide replaces water (hydrogen oxide), the inbuilt diurnal rhythm of the cell or organism can be upset. (Lithium has a similar effect on these natural rhythms). Both substances are best left untapped.

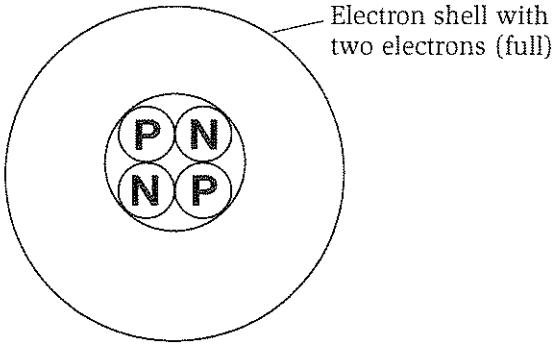


Tritium atom – isotope H-3 – unstable (radioactive)

Tritium is another isotope of hydrogen, but this time, it has 2 added neutrons and it is not stable.

Tritium and all its compounds are radioactive. To become stable it must lose an electron from its nucleus, it then changes to a form of helium, He-3. Tritium is constantly being formed in the earth's atmosphere due to the action of cosmic rays. When it originates in this way, it is one of the sources of natural radiation with which we have evolved.

Most of the heat and energy from the sun comes from the fusion of hydrogen into the next element in Mendeleif's periodic table – element number 2. It has 2 protons and 2 neutrons in its nucleus and two electrons in the electron shell, which is all the electrons the first shell can carry. If electrons or β-particles are emitted from an atomic nucleus, a neutron changes into a proton. The helium atom of 2 protons and 2 neutrons can therefore be thought of as being made up of 4 protons and 2 electrons.



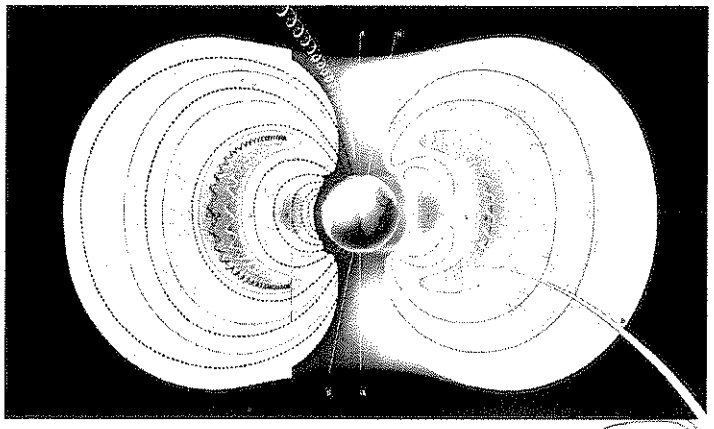
Helium atom, He-4, - stable

Although it appears that there is equality of matter, the weights of 4 hydrogen atoms and a helium atom are not identical. In fact, the weight of the helium atom is 0.7% less, and it is from this loss of matter that the energy that reaches our earth is generated according to Einstein's famous equation, $E = mc^2$. "Each gram of helium produced releases 6.72 x 10^{11} joules of energy." (Cawthorne, 2004, p.203) Helium is formed under great pressure and at a temperature of about 15M°C in the sun's interior.

Since the advent of green plants, certain wavelengths of sunlight have been trapped in the photosynthetic process, and this has allowed

the evolution of animals, which depend on plants for their energy. Most of life, therefore, depends on the sun for its energy.

Sunspot activity influences terrestrial magnetism, atmospheric temperature, and the frequency of tropical storms. More energy is radiated when sunspots are active. There were few or none during the 'Little Ice Age' in the seventeenth century.



The Earth's magnetic field (Reader's Digest, 1974, pp. 38-39)

The earth's magnetic field protects it from the solar wind made up largely of high velocity protons or hydrogen nuclei. The molecules making up our bodies have more hydrogen atoms than any other kind of atom e.g. Ribose $C_5H_{10}O_5$. Hydrogen bonds to hydrogen in a unique way and plays an important role in determining the form of organic molecules.

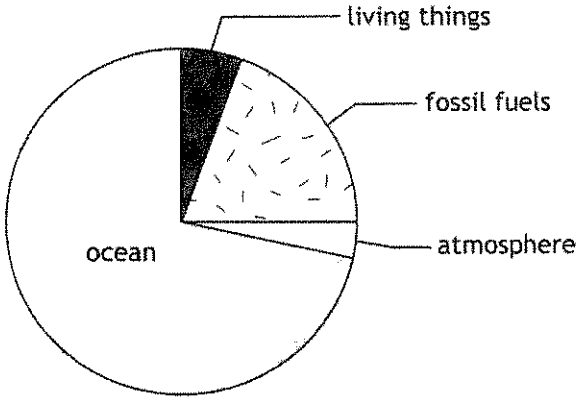
"There are gas hydrates and condensates in the polar regions. But disturbing them would release massive quantities with disastrous consequences for global warming." (Cawthorne, 2004, p.165)

OXYGEN

Oxygen makes up 21 per cent of the atmosphere; 78 per cent is nitrogen and 0.04% by volume is carbon dioxide. Oxygen is present in nearly all minerals and is widely distributed. It is the most abundant element in the earth's crust, 47%, followed by silicon, 28%, and makes up 28% of the earth's total elements, exceeded only by iron, 35%. After photosynthetic organisms evolved, oxygen accumulated in

the atmosphere. In the stratosphere, oxygen was converted to a different molecular form, ozone, O_3, and began to shield the earth from ultra violet radiation from the sun, allowing life to evolve on the land and in the air of planet earth. Without our atmosphere, with its several layers, temperatures on earth would rise above the boiling point of water in the day and fall below -100°C at night.

The atmosphere is a blanket of gases about 1000 km deep. The layers are designated as the troposphere (lowest), stratosphere, mesosphere, thermosphere and exosphere. (Farndon, 2004, p.318) Even though temperature decreases as we climb higher on mountains and drops to about -60°C at the tropopause which marks the top of the troposphere, it rises again in the stratosphere owing to the heat held by oxygen and ozone molecules. Temperatures drop again in the very rarefied region of the mesosphere from 10°C down to -120°C at a distance of 80 km above sea level. Nitrogen gradually decreases to an almost negligible proportion in the outer exosphere. Above the mesopause, the thermosphere gets hotter again rising from -120°C to 2000°C 700 km up, but the air is so sparse that it carries little heat. (Farndon, p.318) The atmosphere of the exosphere which is composed mainly of hydrogen and helium fades into the rest of space where there is almost a vacuum. If its temperature is high, this is presumably due to the impact of the solar wind from which the earth is less protected in its outer layers.



Carbon storage (Bennett, 2005, p.49)

The ozone layer, where ozone occurs at the rate of about 10 ppm is located, as we have seen, in the stratosphere, which lies about 10-50

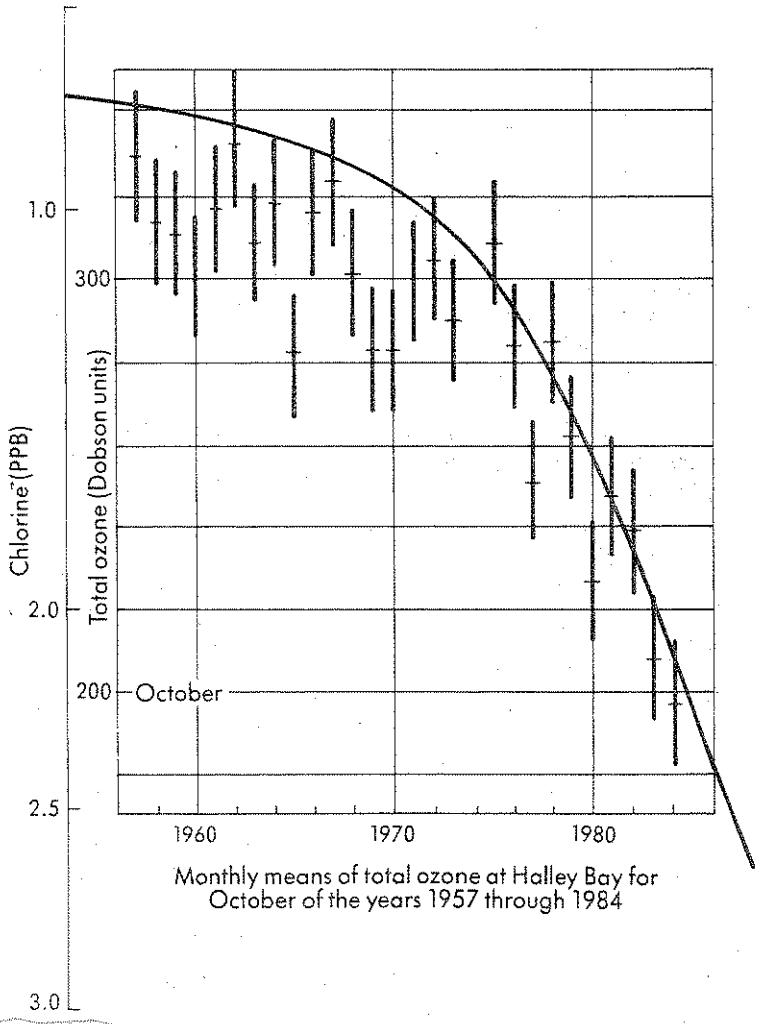


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Figure 10

Elongated 'crosses' show the decline in October concentrations of ozone in the stratosphere measured (in Dobson units) from Halley Bay between 1957 and 1984. The length of the vertical bar indicates in each case the uncertainty in the measurements. The smooth curve shows the total concentration of organochlorine molecules (essentially, CFCs) measured (in parts per billion) at the same site – but plotted *upside down*, so that the steep fall in the curve represents an *increase* in the concentration of CFCs. (Source: Rowland, as Figure 4; based on data from Joe Farman's team)

((Gribbin, 1983, p.97)

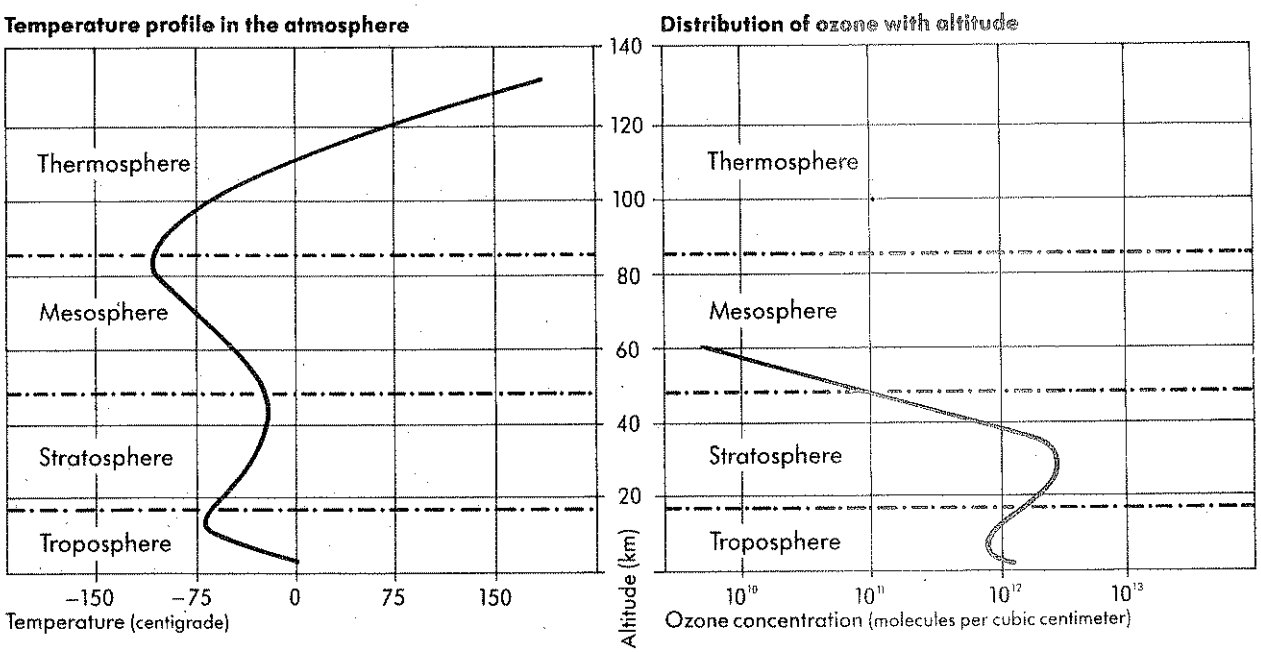


Figure 1
The layered structure of the atmosphere is shown by a temperature 'profile'; ozone is concentrated in the stratosphere, especially between 20 km and 30 km altitude
(Source: *Present State of Knowledge of the Upper Atmosphere,* NASA, 1986)

(Gribbin, 1988, p. 13)

km above sea level. Below it lies the troposphere, which holds about 80 per cent of all the gases in the earth's atmosphere. More gases, in fact, lie dissolved in the earth's oceans, than circulate in the atmosphere, but the solubility of gases in liquids decreases with an increase in temperature. If this were so, less carbon dioxide would be held in the oceans as temperature increases, resulting in positive feedback. There are limits to the solubility of different substances in water and those limits depend on temperature. Carbonic acid is in equilibrium with the dissolved carbon dioxide. Do temperature increases increase the levels of carbonic acid and reduce the levels of carbon dioxide held by the oceans? With what net effect?

Ozone is six times as abundant in the stratosphere as in the troposphere. The stratosphere shields us from 95 per cent of the UV radiation $\lambda < 0.4$ microns. Ozone absorbs UV radiation $0.28 < \lambda < 0.32$ microns and oxygen absorbs UV radiation $\lambda < 0.28$ microns. (Flannery, 2005, p.215)

Although Louise Young wrote about ozone destruction due to atomic tests in 1977, further data took time to accumulate. Farndon records that a 50 per cent loss of ozone was recorded over the Antarctic by 1982 and that an ozone hole appeared over the Arctic for the first time in 1996. (Farndon, 2004, p.354) In 2000, the hole at the South Pole was measured to be 28M sq km and its halo extended to cover most of the globe south of 40°S latitude. (Flannery, p.215) Ozone levels have declined from 320 Dobson units in 1955 to 90 in 1995. (Flannery, p.214) These 1955 measurements would not have given a true picture of proper levels, since ozone had already been depleted by atomic explosions and tests during the period from 1945 to 1955 and by chlorinated compounds during the century before, and stratosphere temperatures also may have been higher. In fact, Farndon gives the temperature of the tropopause as -60°C, while the Reader's Digest Atlas of the Universe tells us that it was -55°C in 1898. (Farndon, 2004, p.318; RD, 1974, p.40)

Gribbin wrote about the greenhouse gases in 1982 and Lovelock praises his later 1990 book, Hothouse Earth. (Lovelock, p.4) According to Lovelock the issue was then taken up by politicians such as Al Gore and Margaret Thatcher and the author of the foreword to his book, The Revenge of Gaia, Sir Crispin Tickell.

> These considerable efforts led to the formation in 1989, by the World Meteorological Organisation (WMO) and the United

> Nations Environment Programme (UNEP) ... of the Intergovernmental Panel on Climate Change (IPCC). (~~Lovelock~~, p.5)

Ibid., p.5

Speaking at an address given to the Royal Society, Thatcher said:

> While the conventional, political dangers - the threat of global annihilation, the fact of regional war - appear to be receding, we have all recently become aware of another insidious danger ... . It is the prospect of irretrievable damage to the atmosphere, to the oceans, to the earth itself. (Beck, 1990, p.219)

Lovelock continues:

> Scientists did not acknowledge the Earth as a self-regulating entity until the Amsterdam Declaration in 2001, and many of them still act as if our planet were a large public property that we own and share. ~~(Ibid.)~~ (Lovelock, 2006, p.5)

Self-regulation depends on the presence of negative feedback mechanisms, but humans and their technological products are destroying some of these and replacing them with positive feedback systems. Many have now seen Al Gore's film, An Inconvenient Truth.

Chlorine levels due to substances such as chlorofluorocarbons (CFCs) are five times their normal level in the stratosphere. A single chlorine atom can catalyse the destruction of 100,000 ozone molecules. Not all chlorine in the stratosphere comes from CFCs. Dr. Helen Caldicott explains:

> Solid fuel used in U.S. rockets and in the space shuttle releases 240 tons of concentrated hydrochloric acid (HCl) at each launch. Chlorine, which splits off from the HCl molecule, is the substance that combines with and destroys ozone molecules. Scientists in 1989 predicted that if NASA continued to launch solid-fuel rocket boosters at a rate of ten per year, this would induce a 10 per cent depletion in the ozone by 2005. Yet the number of civilian and military launches have increased alarmingly since that prediction was made. (For each 1 per cent decrease in stratospheric ozone there will be a 4 to 6 per cent increase in skin cancer ... .) (Caldicott, 2002, p.143)

Another possible source of additional chlorine in the stratosphere, and hence possible further ozone depletion, is pesticides, such as organochlorides, organophosphates with names such as chlorpyrifos and dichlorvos, and fungicides, such as chlorothalonil. These all presumably contain chlorine, which, as the product breaks down, could be released into the atmosphere. Chlorine is a gas.

Most of us eat pesticides such as these every day of our lives and most of them are mutagens.

> ... Large centralized food retail outlets use more preservatives, more long-distance transport and more packaging. They also favour large-scale, industrial farms using monocropping and intensive animal husbandry methods, which in turn are heavily dependent on chemical fertilisers, pesticides, hormones and vaccinations. ("Local Food Directory Makes Instant Impact", 1998, p.4)

In 1988, the 30 year old US Delany Law "which banned the deliberate addition to food of any level of carcinogen" was revoked. (Epstein, 1998, p.73) Although farmers are generally healthier than their city cousins:

> ... for the last several decades, farmers have experienced high rates of several cancers, including leukaemia, non-Hodgkin's lymphoma and cancers of the brain and prostate. Animal and epidemiological studies have linked several of these cancers with exposure to pesticides or solvents. ("Cancer Prevention News", 1998, p.73)

DDT, chlorine and dieldrin, which concentrate in animal fats, may be implicated in breast and other cancers at the same time as they add potentially to ozone reduction.

> Breast cancer mortality in pre-menopausal Israeli women declined by 30% following regulations which reduced the levels of DDT and other carcinogenetic pesticides in dietary fat, in spite of increasing fat consumption among the population.(Hall, 1998, p.75)

Mammograms, promoted as cancer detectors, may actually cause cancer. They deliver a dose of 2 rads per session, so that one mammogram per year for ten years would cause a pre-menopausal woman to increase her risk of contracting breast cancer by 20%. (Epstein, 1998, p.76)

Agent Orange, used in the Vietnam War, is "a mixture of two well - established carcinogenic herbicides, 2,4,5-T and 2, 4-D (the former having since been taken out of production in every country in the Western world". (Walker, 1998, p.85) 2,4,5-T is generally contaminated with dioxin which "can produce a total degeneration of the liver". (Walker, 1998, p.85)

> Great swatches of jungle were destroyed and as much as one tenth of South Vietnam's rural countryside was devastated. Monsanto did very well out of it, as production of 2,4,5-T rocketed from 5.8 million pounds in 1958 to 13 million pounds in 1964, and to 42 million pounds in 1968. (Walker, 1998, p.85)

Although a report, commissioned by the National Cancer Foundation, found that the herbicide caused birth defects, cleft palate and kidney malformation in test animals, it was never released. When "Australian veterans, whose health had been seriously affected", called for an enquiry into its effects, the Royal Commission that was set up "ended up by giving 2,4,5-T a clean bill of health" despite different findings by others. In fact "almost all the conclusions of the report had been taken word for word from the evidence of Monsanto's Australia Ltd." (Walker, 1998, p.85) Corporations go free and individuals continue to suffer. Many of the substances that carry chlorine act detrimentally on two fronts, as ozone destroyers and as carcinogens.

Anaesthetists have also been found to suffer from having more spontaneous abortions in their families, "a lower fertility rate, a greater incidence of cancer, and a greater likelihood that children ... would be born with congenital defects". (Walker, 1998, p.88)

Chloroform was used as an anaesthetic from 1850 till the 1950s, when it was replaced by other compounds such as halothane, which carries both chlorine and bromine. Chloroform decomposes to release chlorine so that the ozone layer may have suffered a decline long before its abundance was first measured. Phosgene ($COCl_2$) is a colourless gas, with an odour like freshly cut hay, but it was used as a war gas in World War I. It is a breakdown product of chloroform in the presence of air or oxygen.

Water supplies have been chlorinated since the first decades of last century and they normally contain from 2 to 44 parts per billion of chloroform, and hence phosgene and chlorine. In December 1998, the US Environmental Agency (EPA) recommended that acceptable levels of chloroform in water supplies be cut from 300 ppb to close to zero, but the Chlorine Chemistry Council and the Chemical Manufacturer's Association took them to court and won in 2000. (Stratmann, 2003, pp. 217-8)

Chlorine was identified as an element in 1809 and was soon used for bleaching and fumigation. Chlorine dioxide is still used as a bleaching agent in paper pulp production. Chlorine dioxide decomposes in hot water to give chloric acid, chlorine and oxygen. The chloric acid is

a strong oxidising agent and is used to decompose organic materials, such as in producing paper pulp, so that pulp mills and paper production could have also added to the destruction of ozone for a considerable period of time. Silver chloride was also used in photography and also released chlorine. (Year Book Australia, 1988, p.800) The dry cleaning process is another chlorine producer since it uses carbon tetrachloride.

Chlorine occurs naturally in sea salt and sea water as sodium chloride and is emitted from volcanoes as hydrochloric acid. When separated from the sodium of salt an energy intensive process of electrolysis is used.

The news that one in three will suffer from cancer and one in four die from it is well known, but news concerning the causes of those cancers is not. Melanomas of the skin increased 300% between 1950 and 1988 in the US. The only cancer, among 21 categories listed, that increased at a higher rate was lung and bronchus cancers in females, which increased by 511 per cent. (Epstein, 1998, p.71) Extra UV radiation due to ozone depletion can lead to an increased incidence of melanomas. In the same period there was a 21% increase in childhood cancers. (Epstein, 1998, p.71) Of particular concern is "a 40% increase in brain and nervous system childhood cancers." (Epstein, 1998, p.78) There are claims that the use of mobile phones is a causal factor. Do these use frequencies that we were previously protected from by atmospheric radiation absorbers? Did Gaia protect us in the past?

Children are more susceptible to many carcinogens because their cells divide more frequently and because the protective myelin sheath on our nerves is not complete until adolescence. Children whose parents use pesticides in their home and garden have been found to be more likely to suffer from leukaemia. Organophosphates are neurotoxins and: "For some organophosphates, the fatal dose in immature animals has been reported to be one per cent of the lethal dose in adult animals". (White, 1998, p.101) "[M]irex the carcinogenic pesticide applied in the ill fated fire ant campaigns of the 1960s [in the US] is still in use as a flame retardant." (Tenner, 1996, p.23)

A study conducted in New Zealand found that a typical lunch of bread, butter, sausage, lettuce, tomato and an apple contained at least 14 different pesticides. Almost every one of these is mutagenic; many can cause cancer, and another set can disrupt the hormone or endocrine system, or the immune system, or both. The most contaminated

products in this survey were celery, wheat products, tomatoes, kiwi-fruit, apples, cucumber, peaches, strawberries, oranges, lettuce, pears and potatoes.

> Wheat products including bread, pasta and pastry are very heavily contaminated (96.6 per cent of 90 samples) because of the practice common in both New Zealand and Australia of applying post-harvest organophosphates in storage. (White, 1998, p.104)

In the US, Spencer Abraham, Energy Secretary in the Department of Energy, "voted to eliminate up to 90 per cent of the toxic chemicals industry must report, undermining the community's right to know". He also supports missile defence. (Caldicott, 2002, p.208)

DDE is an organochlorine and a breakdown product of DDT. DDE was found in

> ... 80 per cent of 40 samples of meat including beef, pork, chicken, lamb, sausages, meat pies and luncheon sausage and 100 per cent of 16 samples each of butter and cheese. (White, 1998, p.104)

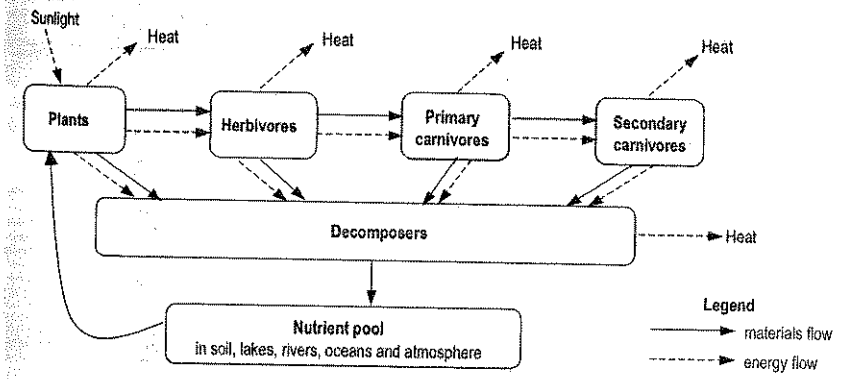
Maximum Residue Limits (MRLs) are set for each pesticide separately so that interactive or synergistic effects are not evaluated. Very low levels at even parts per trillion can have effects. In addition to problems inflicted on the genetic, nervous and immune systems there is also the problem of those that block, mimic or interfere with the endocrine or hormone system. "Children, future generations and the environment are, we now know, at serious risk from pesticide use and policies." (White, 1998, p.105) To those risks described here we must also add the risks due to ozone depletion.

The onus of proof needs to be transferred from the consumer to the manufacturer. The actions of a government acting for the good of the Commonwealth would be to protect consumers from these hazardous chemicals and to protect our planet from global warming.

Whether we like it or not, laws are tools of management and the government serves as manager. It should ensure that those family farms, that care for the land and for the products of the land, are adequately rewarded, while those that destroy the land and care only for the monetary return, are adequately penalised.

Bromine, a halogen like fluorine and chlorine, is forty-five times more destructive than chlorine. (Flannery, 2005, p.217).

Food chain in nature



Note: Less than 1 per cent of the Sun's radiation is converted into chemical energy through photosynthesis. This, in turn, is used by animals that eat both the plants and other animals, and is finally used by microbial and fungal decomposers. All the energy ends up as waste heat.

SOURCE Boyden & Dovers (1997), figure 1.3 (Diamond, 2002, p. 61)

> If it had turned out that chlorine behaved chemically like bromine, the ozone hole would by the 1970s have been a global year-round phenomenon, not just an event of the Antarctic Spring. More by luck than by wisdom, this catastrophic situation did not develop. (Paul Crutzen, Nature, 2002 quoted in Flannery, p.213)

Caldicott and Lovelock both tell us, that the stratosphere is a place "where most of us have been without knowing it, as passengers travelling in jet aircraft". (Lovelock, p.80) In fact the "most heavily used air routes of the northern hemisphere are predominantly in the stratosphere". (Lovelock, p.131) Aircraft and space vehicles passing through the stratosphere give out ozone destroying gases. We should leave it alone if we care for Mother Earth or Gaia.

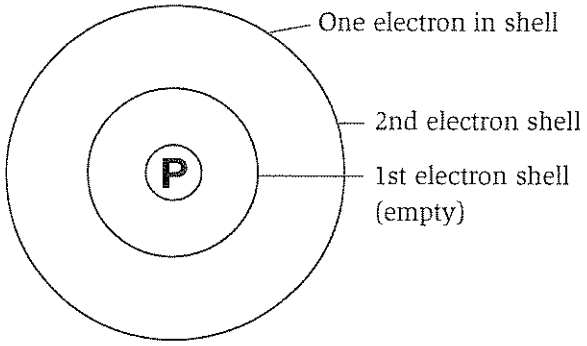
> The supersonic jet ... is possibly the most environmentally damaging technology ever developed. There will never be an eco-friendly F-35 Joint Strike Fighter. If planes like this continue to be developed, they will destroy the climate as effectively as they destroy their targets. (Monbiot, 2006, p.60)

Writing in 1982, Gribbin tells us that only 7 per cent of the electromagnetic radiation from the sun with $\lambda > 0.4$ microns reached earth. The rest was absorbed by molecules such as ozone. (Gribbon, 1982, p.190) If ozone is depleted, more electromagnetic (em) radiation must reach earth. This means a greater energy input than normal, so that if energy input exceeds energy output, which had been held pretty much in equilibrium since life moved onto land and into the air, ozone depletion must be a factor in global warming.

Gribbin also discusses blackbodies. A perfect blackbody is one which absorbs all heat radiation. He claims that the earth's atmosphere already, in 1982, absorbs 90 per cent of the infrared radiation. It is the blackbody effect that keeps earth's temperature within present day limits. (Gribbin, p. 230) Energy in the 8-12 micron range, he tells us, escapes easily into space, but most of the rest is absorbed by greenhouse gases. (Gribbin, p.192)

Each greenhouse gas such as carbon dioxide, water, methane and the nitrogen oxides absorbs wavelengths peculiar to itself. How much can be absorbed at each frequency depends on the quantity of the absorbing material in the earth's atmosphere, but how much is absorbed depends also on how much heat energy of the particular frequency that each absorbs is present and therefore available to be stored in the greenhouse gases.

The storage of energy in greenhouse gases is carried out by the electrons held in the shells surrounding the nuclei of atoms.



Hydrogen atom

To move the electron from the inner shell to the second shell of the hydrogen atom requires an energy input of 0.82 volts. (Lovelock, 2006, p.88) If radiation of a particular frequency hits a hydrogen atom, its electron will move from the inner shell to the next one out, and it will absorb the energy that the move requires. The atom is then in an unstable or excited state. The nucleus is stable; it is not radioactive, but until the electron returns to the inner shell and emits radiation of the same frequency as that which it absorbed, the atom holds energy that it would no longer hold if the electron returned to its most stable position in the inner shell.

Ultraviolet light carries "sufficient energy to disrupt a chemical bond, following excitation, though not to remove an electron from its parent molecule or to disturb the nucleus." (Charlesby, 1961, p.110) Arrhenius hypothesised that pressure from light could exceed that from gravity on very minute objects such as seeds or spores.

Electron shells hold different numbers of electrons, e.g. Shell 1 holds $2n^2 = 2$ n = 1; Shell 2 holds $2n^2 = 8$ n = 2.

Mendeleif's table carried 92 elements; element 92 is uranium, but humans have made more new radioactive elements beyond 92 and beyond 100. Uranium 238 has 92 protons and 146 neutrons in its nucleus. The least reactive elements have full electron shells. Helium, argon, neon and krypton are designated inert gases for this reason.

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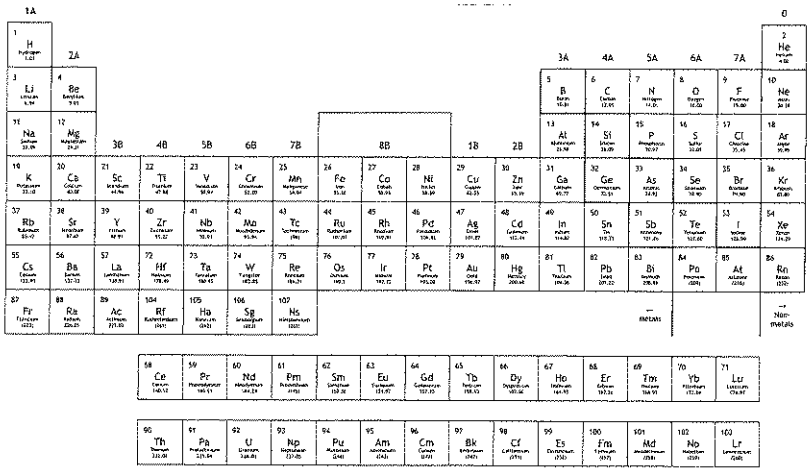
Table 5.1: Volume of Water Stored in the Water Cycle's Reservoirs

RESERVOIR	VOLUME OF WATER (MILLIONS OF KM³)	PERCENT OF TOTAL
Oceans	1,370	97.25
Freshwater	38.71	2.75
of which: Ice caps and glaciers	29	2.05
Groundwater	9.5	0.68
Lakes	0.125	0.01
Soil moisture	0.065	0.005
Atmosphere	0.013	0.001
Streams and rivers	0.0017	0.0001
Biosphere	0.0006	0.00004

Source: http://www.physicalgeography.net/fundamentals/8h.html

(Seeber, 2008, p. 117)



Periodic Table of Elements

WATER

Writers now tell us that future wars will be over water rather than oil. The demand for water keeps increasing, while about two-thirds of it is used already for agricultural purposes. Only 3% of the world's water is fresh and 3/5 of that is in the Antarctic Ice Sheet. Only enough to rain 1 inch of rain over the whole globe is held in the atmosphere.

When icebergs melt, the water they produce exactly fills the space occupied by the iceberg so that there is no change in sea level from the melting of icebergs, but if the Greenland Ice Sheet, and the East and West Antarctic Ice Sheets melt, then large quantities of agricultural land will be flooded. A six foot rise in sea level could remove 16% of Bangladesh and displace 13% of its population. (Cawthorne, 2004, p.175) The reduction in the saltiness of the ocean due to the addition of large amounts of the fresh water could mean that the heavy saline water that sinks to power the Gulf Stream no longer sank, upsetting one of the Earth's major sea currents. Warmer water added could do likewise. The North Atlantic Conveyor Belt might no longer exist.

Sea levels would rise due to the melting of ice on land, but as the ocean temperature rises, clathrates would release hydrates such as methane from the ocean floor and this release could lower sea level at

a particular time when the conditions were appropriate, but it is thought that the rise would still markedly outweigh the reduction.

Most of the water used on land is used for agriculture, but 20,000 square miles of fertile land become desert each year under present practices and population. Seventy-four per cent of the arable land in North America is threatened due to a man-made shortage of water. (Cawthorne, 2004, p.177) Aquifers are being drained faster than they can refill.

> Shortage of water is now is worldwide problem. By the year 2000, in the fertile Punjab, water was being pumped out of aquifers twice as fast as the rainfall was filling them. A similar depletion is going on under the breadbasket of northern China. (Cawthorne, 2004, p.177)

If water is taken and aquifers collapse, then the present source will disappear.

Already 33,000 people starve to death every day. Writers on economics continue to deny that the warnings of Malthus have any substance, but if desertification and aquifer depletion continue at their current rate the problem of water could lead to a food problem of enormous magnitude. "Already 3.6 billion of the world's 5.2 billion hectares of dry land used for agriculture is affected ..." (Cawthorne, 2004, p.177) Moreover, even in Australia, "10.14 per cent of 'income units' in Australia live below the poverty line". (Falk and Browlow, 1989, p.218) Industry as well as agriculture is supported by water and since those on high incomes are also the most prolific consumers, these are the group whose consumer demands both reduce water supplies and enhance greenhouse emissions the most.

When oxygen combines with two hydrogen molecules, the 6 electrons in oxygen's outer shell together with the two electrons from the hydrogen atoms complete that electron shell of eight electrons. Water molecules absorb em energy at a frequency of their own and distinct from the frequencies absorbed by hydrogen and oxygen. In other words every atom and every molecule absorbs and emits em energy at a frequency or frequencies peculiar to itself. Electrons from shell 3 can move not only to shell 4 but also to shell 5 and the em frequency to do this is specific and different for each isotope and molecule. Oxygen molecules, O_2, absorb different UV frequencies from ozone molecules, O_3.

> Ozone depletion increases the amount of biologically harmful solar radiation, specifically, ultra-violet B (UV- B) rays, that penetrates the ocean's surface. UV-B radiation damages fish larvae

Australia's Water - Murray-Darling

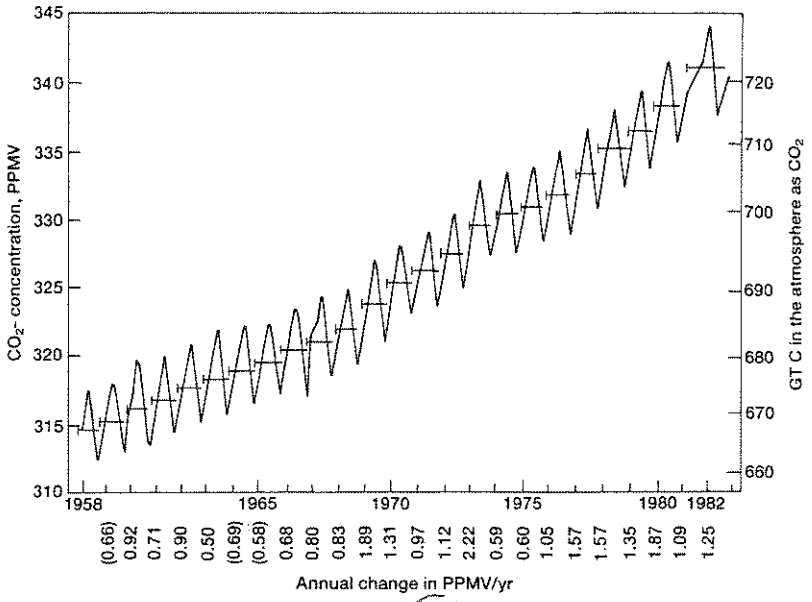
Rivers collapse unless they flow. Lakes Alexandrina and Albert need water added to them to prevent oxidisation and increased acidity. Rivers must be above sea level at all points. Flow must be restored. Use must be capped at a level allowing proper flow at a level preventing the oxidation of sulphates to form sulphuric acid. Water quality must be maintained, and the quantity of flow to maintain quality must be protected.

When Australia exports food or cotton from irrigated soils it exports water and nutrients from Australian soils and rivers. Wine was mentioned as constituting export of Australian water. Questions were also raised about cotton and rice. To buy back enough water for viable restoration the government would need to buy back $3B worth not $50M worth. Dams on streams that feed into the Murray-Darling system also deplete the system. Dairy farms in Queensland have folded following 'rationalisation' under the previous government. Dairy farms need and use large quantities of water. Smaller biodynamic forms of agriculture were advocated.

There are now proposals to drain Lake Albert in order to save Lake Alexandrina (August, 2008). The federal government is buying back some of the over allocated water permits from properties.

and juveniles as well as the phytoplankton base of the food web. Shallow-water plants and animals appear to be at greatest risk. Some studies suggest that increased UV-B radiation alters the genetic material of marine plants and animals, thus affecting their growth and reproduction. (World Resources, 1990, p.126)

It is also suggested that any resulting decrease in phytoplankton would reduce carbon dioxide utilisation and hence exacerbate greenhouse problems. (World Resources, p.196) Additional carbon dioxide held by the oceans of the planet also adds to the acidity of the sea and threatens marine organisms. (Lovelock, 2006, p.129)



(Simmons, 1989, p.334)

GLOBAL WARMING

"Our wrong doing, if that is an appropriate term, is taking energy from Gaia hundreds of times faster than it is naturally made available." (Lovelock, 2006, p.72)

Before humans exploited forms of energy not available to the rest of life, the earth system or Gaia served to match inputs with outputs. There was a carbon cycle, a water cycle, a sulphur cycle, a nitrogen

cycle and so on. Carbon dioxide was released from volcanoes and by living organisms, and converted into fossil fuels, when living forms were held for long periods within the earth. The geological record tells us that there have been cyclic fluctuations in temperature and in the carbon dioxide content of the atmosphere. These can be attributed to rhythmic changes in the motion of the earth, sun and other celestial bodies.

The earth travels around the sun in an elliptical orbit that is almost circular. The eccentricity is only 0.017 but if this varies, weather patterns will vary. At present the earth is closest to the sun at perihelion on 3 January and furthest from the sun at aphelion on 4 July. Ellipses have 2 foci which meet to form one in a circle. There are cyclic differences in the distance between the foci of about 100M years. The precession of the equinoxes is another cyclic phenomenon which affects weather cycles. Farndon refers to these cycles:

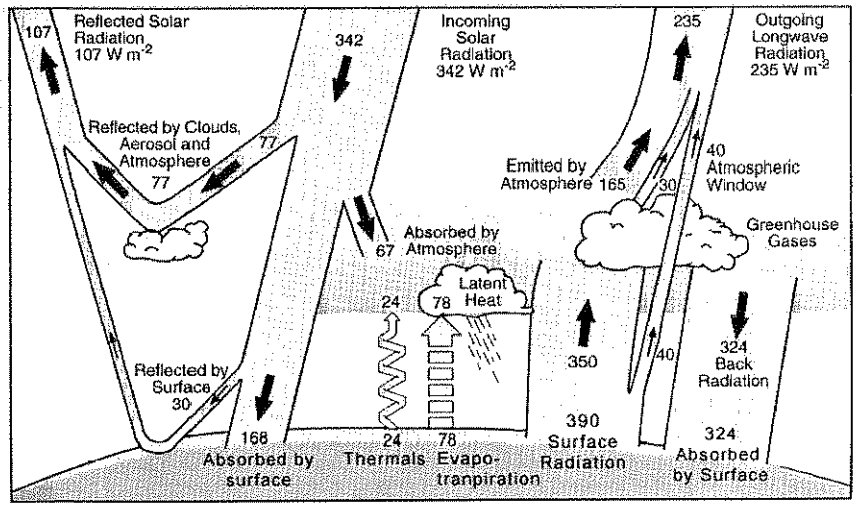
> One Milankovitch cycle is the way the Earth's axis wobbles round like a top every 21,000 years. Another is the way its axis tilts like a rolling ship every 40,000 years. A third is the way its orbit gets more or less oval shaped every 96,000 years. (Farndon, 2004, p.317)

There is also a galactic cycle through which the solar system passes about every 250 million years. The tilt of the earth on its axis, giving rise to the summer and winter solstices and autumn and spring equinoxes, is the major determiner of seasonal changes on earth.

Carbon dioxide used by plants depends on sunlight so that carbon dioxide use must follow a daily cycle, with an input during the day and an output at night. This would have an equalising effect on the weather. Water is also a great equaliser; the oceans hold heat, while the land cools every night. Dry land is more subject to frosts than damper and wetter areas. It is also more subject to fire.

The earth's magnetic field also varies. Gribbin describes how changes in the deposits of foraminifera in lake and ocean sediments indicate changes in temperature and were discovered by chance to be inversely proportional to changes in the earth's magnetic field over a period of 9,000 years. "[W]hen the earth's magnetic field is weaker the climate is warmer." (Gribbin, 1982, p.173) If the earth's magnetic field deflects the solar wind, then a weaker field would allow more high energy particles to have an impact. That is, more energy would reach the earth and hence it would be warmer, or so one might think, but Gribbin states that is was the rate of change in the magnetic field

Earth's energy balance



SOURCE Kiehl & Trenberth (1997)[7]

(Diesendorf, 2007, p.11)

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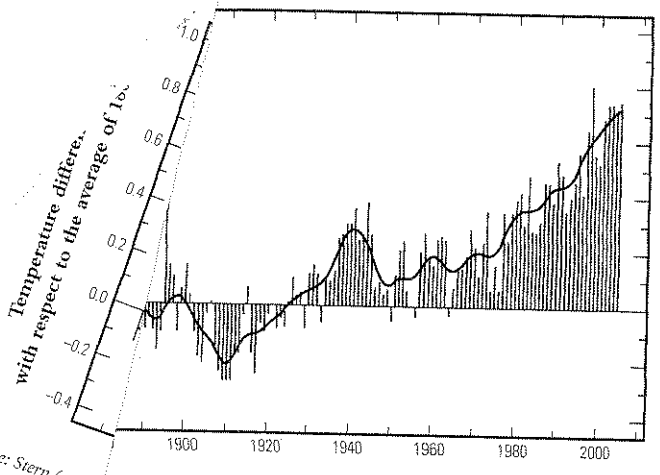
Surface Temperatures from 1850 to 2005



Source: Stern (2006).
Note: The individual ages are shown as bars and the dark line is the smoothed trend.

(Stern, 2009, p. 56)

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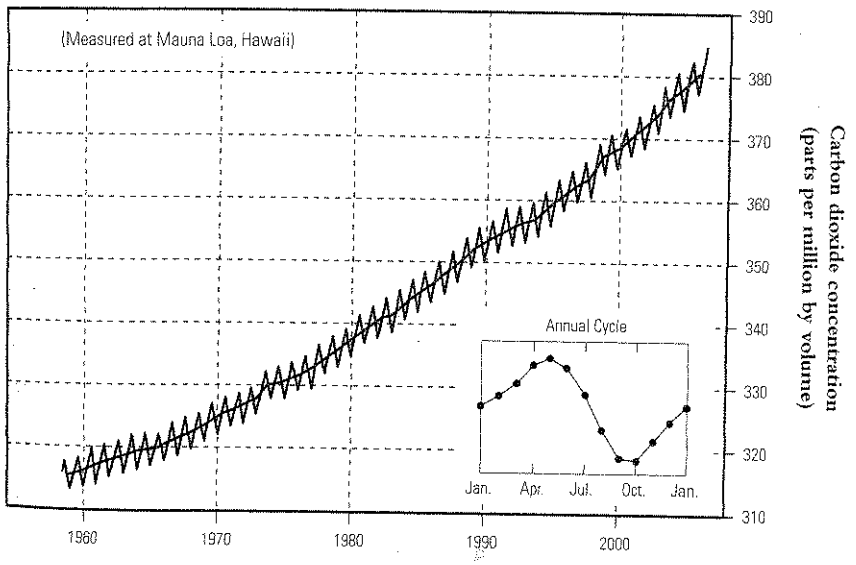
Figure 4.1: Atmospheric Carbon Dioxide



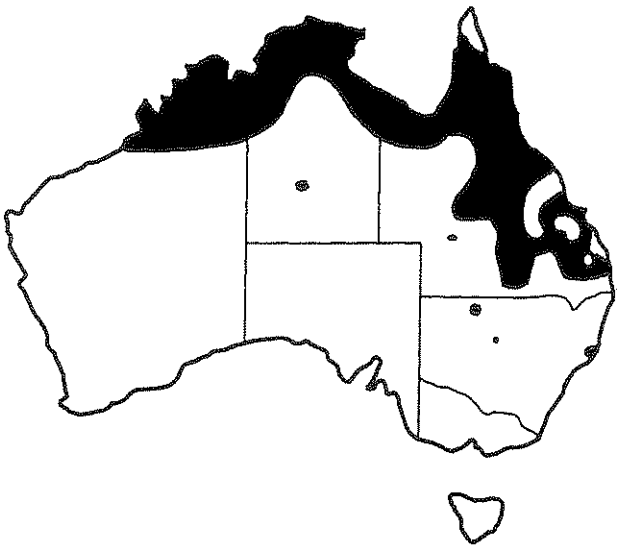
Source: Image created by Robert A. Rohde, Global Warming Art Project,

(Stern, 2006, p. 85)

that affected surface temperatures and affected ocean currents. Cawthorne tells us that pole reversals have occurred at periods of 250,000 years but there has been none for the last 1M years; that the earth's magnetic field declined by 5% last century; that before reversal the earth will have no magnetic field. If there were no magnetic field to protect the earth then:

> Particle storms would pound the atmosphere, heating it up with unpredictable effects on the climate. It is thought that the loss of Mars's magnetic field billions of years ago led to its atmosphere being boiled off. (Cawthorne, 2004, p.112)

Under natural conditions there are cycles in the earth's weather and there have been ice ages and warmer periods. It is thought that we have been in a warmer period for the last 7000 years and that planetary and cosmic cycles could soon lead us into a cooler phase.



Areas of Australia affected by the El Nino event in 1992
(Bennett, 2005, p.97)

Like almost everything in the world as we now know it, there is therefore natural global warming and cooling and unnatural global warming and cooling.

Infrared radiation from the sun is to a large extent reflected or absorbed by the outer layers of the earth's atmosphere. So also are or were frequencies in the ultraviolet and higher frequency range. Most of the em radiation, that reached the biosphere of the earth naturally, lay in the visible light range and the much longer wavelength radio frequency range. The rest were absorbed or reflected by our protective atmosphere. Farndon tells us that:

> About 41 per cent of solar radiation is light; 51 per cent is long-wave radiation that our eyes cannot see, such as infrared light. The other 8 per cent is short-wave radiation, such as UV rays.
>
> Only 47 per cent of the solar radiation that strikes the Earth actually reaches the ground; the rest is soaked up or reflected by the atmosphere. (Farndon, 2004, p.330)

During the day water vapour is transparent to visible and near ultra violet radiation, but its strong ability to absorb infrared frequencies means those reflected out at night are held. When sunlight passes through glass into a glasshouse, the glass allows radiation of certain frequencies through, but blocks the passage of other frequencies. When plants utilise certain frequencies in the photosynthetic process, they emit different frequencies from those they absorbed. Energy is used by the plants and that re-emitted is downgraded to slower frequencies such as infra-red. This is the glass-house effect. Because the infra-red frequencies are not passed out again from the glasshouse; they are trapped.

Many of these em frequencies that were previously absorbed or reflected by the earth's protective atmosphere have now been made as products of the capitalist system.

> The electromagnetic spectrum that once appeared so simple is now so close to bursting with media and telecommunications channels that reallocation may leave some users out in the cold or largely dependent on telephone lines.(Tenner, 1996, p.9)

They have been turned into objects of commerce and governments sell them to communications networks. Frequencies from which we were once guarded, now rain down on us and the rest of life, with unknown health effects on both individuals and Gaia as a whole, since no existing life is adapted to frequencies from which we have been protected for millennia and to which we have no sensory sensibility. We did not evolve with them.

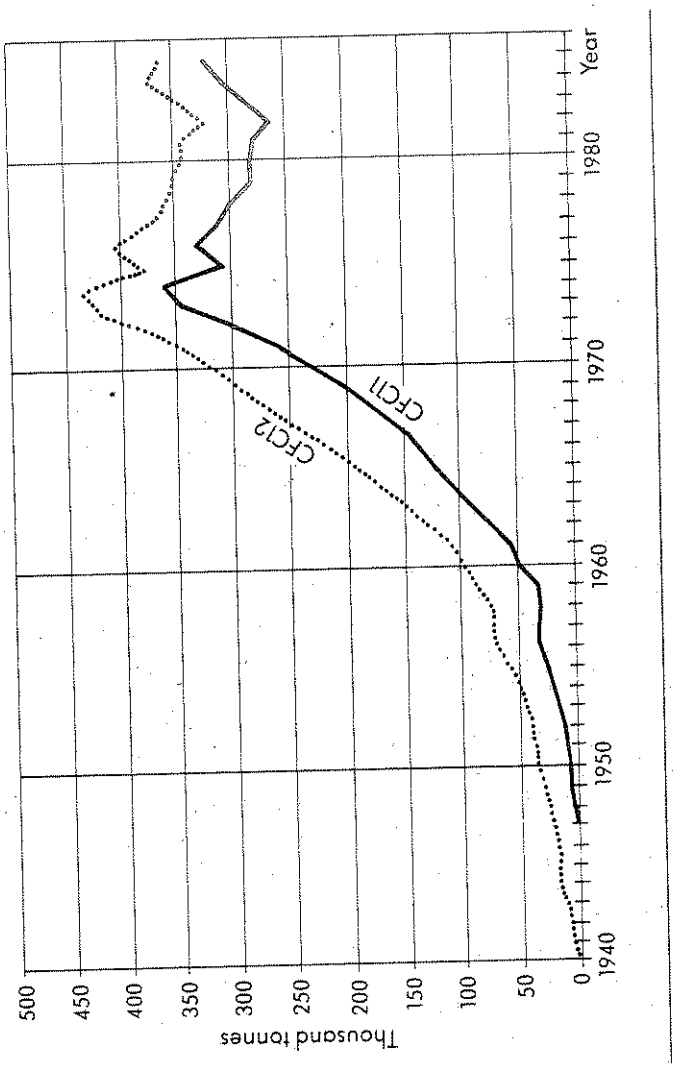


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Figure 3
The buildup of chlorofluorocarbons in the atmosphere from 1940 to 1985. These figures cover only countries reporting to the CMA, and exclude, for example, the Eastern Bloc production of CFCs.
(Source: Chemical Manufacturers Association reports, summarised in UK DoE/Met Office report *Stratospheric Ozone* (HM Stationery Office, 1987))

(Grimbin, 1988, p. 45)

If ozone is destroyed, radiation passes through to the biosphere at frequencies and in quantities previously withheld. More energy passes into the 'glasshouse'. "For every 1 per cent loss of ozone, 1 per cent more UVB rays reach the Earth's surface." (Farndon, 2004, p.355)

Just as em radiation passes in from the sun unless absorbed or reflected by the material making up the layers of the earth's atmosphere, so also will em radiation pass out from the earth unless similarly absorbed or reflected. This is where greenhouse gases enter. Greenhouse gases such as carbon dioxide, methane, water vapour and the nitrogen oxides absorb and hold radiation of particular frequencies so that they don't escape. Carbon dioxide absorbs frequencies in the range 13-19 micrometres and water vapour absorbs those in the range 4-7 micrometres. Those between 7 and 13 are absorbed by a number of man-made gases. (Falk, 1989, pp.49-50) Methane gas traps 24 times as much heat as carbon dioxide but decomposes to carbon dioxide and water. Falk and Brownlow estimate that 6.1% of warming due to methane came from cattle and sheep in Australia in 1989. (F & B, 1989, p.271) There are more than 14 billion farm animals in the world. (Farndon, 2004, p.485) Carbon dioxide decomposes at a much slower rate than methane. CFCs, as well as depleting ozone in the stratosphere, serve as greenhouse gases in the troposphere. They store thousands of times the heat energy stored by CO_2 and store it for decades or centuries longer. Nitrogen Fluoride (NF_3) is used in the manufacture of flat screen TVs, and traps 17,000 times as much heat as carbon dioxide. Does its use lead to ozone destruction as well? Plasma screen TVs, on the other hand, ~~need~~ to use more energy than these LCDs. (Diesendorf, 2007, p.360)

At every particular concentration of gases there will be an equilibrium position where the rate of decay equals the rate of replacement.

The value of the equilibrium constant depends on the temperature. If the forward reaction is exothermic [gives out heat], the equilibrium constant decreases as the temperature rises, if endothermic [needs heat or energy to drive it] it increases. (Daintith, 2004, p.221)

Water vapour gives out large quantities of heat when it condenses into liquid rain. That same heat could assist in the evaporation process which is largely driven by the wind systems and the amount of energy needed to evaporate the water to water vapour again equals that given up when rain forms. The latent heat of evaporation is the same irrespective of the directionality of the process.

The amount of water that can be held in the atmosphere is ~~said to~~ be finite. If the air warms up and expands it can hold more. But if it cools, the water vapour will condense to form clouds. "Clouds are dense masses of water drops and ice crystals that are so tiny they float high in the air." (Farndon, 2004, p.322) Morning mist, seen in forested areas forms when the water vapour that the trees transpire is con-

densed due to a fall in temperature. Rain falls when the water drops or ice crystals increase to a size too heavy for the air to support them. Air currents that carry droplets high into the atmosphere where the temperature is cooler cause condensation.

Life and the biosphere depends on these greenhouse gases. The temperature extremes that would be experienced on earth without this modulating effect would restrict life forms to those such as extremophiles, which can flourish in the heat of volcanic springs, in lagoons of brine, in the Antarctic cold, or at the edge of the habitable world. The biosphere needs greenhouse gases, but it needs them at an optimal level. Just as the percentage of oxygen in the atmosphere is critical – too much would lead to conflagration and too little would place severe restrictions on life – so too is the level of each and every atmospheric gas. Gaia or the interplay of living and non-living processes within the biosphere had held the system in balance.

The greenhouse gases are like the glass in the glasshouse; they trap em frequencies and hold them within the biosphere, but they don't make the em frequencies that they trap. In 1896 "the Swedish geochemist Svante Arrhenius speculated on a possible increase of up to 6 degrees C. in air temperature if industrial carbon dioxide emissions continued to grow". (Tenner, 1996, p.271)

The em frequencies that are trapped used to originate from those that passed from the sun through to the biosphere through the atmospheric filter, but that atmospheric filter has now been damaged largely due to ozone depletion so that more em energy from the sun now reaches the biosphere and is trapped by the greenhouse gases. If there are more greenhouse gases then more can be trapped.

Fossil fuel use means that carbon based products are being sourced from the earth, burnt with oxygen and released as carbon dioxide. The burning process or energy production using fossil fuels releases great quantities of heat energy and the resulting carbon dioxide is sitting there waiting to absorb the extra energy that is released. Carbon dioxide levels are said to have been as low as 180 ppm in the past (Lovelock, p.45), to be about 380 ppm now and may induce a major shift in equilibrium when they reach 500 ppm. (Lovelock, p.33, p.58) When it is as low as 180 ppm there are periods of major glaciation. At the end of the last ice age it rose to 280 ppm, but humans have now added another 100 ppm. (Lovelock, p.58) The rise after the end of the ice age is thought to have been due to methane release from clathrates which are a form of ice crystal with embedded methane. That added by humans is attributed mainly to carbon dioxide from burning fossil

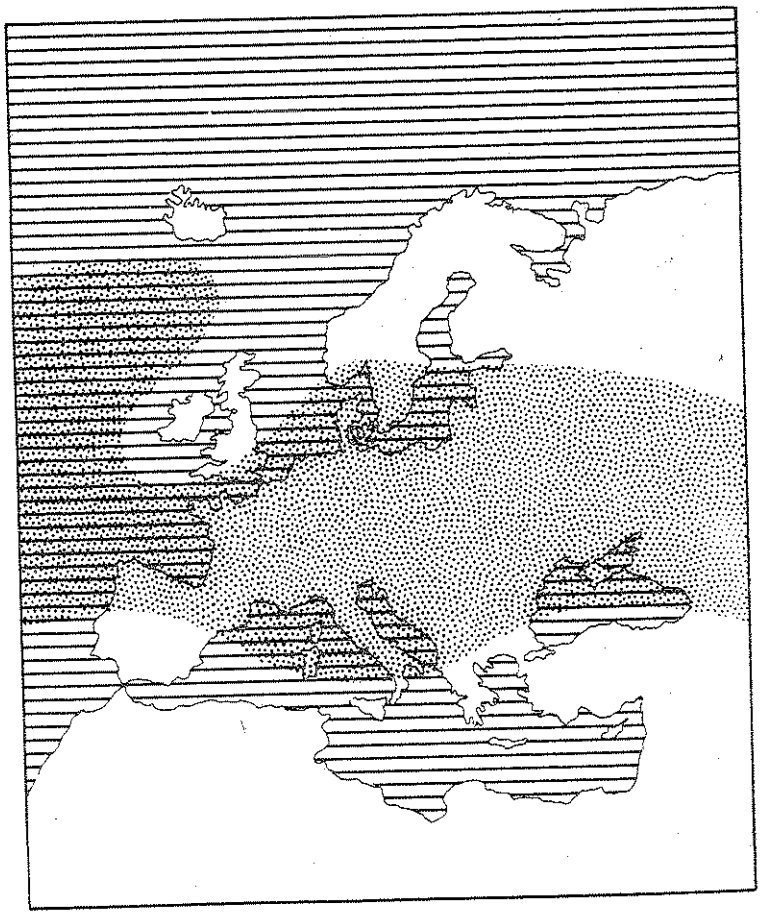

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Figure 9
The stippled area shows the region of Europe that is likely to experience colder winters when the Earth warms.
(Source: as Figure 8)

(Gribbin, 1988, p. 87)

fuels. We have released about 0.5 terratons of carbon, (Lovelock, p.59), and are releasing 27B (27,000M) tons of CO_2 pa. (Lovelock, p.73)

In past times, if carbon dioxide levels reached as high as 280 ppm, they either remained at that level or began to decrease. Levels have been higher when temperatures were higher and lower conversely. Natural processes held levels in dynamic equilibrium - essentially stabilised. We therefore know that at a concentration of 280 ppm, carbon dioxide can be broken down at the same rate at which it is produced. If the temperature falls, breakdown, it seems, occurs faster than production, so that in past times, it has fallen as low as 180 ppm.

According to Falk & Brownlow even in 1989, when levels were 351.2 ppm, about 58% was destroyed or broken down.

> Best current estimates suggest that some 183 ± 15 Pg of carbon have been injected into the atmosphere from fossil fuel burning since the Industrial Revolution. In 1986 perhaps a further 5.3 Pg of carbon were sent aloft, by burning fossil fuels. Of this carbon, perhaps 2.3 Pg may have stayed in the atmosphere. (Falk & Brownlow, 1989, p. 112)

The question that arises is whether humans could add 3 Pg to the atmosphere and find that all 3 Pg were broken down, so that levels remained unchanged, or whether only 58% of the 3 Pg would be broken down? Or more? Or less? Levels are stated to be 380 ppm now, so is 58% still broken down?

In a sense, we can think of the biosphere as performing additional work as it breaks down artificially high levels of greenhouse gases. What is involved in the processes underlying that additional performance of work? Is it like a refrigerator that stays switched on for longer and longer as temperatures rise and it works to keep the internal temperature constant? Is there a point like that at which a refrigerator is on all the time, but still fails to return the internal temperature to the required level? Is there a maximum amount of heat that can be removed in a 24 hour period? There are a variety of different kinds of limits that could be at play in atmospheric controls.

Additional greenhouse gases enhance storage capacity, but the sources of that which is stored are important players in the overall system. The major source is energy derived from the sun, which provides "1.35 kilowatts of energy for every square metre of surface on which it shines". (Lovelock, p.86) Over what time period? Monbiot gives a figure of 2.55 kWh/m^2 for London and 5.70 kWh/m^2 for Sde Boker in

Israel per day. (Monbiot, 2006, p.126) "The UK currently uses some 400 TWh" per year. If we took 4 kWh/m^2 per day as an average then the earth would receive 243,924 TWh/m^2/day.

> The Sun provides the Earth with about the same as 500 trillion barrels of oil in energy a year - 1000 times as much as the world's oil reserves. Yet solar panels provide just 0.01 per cent of human energy needs. (Farndon, 2004, p.482)

Energy from the sun far exceeds that produced artificially by humans, but with reduced stratospheric ozone and hence more from both natural and artificial energy sources added to the system, there is now more heat energy available for the greenhouse gases to trap. The tropics receive more than twice as much heat per day than regions at the Earth's poles. (Farndon, 2004, p.331)

The major causes of additional global warming due to human impact are ozone destruction, energy production and greenhouse gases derived from human technological use.

The effects of global warming due to these additional sources are still being documented, modelled and investigated. Prediction is difficult and limited.

In 2000 there were fires at 3 US nuclear weapons facilities – at Los Alamos, Hanford and Idaho; they covered 6.4M acres. (Caldicott, 2002, p.65) Heat from fires dries more vegetation and makes the area more susceptible to further fire.

More heat means that more water evaporates. If polar ice melted, creating a more even temperature, it could mean less wind and less evaporation. Temperature, wind strength and the dryness of the wind are all factors in determining evaporation rate. Precipitation is also determined by multiple agents and gases such as dimethyl sulphide (DMS), emitted by marine organisms, play a role in cloud condensation. (Lovelock, p.23, p.43)

> This gas converts into tiny particles of sulphuric acid and ammonium sulphate which act as condensation nuclei in the formation of clouds, cloud cover could increase. (Falk & Brownlow, 1989, p.96)

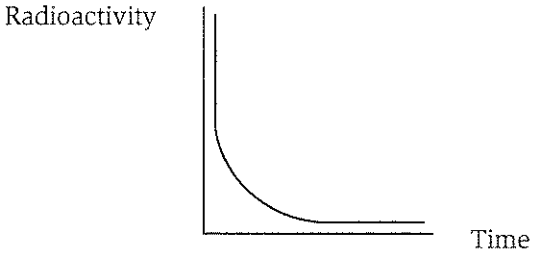
It could increase if the marine emitters of DMS increase, but they might also decrease. When more water evaporates, the vapour serves as a greenhouse gas adding heat to the system and acting as positive feedback. The same applies to the albedo effect; as the amount of snow diminishes, there is less snow to reflect sunlight, and hence still

more melting. Snow and ice reflect 85-95% of the Sun's heat whereas a forest reflects only 12%. (Farndon, 2004, p.331) "Fresh snow can contain up to 90 per cent air, which is why snow can actually insulate the ground and keep it warm, protecting plants." (Farndon, 2004, p.336) Snow therefore reflects radiation from its surface but can assist in holding ground heat. Water must also evaporate at different rates from different habitats and ecosystems; from ocean, ice and desert.

> J.B.S. Haldane even made the claim that if
> ... a lot of ice melts at the Poles and water therefore flows towards the Equator, and so has to be carried through a larger distance each day, the effect should be to slow down the earth's rotation and lengthen the day. (Haldane, 1941, p.24)

It seems that the possibility of melting ice caps is not entirely new. If the earth spun more slowly it would presumably create a greater temperature differential between day and night and possibly more wind. At the same time, if surface area increased then a greater quantity of sunlight could be captured.

The earth constantly picks up debris from outer space at the rate of about 40,000 tons pa (Cawthorne, 2004 p.79), a rate which might vary depending on cosmic factors, and burns up matter internally at an ever decreasing rate, due to the fact that the decay of radioisotopes can be measured in exponential half-lives, and releases that heat. Losses from the atmosphere also continue over time.



Rate of radioactive decay

Lovelock quotes figures suggesting that radiation from the sun is increasing. I'm a bit sceptical that the rate is anywhere near that quoted. If ozone depletion has been progressively letting more and more solar energy through since the 1940s or before, how can we make comparisons?

Ice ages and interglacials are thought to have followed a repeated rhythmic pattern over the past millennia. The sun gives out energy so it must be losing matter and the earth does the same – both due to nuclear processes, but the sun is building matter and energy into more complex forms, while the earth is breaking matter down into simpler forms and releasing energy. The actions are both nuclear, but they are in opposite directions. Rates of change are almost certainly still to some extent conjectural.

More water is melting from the poles and from glaciers. Species are moving as vegetation changes, but weather changes can move faster than species can adapt and some habitats at the poles and mountain peaks may disappear altogether. When ice melts on the tundra more carbon dioxide and methane may be released. The tropical region will expand with tropical diseases spreading further north and south. Coral reefs are threatened. Fisheries are threatened. It is difficult to deny that there are threats to the globe's biodiversity and ocean current patterns.

The North Atlantic's 'conveyor belt' current is particularly under threat due to the increase in the rate at which melting is occurring in Greenland's ice sheet. The current has been kept in circulation because the melt water (water from the melt) sinks due to its temperature, but the water from the ice is fresh and if more melts and if its temperature is higher, it will sink more slowly, to a lesser depth. If Greenland's ice sheet completely melted, it is easy to see that there would be no current, but it would actually cease earlier than this. There would be restructuring of ocean currents at some critical point and the UK and Western Europe would become colder. "The Greenland ice sheet is currently [2004] dumping 50 cubic kilometres of ice and snow into the sea each year, and this pace is accelerating as melt water lubricates the base of the glacier, speeding its progress." (Cawthorne, 2004, p.182) As I write this, we are told that about 100 icebergs from Antarctica can be seen from New Zealand, so that there may be further evidence that changes of this kind are occurring.

Hydroxyl ions are thought to be present in the atmosphere at the rate of less than one part per trillion during normal times, but they are very reactive – so reactive that "they rarely exist for more than one second". (Cawthorne, 2004, p.141) Measurements made in the 1980s showed a 25% decline in their presence between 1950 and 1985. Their levels can also be increased by engines due to emission of nitrous oxide and its interactions within the atmosphere, and by the increased quantities of ultraviolet light reaching earth due to the hole in the

ozone layer. The hydroxyl ion converts many pollutants into soluble substances which are washed from the atmosphere. Cawthorne thinks that if the ozone hole were to mend and the level of the hydroxyl ion were cut:

> Japan would disappear under clouds of sulphur dioxide from factories in China ... . Asthma would become the world's number one killer, soon to be overtaken by carbon monoxide poisoning. Carbon monoxide levels tripled between 1800 and 2000, but had been kept at safe levels by hydroxyl. (Cawthorne, 2004, p.143)

Falk and Brownlow claim that it is the increasing industrial emissions of carbon monoxide that interact with and deplete this ion. (Falk & Brownlow, 1989, p.52) The hydroxyl ion also acts to break down methane, but with a reduction in its presence, methane could remain intact for longer periods of time. The levels of every component in the atmosphere and ocean were once controlled by natural process, by biotic and abiotic processes working in harmony under the guidance of Gaia or natural selection. Substances present in minute quantities play their own roles which can be of supreme importance to the picture as a whole. Human pollutants interact with components of the atmosphere and those interactions are inadequately understood. Indeed to understand the interplay may be beyond even the human mind.

Suzuki tells us about the Rio Earth Summit in 1992 and the proposals put forward by the Environmental Children's Organisation (ECO) and David Suzuki Foundation (DSF):

> To persuade all countries to sign on, the wording in the document had to be fine-tuned to avoid offending signatories - oops, can't talk about overpopulation to the developing countries, don't mention family planning lest it scare off the Catholic countries, mustn't raise the issue of hyperconsumption in the industrialized countries. (Suzuki, 2006, p.274)

I've included the DSF's Declaration of Interdependence and Severn Suzuki's speech for ECO in the appendices.

Suzuki explains that looking at inputs and outputs is an incomplete view. We have to see ourselves as part of the being of the biosphere. "When we compromise the air, the water, the soil and the variety of life, we steal from the endless future to serve the fleeting present." (Suzuki, 2000, p.276)

Agenda 21, a doctrine aimed at sustainability, was adopted by 178 governments at Rio, and more locally, by a number of Australian Councils. There was a further Earth Summit at Johannesburg in 2002.

The Kyoto Statement was agreed in 1997, but was not signed by Canada till December 2002. Russia's ratification took effect from February, 2005, so that the protocol could finally become international law, even though the US and Australia have not signed it. Australia signed down after the change of government in November 2007.

The Kyoto Statement calls for a reduction in energy use and carbon dioxide production, yet the "International Energy Agency forecast a 60 per cent increase in global energy demand by 2030, with fossil fuels expected to meet more than 80 per cent of this demand". (Oakeshott, 2006, p.36)

RADIOACTIVITY

Nature seeks stability. Radioactive isotopes or radioisotopes have nuclei that are unstable. They decay to a stable isotope of the same or a different element. Uranium decays to lead, but others decay to isotopes of the same element. As they decay, they emit 3 main kinds of particles or radiation. Alpha particles are the same as a helium nucleus; beta particles are electrons emitted from the nucleus of atoms and when α or β particles are emitted, energy in the form of a gamma ray is often also emitted from the nucleus. Gamma rays are very energetic electromagnetic radiation with frequencies similar to those of X-rays; they leave a trail of ionised particles along their path as do α or β particles as well. Protons and neutrons can also be emitted or forced from nuclei.

Alpha rays or particles are made up of 2 protons and 2 neutrons (helium nucleus); they are ejected from the radioactive nucleus with one of several well-defined speeds. They have a double positive charge. Every alpha particle can produce 140,000 ionisations (Putman, 1960, p.31), but every gram of uranium 238 produces 12,400 alpha particles per second, so a total of about 1,700,000,000 ionisations can result from one gram of U-238 every second and U-238 has an extremely slow rate of decay with a half-life of 4.5B years. The level of danger due to radioactivity depends on the frequency of decay, on the nature of the particles or waves emitted, and on the energy with which they are emitted. Those with short half-lives are generally more dangerous than those with long ones, but their danger is much more short-lived. If tritium is produced by the fusion process, then to say

that there is no danger, because there are no long-term radioactive wastes, is misleading. (See Lovelock, 2002, p.90)

β rays or particles are electrons emitted from the nuclei of atoms; their speed varies from almost zero to a maximum that is close to the speed of light and is different for each isotope. They change course after every collision and can travel several feet in air. They have a negative charge which is equal but opposite to the charge carried by a proton.

If a positron meets an electron, 2 gamma rays with an energy of 5.1 MeV will be emitted, each travelling in opposite directions.

Gamma rays travel at the speed of light because they are electromagnetic (em) waves. They have no electric charge and are not deflected by magnetic fields as α and β-rays are.

The radioactivity of an atom is normally affected by neither the chemical combination of atoms with other atoms, nor by ordinary physical influences such as temperature or pressure.

Radioactivity decreases over time according to a definite law which states that the intensity of radiation decreases by half in a particular time span, T, where T, which is constant for each substance, but different for each, is called the half-life of the substance. The half-life of uranium - U238 = 4.5B years, so there was half as much U238 on earth in 1896 as when the earth formed, and if it had been left alone, in another 4.5B years it would have reduced by half with respect to the quantity present in 1896, meaning that the total amount would then have been a quarter of that present a the time of the earth's formation. After ten half-lives only about one thousandth would still remain.

Atoms carry in their nucleus protons with a single positive charge and neutrons with no charge. Minute electrons with a negative charge equal and opposite to that carried by a proton move in spherical orbits at a great distance from the nucleus. The orbital spheres are at fixed distances from each other and when an electron jumps from one orbit to another, em radiation is either emitted or absorbed at a certain discrete wavelength. Every vapour absorbs the wavelength that it emits. If an atom loses or gains one or more electrons from its outer shell it is said to be ionised.

When an atom within a molecule is ionised, the ionised atom no longer binds to other atoms within the molecule and the molecule breaks. "The molecular fragments resulting from this disintegration are usually very reactive, and may come together in a different

arrangement, to give a new type of molecule." (Charlesby, 1961, p.109)

It was claimed by H.G.J. Moseley (1887-1915) that there was a linear relationship between the square root of the γ-ray frequency and the atomic number of an element. The atomic number of an element is the number of electrons and protons held by the atom when not ionised. The atomic number of hydrogen which has one proton and one electron is 1; the atomic number of uranium is 92 and it was said to be the element with the highest atomic number until humans made new radioactive elements with higher atomic numbers.

As we have seen, α, β and γ-radiation are all agents producing ionisation. Electrons are removed from or added to the outer shells of atoms or molecules, so that uncharged atoms or molecules are changed into electrical entities with a charge. Molecules may be broken or ionised. Multiple ionisations caused by these particles in our bodies can cause cells, specially those that are dividing to die. The membranes surrounding cells or cell structures are particularly vulnerable. The genetic material in the cell nucleus, in the mitochondria or in chloroplasts can be changed; changed DNA can produce oncogene activity and cancer or it can cause mutagenic effects in later generations. In other words, healthy cells can be changed into potentially cancerous ones and sex cells can be changed so that mutations occur. These effects have appeared at an increased rate since 1895, because of medical and industrial applications of X-rays and radioactivity. These effects have been increasing "still more rapidly since 1945 because of A-bombs and H-bombs". (Hextall-Smith, 1957, p.22)

NATURAL RADIATION

Uranium, U-238, occurs naturally on earth because it has such a long half-life, T = 4.5B years. As it emits radioactive particles and rays it passes through 13 isotopes which are all radioactive until it reaches a stable form of lead.

U-235 and Thorium, Th-232, also have long half lives and decay to stable lead isotopes. Nine others such as Potassium 40 (T = 1.2B years) decompose to a stable isotope of the same element. Two radionuclides, tritium, a radioactive form of hydrogen, H-3, and carbon, C-14, have much shorter half-lives, but are constantly reformed due to cosmic radiation.

Cosmic radiation increases in intensity "with height from the ground-level by a factor variously estimated at 3 or 4 or 5 if we rise 10,000 feet". (Hextall-Smith, 1957, p.29)

> Some cosmic ray particles, detected by photographic plates attached to balloons and lifted to an altitude of over 100,000 feet, about 20 miles, have been shown to have energy more than 10 million times the energy achieved on earth by the most energetic particle-accelerator made by men up to 1957. (H-S, p.29)

The dangers of space travel!

Cosmic rays are high-energy particles that impact on our earth or its layers. About 85 per cent of galactic cosmic rays are the nuclei of hydrogen atoms or protons. Others include helium and heavier nuclei, but there are also positrons, electrons and neutrinos. The latter pass straight through the earth and everything on it. Most of the larger cosmic rays are deflected by the Earth's magnetic field or release their energy before reaching sea level on earth.

"[A]fter a supernova explosion every possible nuclide is likely to exist at first, including all the 1,300 we now know of and a great many more." (H-S, p.18) Hextall-Smith also tells us that Dr. Teller "adds in another context that our survival may also be made possible because the solar system is so far from the centre of our galaxy. Near the centre the cosmic radiation may be so intense that life could not persist." (H-S, p.25)

The sun emits a solar wind with velocities up to 500 km/sec. This mainly consists of protons or electrons depending on polarity. Many of these are trapped in the Van Allen belts surrounding the earth, due to the magnetosphere. The Van Allen zone varies from day to night, extending 75° N and S during the day and 70° N and S during the night. "The inner zone, whose highest-energy particles are chiefly protons, reaches it maximum intensity at a height of 3000 miles." (RD, 1974, p.38) Neutrons, being neutral do not get deflected by the earth's magnetic field but free neutrons have a half-life, T = 15 minutes, and decay to a proton and an electron.

> Beyond 6000 miles, protons sent out in the solar wind ... are thought to make a major contribution to the total. Once a proton has been dropped in the Earth's magnetic field, it will remain there for several hundred years. (RD, p.39)

Since the discovery of radioactivity and X-rays in the 1890s, technocrats have made hundreds of radioactive isotopes. These may have

existed in nature in the past, but no longer existed naturally because of their short half-lives. That is to say, during the formation of the earth and the evolutionary history of life on the earth, radioactive decay changed many of the unstable isotopes into stable ones and the radiation dose had reached a level estimated at about 100 millirads per annum prior to technocratic manufacture. Over millions of years humans and all other forms of life evolved with and became adapted to natural radiation.

Natural radiation occurs due to uranium, thorium and other natural radioisotopes. Levels are generally greater in igneous rocks since the earth is still heated internally due to radioactive decay. From rocks, soil and earthen sources we get about 23-90 mr pa. Air also contains some radioactive gases, particularly radon gas. The average human being in 1958 is said to have had a natural dose of about 24 mr pa from inside itself. Cosmic rays contribute about 30 mr pa at sea level.

ARTIFICIAL RADIATION

Building materials can now carry natural or artificial radioactive components, but buildings offer some protection from cosmic rays.

Authorities have sought to relax regulations on the use of radioactive waste. Writing in 1998, Goldsmith tell us that:

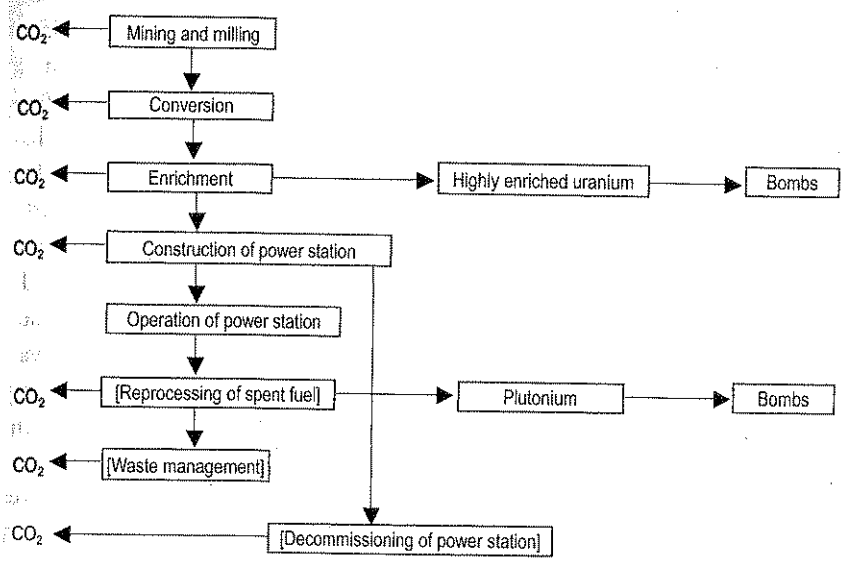
> ... even more incredible is the new directive of the European Commission that legalizes the incorporation of radioactive waste in consumer products. Already British Nuclear Fuels are making available the radioactive remnants of a dismantled nuclear reactor for the manufacture of pots and pans. (Goldsmith, 1998, p.53)

Most smoke detectors are radioactive and hence a cancer risk; they contain Americium 241, and for a time, they could not be disposed of at general tip sites, but in Tasmania, at least, that is no longer the case. From tips, water will be contaminated, and from incineration, the radioactive substances are carried to the lungs, which would help explain the increasing incidence of lung-cancer among non-smokers.

Cosmic ray effects are said to have increased since the ozone layer has been depleted. (Dudley, 1991, p.232) Even so, there is usually more radiation inside a home than outside it. Radon, present in uranium and coal mines, can accumulate in homes if the air is still. It rests in low lying areas and enters buildings that are warmer than the outside

delete

Figure 12.1 The nuclear fuel chain, showing main steps where CO_2 is emitted and where nuclear explosives can be produced



(Diesendorf, 2007, p. 249)

temperature, due to suction pressure. (Dudley, p.139) "The British government has set a national radon limit of 20 millisi[e]verts a year; the NRPB estimates that someone exposed to this level constantly runs a 5 per cent lifetime risk of developing lung cancer." (Dudley, p.141) As a cause of lung cancer, radon gas is now estimated to rank second after cigarette smoking. (Dudley, p.140) In fact, when organic materials are burnt radionuclides are released so that the process raises radiation levels. Coal fires and smog spread radium and radon from uranium associated with coal; there is more radon in London and particularly in London smog than in the British countryside. (H-S, p.40) The same is almost certainly true of other cities throughout the civilised world. Caldicott also claims that "radioactive material should never be subjected to incineration ..." (Caldicott, 2002, p.68)

Those who worked with luminous paint developed bone tumours more than 15 years after their first exposure. Those mining uranium ore, pitchblende, are said to have a high incidence of lung cancer. Alpha radiation has little effect unless ingested or breathed in.

Medical use of nuclear technology also has its danger's.

"Cancer patients in Texas, Georgia, Washington State, and Ontario, Canada, received lethal X-ray doses from a software-controlled radiation therapy machine that failed after a specific sequence of commands to change its mode, as instructed, from a high-intensity X-ray beam to a low-intensity electron beam - while it nonetheless removed the tungsten shield that protects patients during X-ray sessions. (Tenner, 1996, p.189)

Tenner continues: "The ghastly consequences of some of these failures, and the existence of computer codes that might automate nuclear strikes, make complacency about electronic risks nearly criminal". (Ibid.) Safely demands vigilance and expense and still can't be guaranteed.

In 1903, the Rutherfords and Curies met in Paris. Pierre Curie told Ernest Rutherford: "I am anxious, concerned at what we are doing! You see radium and such substances could be dangerous in criminal hands." (Bickel, 1980, p.37) In 1919, Rutherford told an audience: "Scientists are trying hard to find a way to release this energy (from the uranium nucleus) at will. Personally, I hope they do not succeed until man has learned to live with his neighbours in peace." (Bickel, p.52) Rutherford died in 1937 before the war and the atomic explosions in 1945. Pierre Curie died in an accident in 1906. (Bickel, p.37, p.89)

The 1931 Pears Cyclopaedia describes radium as:

> ... a remarkable element discovered by Madame Curie in infinitesimal quantities in pitchblende, and possessing an astonishing degree of radioactivity, giving off heat and light with an intensity not approached by any other substances. (PC, 1931, p.252)

The entry continues:

> The Radium Institute founded and equipped by Lord Iveagh and Sir Ernest Cassel, was opened on August, 1911, for the treatment of patients and the prosecution of researches into the effects of radium on the human system. In 1929 a public subscription for the supply of radium to hospitals reached over £150,000 in a few days, the Government providing a further £100,000 (PC, p.252)

There are practices that have been abandoned.

By 1939, the American press made public the ideas of fission and chain reaction as well as Einstein's $E = mc^2$, published originally in 1905. (Bickel, 1980, p.111) The New York Times headed their report "Vast Energy Freed by Uranium Atom". (Bickel, p.104) Szilard, who had already patented the production of power by a chain reaction with the UK military in 1934 so that it wasn't public, asked scientists to cease making their findings in this area public, but US journals ignored his concerns. In 1940, the Physical Review announced what Fermi had hoped to achieve much earlier, man-made elements beyond number 92. Element 94 is deadly plutonium. (Bickel, p.181, p.187, p193) In 1942 Oppenheimer told Compton that a plutonium bomb would be much more dangerous than a U-235 bomb. He expressed fears for the environment; it might even set fire to the atmosphere. (Bickel, p.206)

The atmosphere is composed largely of nitrogen (78 per cent) and oxygen (21 per cent). Nuclear detonations, like lightning, do provide conditions under which nitrogen and oxygen are more likely to unite. Nitrogen oxides are both greenhouse gases and catalysts for ozone destruction.

Writing in 1977, Louise Young expressed concerns regarding the effects of H-bomb tests on the ozone layer. "During 1961 and 1962, when the United States and Soviet Union set off about 300 megatons of nuclear devices, the ozone layer may have been depleted by about 4 per cent." (Young, 1977, p.100) She continues:

> A study made by the National Academy of Sciences indicated that a nuclear attack involving 10,000 megatons could wipe out as much as 70 per cent of the ozone layer over the Northern Hemisphere. (Young, p.100)

In Earth & Science, Farndon now tells us that: "In 1982 scientists in Antarctica noticed a 50 per cent loss of ozone over the Antarctic every spring. This finding was confirmed in 1985 by the Nimbus-7 satellite." (Farndon, 2004, p.354) In 1996 an ozone hole was recorded "over the Arctic for the first time". (Farndon, p.354)

NUCLEAR EXPLOSIONS

The atomic or fission bomb was first tested on 15 July 1945. It went off 15 seconds early, vapourised much of the monitoring equipment and produced much stronger light than expected. Bainbridge said it was a "foul and awesome display". (Bickel, 1980, pp.25-75) Oppenheimer later told William Laurence that the event brought lines from the Hindu Bhagavad-Gita to his mind: "I am become Death, Shatterer of Worlds". (Bickel, p.258) Charlesby tells us that;

> Perhaps the most surprising feature is the remarkably small amount of energy needed to produce lethal damage. For the human being the lethal dose of about 500 rads or röntgens would, if converted to heat, only raise the body temperature by 0.001°C. (Charlesby, 1961, p.106)

A U-235 bomb (Thin Man) was dropped on Hiroshima on 6 August, 1945 and a plutonium bomb (Fat Man) on Nagasaki on 9 August; the Russians detonated a plutonium bomb in 1949: the UK exploded a plutonium bomb at Montebello off the west coast of Australia in 1952, and the US eliminated an island, Elugelab, from the Marshall Islands with an H-bomb on Halloween the same year. This first H-bomb pierced the stratosphere. The Russians exploded an H-bomb the following year. (Ibid., pp.262-265, pp.270-275)

According to Hall, 23 atomic bombs were "detonated on Bikini before 1958 when Nevada became America's only atomic test site". (Hall, 1996, p.83)

Following these early tests "giant clams were found to be 2,000 times as radioactive as the water in which they were living". (H-S, p.65)

> Fish and plankton have been found with 150,000 times the concentration of radiophosphorus that exists in the water they live

> in. If the radiophosphorus in the water of the Colombia River were at the maximum level allowed for drinking by man, the plankton would (it is said in Fallout, p.146) receive doses up to 70r per hour and fish up to 50r per hour, and a man eating a pound of such fish would get a dose of about 30r. (H-S, p.66)

In a table on the same page of Fallout

> ... it is stated that the ratio of bird/water level of radiophosphorus was found to be 75,000 for adult swallows and 500,000 for young ones; and 7,500 for adult river ducks but 1,500,000 for egg-yolk.
>
> After the Bikini bomb on 1st March 1954 fish too radioactive to be eaten were caught during the summer up to 2,000 miles from the explosion; and during the summer radioactive tunny were found quite near Japan, where the sea had too little radioactivity to be detected. (H-S, p.66)

Bioaccumulation is now a well acknowledged fact, but it had to be established by investigations after early tests.

Fission plants use uranium and plutonium just as fission bombs did. The residues or wastes have been "sunk in the sea; released into rivers on purpose and by accident; allowed to accumulate in the basement ..." (H-S, p.68)

Each one of us carries a legacy left by the nuclear tests last century. Strontium 90 and caesium 137 are isotopes that did not exist before humans exploded these bombs. Iodine 131 was also made but it has a short half-life (T = 8 days). It has none-the-less left a legacy of cancer and destruction.

> It is ... doubtful that the 8,358 individuals diagnosed between 1986 and 2001 with thyroid cancer in Belarus, downwind of Chernobyl, would choose the adjective 'safe' to describe nuclear power. (Caldicott, 2006, p.viii)

Dr. Chris Busby claims that cancer rates are higher in areas of high rainfall which could be due to the fact that:

> The cancers were caused by mutation produced by exposure to radiation from atmospheric nuclear bomb testing which occurred in the period 1955-1963. The bombs were exploded by the nuclear superpowers in Kazakhstan, Nevada and the South Pacific. The force of the explosions drove large quantities of radioactive material into the stratosphere and this was circu-

> lated globally, falling to Earth everywhere, but particularly in high rainfall areas. (Busby, 1998. p.55)

The recent small nuclear underground explosion conducted by North Korea was confirmed to have taken place by radioactive isotopes that were found to be present in the atmosphere. Underground test products, particularly radioactive gases, do not remain underground.

After the 1961-3 tests "infant mortality began to rise" and John Kennedy took the advice of people like Linus Pauling and Ernest Sternglass "and called a halt to the tests in 1963". (Busby, 1998, pp.55-56)

On September 7th, 1957 there was a Nevada bomb test. The father of Terry Tempest Williams recalls the day:

> We were driving north, past Las Vagas. It was an hour or so before dawn when this explosion went off. We not only heard it, but felt it ... . We pulled over and suddenly, rising from the desert floor, we saw it, clearly, this golden-stemmed cloud, the mushroom. The sky seemed to vibrate with an eerie pink glow. Within a few minutes, a light ash was raining on the car. (Williams, 1998, p.110)

In 1979, 1,200 plaintiffs sought compensation from the US government "for cancers caused by nuclear testing in Nevada". (~~Williams~~, ~~1998~~, p.110)

Irene Allen's first husband died of leukaemia in 1956 and her second of pancreatic cancer in 1978.

> On May 10th 1984, Judge Bruce S. Jenkins handed down his opinion [following the trial of 24 test cases]. Ten of the plaintiffs were awarded damages. It was the first time a federal court had determined that nuclear tests had been the cause of cancers. (~~Williams, 1998~~, p.111)

This landmark ruling was appealed and overturned in April 1987 due to "the legal doctrine of sovereign immunity". (Williams, 1998, p.111)

At the time of writing Williams claims that tests are still being conducted. (~~Williams, 1998~~, p.112)

Governments seem not to want people to understand the dangers that result from their actions, which are largely guided by money, not safety. The University of Colorado Medical Centre began a study into birth defects and radioactivity, but "one year into the study, funds were abolished [by] ... federal [US] authorities". (Caldicott, 2006, p.51)

> [US] Government regulations allow nuclear plants 'routinely' to emit hundreds of thousands of curies[1] of radioactive gases and other radioactive elements into the environment every year. Thousands of tons of solid radioactive waste are presently accumulating in the cooling pools beside the 103 operating nuclear plants in the United States and hundreds of others throughout the world. (Caldicott, 2006, pp.xiii-xiv)

Jimmy Carter ruled out reprocessing nuclear waste in the US and in 1982 an agreement was made with each nuclear plant for the US government to take responsibility for their waste. Plans have been made for this to be stored in Yucca Mountain in Nevada near the site of nuclear tests last century, but none has yet been stored there. Seventy per cent of Nevadans are opposed to the plan. Nuclear plants are contaminating land, sea and air and no solutions for the waste problem exists.

The GENEP wants a single reprocessing plant so that a single country supplies all nations and takes back all wastes. Mohamed ElBaradei the head of IAEA (International Atomic Energy Agency), believes that all countries should be allowed to reprocess under a set of regulatory conditions determined by the global body.

No new nuclear power plants have been built in the US during the last 30 years, but the nuclear industry - those who make money by selling the technology - are pushing for a change of policy. Every time we buy, we should question the morality of the makers of the products we buy.

Nuclear power production is unsafe, energy expensive and costs US taxpayers billions. (Caldicott, 2006, p.xiv)

"Nowhere is there a nuclear power station which does not rely on subsides of one kind or another. Even the famous Olkiluoto reactor in Finland, which is the only nuclear power station currently under construction in Europe, and the only one being built anywhere without government money, now seems to be a loss leader underwritten by the French company Areva, in order to create the impression that the technology is commercially viable." (Monbiot, 2006, p.93)

Nuclear accidents fall into two main categories, overheating or loss of control over the rate of neutron release. Neutrons are used to bombard the radioisotopes which then release more neutrons in a chain

1. One curie is the amount of radiation released by 37B atomic decays per second.

reaction. This reaction has to be controlled and a variety of agents are used for this purpose including water, heavy water, graphite, etc. The process produces heat which, as in coal fired powered stations, boils water so that steam turns a turbine and produces electricity. Nuclear reactors are most commonly located close to water sources - rivers, or the ocean and water is constantly taken from the environment and returned to the environment. Casings are supposed to stop the release of neutrons into the cooling agent, but when neutrons are added to heavy water, deuterium oxide changes to tritium oxide. "At least 1,360 curies of tritium are released annually from each reactor." (Caldicott, 2006, p.57)

> CANDU reactors generate large quantities of tritium as a by-product of heavy water irradiation and expel large quantities of tritium to the biosphere. In April 1996, a massive 50 trillion curies of tritium were released into lake Ontario from a leak at a heat exchanger at the Pickering-4 station. (Caldicott, 2006, p.116)

Reactors are moreover, being used specifically to produce tritium. (Caldicott, 2006, p.139) Hydrogen bombs need tritium for their fusion process.

> The original uranium fuel that is subject to the fission process becomes 1 billion times more radioactive in the reactor core. A thousand megawatt nuclear power plant contains as much long-lived radiation as that produced by the explosion of one thousand Hiroshima-sized bombs. (Caldicott, 2006, p.14)

The fuel rods become so contaminated that about a third must be removed annually and must "be stored for thirty to sixty years in a heavily shielded building and continually cooled by air or water" before further decommissioning is possible. (Caldicott, 2006, p.15)

Nuclear power plants have a limited life, and must ultimately be decommissioned. When processing, transport, enrichment, plant construction, decommissioning and dismantling are taken into account, the monetary economics of nuclear reactors becomes questionable. If health costs were added to the economic equation, nuclear power would never be considered an option. Moreover, the input of energy into all the processes and infrastructure required show that far from using no fossil fuels, the industry uses substantial quantities.

> Construction and dismantling of a gas-fired plant requires about 24 petajoules together. The energy requirements of construction and dismantling of a nuclear power plant may sum up to about 240 petajoules. (Caldicott, 2006, p.13)

One petajoule = 10^{15} joules.

Problems with nuclear plants also stem from the power production process. "In order to produce electricity from nuclear or fossil fuel-burning power stations, almost three times as much energy must be used as is finally produced as electricity." (Falk & Brownlow, 1989, p.127) Moreover, calculations made in 1987 based on a 3.3% pa growth rate in energy consumption and spending more than a trillion pa (in 1989 terms) in building nuclear plants, would still lead to a net increase in "annual carbon dioxide emissions in 2025 by 60 per cent above today's level". (Falk & Brownlow, 1989, p.128) Even with a growth rate of 1.9%, with "a nuclear reactor built every 2.5 days until 1025", the carbon dioxide emissions rose from 5.2 Pg to 5.27 Pg. (Ibid., p. 130)

> Perhaps it is not surprising that opposition to nuclear power in the USA, the heartland of the industry, has risen from 22 per cent in 1976 to around 78 per cent in 1986, with support falling from 61 to 27 per cent over the same period. (Ibid., p.131)

In order to separate U235 from the more abundant U238, the uranium is converted to uranium hexafluoride, which is the only gaseous uranium compound known. This is an energy intensive process. Moreover:

> It has only recently been revealed by the US Department of Energy that CFC 114 gas - a compound that is a potent global warmer and that destroys the stratospheric ozone layer - leaks unabated from the hundreds of miles of cooling pipes used in the uranium enrichment operation at Paducah, Kentucky, and its sister facility in Ohio. (Caldicott, 2006, p.10)

Fluorine is said to be the most reactive and electronegative of all elements. Moreover, we already know that CFCs containing fluorine and chlorine are ozone destroyers. Is this due to the fluorine atom(s) as well as chlorine atoms? The halogen series begins with fluorine, followed by chlorine, then bromine. Bromine acts as a stronger catalyst of ozone depletion than chlorine, so it seems likely that chlorine's action would be stronger than that of fluorine. Is the fluorine ion implicated as well or not? Perflurocarbons or PFCs, compounds of carbon and fluorine, are potent greenhouse gases. (Cawthorne, 2004, p.115)

Claims have been made that fluoride added to our water supplies supports the aluminium industry and even the sugar industry. Is it a by-product of these industries? Has support for its use stemmed from

commercial interests rather than health interests? "Aluminium production releases CF_4 and C_2F_4 from carbon electrodes." (Falk & Brownlow, 1989, p. 267)

> In 1990 the American National Toxicology Program announced that it had established a clear link between fluoride and a type of bone cancer called osteosarcoma. It also indicated that fluoride might be responsible for a particular type of cancer of the mouth. (Walker, 1998, p.89)

Possible problems with bones due to added fluoride were also listed by the American Medical Association as early as 1944. The list includes osteosclerosis, spondylosis, and osteopetrosis, as well as goitre. (Ibid.) Have these problems increased since fluoride was added to our water?

Between 1950 and 1988 there was a 43% increase in cancer rates, but the list of kinds for which figures are given in this source does not include any figures for bone cancer. (Epstein, 1998, p.71) Before the industrial revolution began, cancer rates were almost zero. (Goldsmith, 1998, p.93)

SOME FISSION PRODUCTS

Caesium-137

Caesium-137 "appears in about 6% of all fission events". (H-S, p.51) It emits beta and gamma rays. T = 33 years. "It gets into milk, plants, and muscles of animals, including humans." (H-S, p.51)

Hextall-Smith details data collected by Professor Rotblat who won a Nobel Peace Prize for his efforts to stop the use and testing of nuclear weapons.

> For a long time Professor Rotblat has kept a watch on the radioactivity coming from inside his own body. Up till 1954 it showed only the one peak which is due to natural radiopotassium, $19K^{40}_{21}$. Since mid-1954 – the very large H-bomb was exploded at Eniwetok Island in the Pacific on 1st March 1954 – his body has shown two peaks, the second due to radio-caesium. This must be due to fallout or it would have been detected before. (H-S, p.52)

Radio-caesium is both a cancer risk and a genetic risk because it lodges in the tissues of the body and emits penetrating gamma rays.

Sellafield is considered to be the biggest ocean-polluting nuclear installation in the world. The Irish Sea has been renamed the 'plutonium sea'. Radioactive discharge spreads up the Scottish coast, across the North Sea, and is carried by the Norwegian current to the Greenland Sea. It has even been detected in the Atlantic Ocean. Oceanographers can trace Arctic currents by following the spread of plutonium and caesium. (Hall, 1996, p.171)

Strontium-90

No radioactive strontium was identified on earth before the 1940s. Krypton-90, one of the inert gases constitutes about 5% of fission products. In the early mushroom cloud blasts, it would have risen to a great height, but changed within seconds to Rubidium-90, which itself changed within minutes to Strontium-90. Since strontium resembles calcium, strontium-90 settles in the bone where it emits rather feeble beta-rays. It can cause cancer of the bone, but normally has no effect on the gonads. T = 28 years so it will continue to be rained on us for 280 years after it is produced. From the rain it can (1) enter drinking water, the digestive tract and settle in the bone; (2) enter cereals and vegetables, via their leaves, enter our digestive tracts and settle in our bones; (3) enter cereals and vegetables via their roots, enter our digestive tracts and settle in our bones; (4) enter grass on which cows feed, and pass into their milk, which carries it into our digestive tract so that it can settle in our bones. It can also be inhaled into the lungs and carried in the blood stream to our bones. About 5% comes down dry and 95% in rain. Hextall-Smith suggests that Sr-90 is about 10 times as harmful for young children as for adults. (H-S, p.59) This is because their cells are still dividing at a much faster rate as they grow.

Tenner writes:

> The turn of opinion against testing showed that the certainty of steady, invisible, and not immediately hazardous process(es) - the accumulation of strontium 90 in human bones, plus cumulative genetic damage - could be as frightening as the much smaller chance of a direct nuclear confrontation. (Tenner, 1996, p.21)

processes

Plutonium-239

Plutonium was created artificially in 1940 at the University of California, Berkeley. (Hall, 1996, p.128)

> There is estimated to be 1,200 tonnes of plutonium in the world: about 200 tonnes have been used for making bombs and the rest is a by-product of the nuclear industry ... . Ironically, fifty years on [after the Nagasaki Pu-239 bomb], the Japanese Government has just confirmed its commitment to the fast breeder reactor, and to plutonium as a major part of its future energy policy. Such a commitment now makes Japan a world leader in the sale and procurement of the world's deadliest material. (Hall, p.128)

Caldicott describes Japan as:

> ... a country with the third largest military in the world, with the world's most advanced technological base, a country with an aggressive past and huge stockpiles of pure plutonium, on the cusp of nuclearization. (Caldicott, 2002, p.176)

Hall continues: "local opposition to the escalating nuclear programme has dubbed Japan a 'flat without a toilet', because despite having over fifty nuclear power plants, there is still little idea of how to deal with the waste". (Hall, p.129) In the final paragraph of his 1996 book, Hall suggests that:

> In the future the talk will be of decommissioning nuclear weapons and reactors. Yet mankind is still wrestling with the legacy of radioactive waste, still trying to come to terms with the dark side of nuclear physics, our hubristic interference in the fundamental order of things (Hall, p.207)

Humans have created more than 1,200 tonnes of plutonium in the course of half a century. Every nuclear reactor continues to create new nuclear wastes.

Plutonium is an alpha emitter so that it must be ingested or breathed in to become harmful. Pu-239 has a half-life of 24,400 years so that already created will be around for at least 10 times that long – a quarter of a million years. Dr. Helen Caldicott tells us that "hyperthetically one pound [of plutonium], if uniformly distributed, could induce lung cancer in every person on earth". (Caldicott, 2002, p.62) It would also produce genetic mutations.

> She also lists some of the other fission products:
>
> Cesium 137 concentrates in meat and causes cancers of the muscle; strontium 90 concentrates in milk and induces bone cancer and leukaemia; radioactive iodine concentrates in vegetables and milk and migrates to the thyroid gland, inducing thy-

> roid tumours and cancer. Tritium combines with water molecules and is incorporated into the actual genetic structure. It is a potent carcinogen. Many of these elements also remain radioactive for hundreds of years, well beyond our lifetimes. (Caldicott, 2002, p.62)

When plutonium is burnt it "could potentially enter the lungs of people hundreds of miles away depending on wind direction. One millionth of a gram of inhaled plutonium is a carcinogenic dose". (Caldicott, 2006, p.67)

Lovelock tells us that:

> ... gradually as the Cold War intensified and the two superpowers [the USA and USSR] tested larger and ever larger weapons, the all-pervasive fear of all things nuclear became widespread. This period of madness culminated in 1962 in the test explosions of hydrogen bombs equal in power to 20,000 of the bombs dropped on Hiroshima. (Lovelock, 2006, p.24)

Nuclear testing and weapons use was supposed to have been banned in the 1990s.

Lovelock admits that: "It is true that plutonium is a poisonous element and there is always a risk that it may be stolen to make nuclear weapons". (Lovelock, 2006, p.103) Despite this, he advocates the use of nuclear energy, owing to the fact that it is such an intense source of energy. (Lovelock, pp.99-104) He points out difficulties with all other sources; fossil fuels, hydrogen, and renewables, such as wind, tidal, hydro, and solar.

As well as PU-239, the closely related isotope Pu-238 is also made and preferred for space missions. It has a shorter half-life than Pu-239 and produces more heat and hence more electricity for space probes. (Caldicott, 2006, p.138) The space programmes conducted by the US and Russia have had a 15 per cent accident rate (Ibid.) and that means that parts of the planet are contaminated with Pu-238. (Ibid., pp. 137-141) "Plutonium 238 is 280 times more carcinogenic than the more prevalent isotope, plutonium 239." (Ibid., p.138) Caldicott asserts that solar power could be used instead of nuclear – that it is commercial interests that lie behind its use. The Cassini mission carried 72.3 pounds of Pu-238. (Ibid., p.140)

Under US law "Price-Anderson allocates a domestic liability of 8.9 billion dollars in the event of a nuclear accident, but just 100 million dollars for damage incurred in all foreign nations". (Ibid., p. 141)

Among the products of the nuclear industry are inert or noble gases which are said to be without danger and are released routinely. Although they themselves are chemically inert, they are not radioactively inert and they give rise to elements that are not inert chemically.

> ... they are fat soluble, and they tend to locate in the abdominal fat pad and upper thighs, adjacent to the testicles and ovaries. There, they [decay to daughter isotopes, which themselves are chemically very active and] can induce significant mutations in the eggs and sperm of people living adjacent to a reactor. (Caldicott, 2006, p.55)

The noble gas, Xenon 137 (T = 3.9 min) decays to caesium 137 (T = 30 years), similarly, xenon 135 decays to caesium 135 (T = 3M years). Krypton 90 (T = 33 secs) decays to rubidium 90 (T = 2.9 min) which decays to strontium 90 (T = 28 years). Krypton 85 (T = 10.4 years) and argon 39 (T = 265 years) are also among those released. When an element decays to another element with the same mass number, a neutron decays into a proton and an electron and the electron (β-ray) is ejected from the nucleus, often with a γ-ray as well.

Zenon is not completely inert chemically; it can form compounds with fluorine, carbon, silicon and oxygen.

> Nuclear power may appear, superficially, as a straightforward solution to the problem posed by fossil fuels. But, as well as the practical impediments to its implementation, it carries with it numerous far-reaching side-effects which may be as bad or worse than the problem it was supposed to solve. (Falk & Brownlow, 1989, p.134)

Falk and Brownlow also refer to Krypton-85, which they tell us "affects the ability of the Earth's atmosphere to conduct electricity". (Ibid.) Krypton-85 is produced in fission reactors. Clouds are negative at their base and positive on their upper surface. Sheet lightning is an electrical phenomenon within a cloud. Forked lightning discharges the electricity to the ground. The atmosphere is an electrical system, but what the effects of Krypton-85 are likely to be, I have yet to discover.

Nuclear power production was curtailed for a time, so why is it again on the agenda?

> By 1988 it was clear that for existing reactors the operating costs were rising rapidly (roughly exponentially) with age. A report from the US Energy Information Administration concluded that these costs were escalating so such an extent that it

> might be more economic to retire a nuclear plant before it reached the end of its physical life. (Ibid., p.147)

How much would American tax payers have been saved if nuclear plants had never been constructed?

Instead of imposing tax penalties on the industry so that they pay some of the long term costs resulting from its use, the nuclear industry has been subsidised time and time again. The "cost of those energy forms which create hazards for the community, or for future generations" needs to be paid if the right signals are to be sent to consumers.

NUCLEAR WEAPONS

> The US currently [2002] has 2000 intercontinental land-based hydrogen bombs, 3456 nuclear weapons on submarines roaming the seas 15 minutes from their targets, and 1750 nuclear weapons on intercontinental planes ready for delivery. ... Russia has a similar number of strategic weapons, with approximately 2000 on hair-trigger alert. In total there is now enough explosive power in the combined nuclear arsenals of the world to 'overkill' every person on earth 32 times. (Caldicott, 2002, p.3)

In October 2001, the US Senate unanimously passed a massive $345B Defense Appropriations bill. (Caldicott, 2002, p.79) Just 2 years before on 1st November, 1999,

> 138 nations voted at the United Nations for a resolution ... which ... reaffirmed the will of all states that the exploration of space shall be for peaceful purposes and shall be carried out for the benefit and in the interests of all countries ... . Prevention of an arms race in outer space would avert a grave danger for international peace and security. (Caldicott, 2002, p.82)

Only the Unites States and Israel refused to support this resolution. (Ibid.)

Ballistic missiles continue to be produced. Even when these are destroyed before they reach their target - in boost, transit or terminus - their use has "grave medical implications". (Ibid.)

> If ten hydrogen bombs on one missile were destroyed in the atmosphere, approximately 100 pounds of carcinogenic plutonium would rain down upon the population ... . Prevailing winds would scatter the deadly, long-lived carcinogenic pollu-

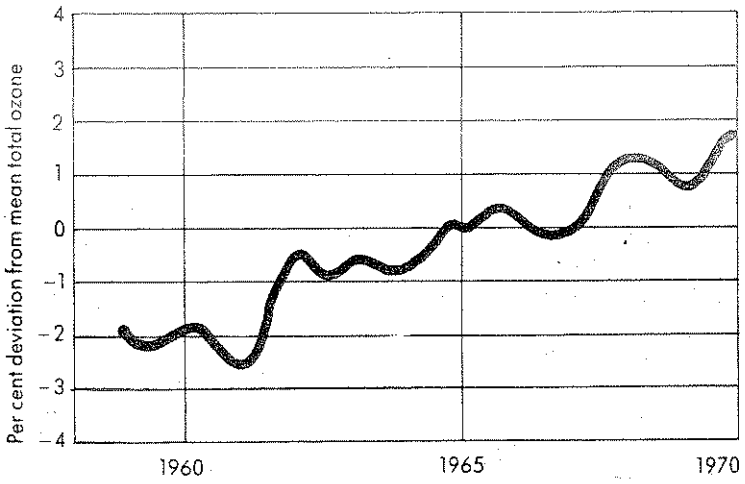


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Figure 6
After a dip in the early 1960s, ozone concentrations over the whole globe increased up to about 1970. Did this show the recovery of the atmosphere from the effects of atmospheric nuclear tests, banned by the superpowers in 1962?

(Gribbin, 1955, p. 69)

> tion hundreds to thousands of miles. The contaminated earth would be polluted forever. (Ibid., p.83)

Lovelock tells us that:

> The nuclear bombs dropped on Nagasaki and Hiroshima were puny compared with the contemporary nuclear explosives devices borne by long-range missiles; each of these carries a clutch of separately targeted bomblets, each representing one megaton of explosive power, or about sixty-six Hiroshima bombs. A single one of these bomblets is powerful enough to ruin a major city. (Lovelock, 2006, p.27)

Lovelock asserts that nuclear poses no danger, yet tells us that Edward Teller "tried to persuade his government not to drop the first bomb on a Japanese city". (Lovelock, p.97) He seems to assert its safety one minute and describe its dangers the next. "We are right" he says "to fear nuclear weapons." (Lovelock, p.98)

Ballistic missiles lead to counter weaponry. The US aims to dominate the globe by the militarisation of space with antiballistic missile weapons, antisatellite weapons, "laser beam weapons, nuclear missiles, nuclear reactors, and possibly orbiting nuclear weapons". (Caldicott, 2002, p.81)

> Their goals are to learn more about plutonium, explore the possibility of laser-powered fusion, conduct subcritical tests and computer testing and devise new nuclear weapons. (Caldicott, 2002, p.50)

Lasers are being used more and more, though few of us have any real understanding of their dangers.

> The word LASER is an acronym for Light Amplification by Stimulated Emission of Radiation ... . Laser light is usually almost monochromatic and ... can be many thousands of times brighter than sunlight ... . The high intensity image produced on the retina can be dangerous to vision ... . Laser wavelengths range from the ultraviolet to the far infra-red regions of the electromagnetic spectrum; both extremes are well beyond the range of visible light. Lasers emit light either continuously (continuous wave laser) or in pulses (pulsed laser). (NH & MRC, 1993, p.1)

Under the heading "Other Hazards Associated with Laser Operation" reference is made to "atmospheric contamination arising from the cryogenic coolants used in the laser system and electrical hazards resulting from the high voltages present". (NH & MRC, p.3)

The world's most energetic laser is being constructed at the Lawrence Livermore Lab in Berkeley, California at a cost estimated at $4B. One hundred and ninety two beams will produce 1.8M joules of energy in attempts to reproduce conditions similar to those found at the centre of the sun. (Caldicott, 2002, p.53) In a 1996 report it states: "These advances will enable lasers with reasonable mass and cost to affect very many kills". (Quoted in Caldicott, 2002, p.127) If fusion were successful, the US would "have unleashed an entirely new threat to the planet's safety". (Ibid.)

Although testing at Nevada ceased when Test Ban treaties were signed there have now been 9 subcritical tests at that site since 1996. Russia and France are also conducting subcritical tests. (Caldicott, 2002, p.58) The breakup of the Soviet Union in 1991, meant that bomb materials were scattered far and wide. (Cawthorne, 2004, pp. 25-30)

> Uranium shells and bullets are referred to
>
> ... as "nuclear tipped". They are not: the shells are composed of solid uranium. The uranium is alloyed with other elements that may also be medically dangerous, but these materials are classified. (Caldicott, 2002, p. 147)

Uranium 238 bursts into flame when it hits a tank at high speed and as much as "70 per cent of the shell is vaporised and converted to tiny particles of uranium 238". These particles

> ... are small enough to be inhaled into the terminal bronchi - the tiniest air passages of the lungs. They can reside in these terminal bronchi for many years, irradiating a small volume of surrounding cells with high doses of radiation. (Caldicott, 2002, p.151)

Although the UN has sought to outlaw the use of uranium munitions, the US has exported or encouraged their construction in 16 other countries including Australia, Britain and France. (Caldicott, p.157) The use of these weapons affects civilians and even if never used, their manufacture does likewise.

Cawthorne cautions that tsunamis could rip nuclear-powered submarines apart, "contaminating huge areas with radiation". (Cawthorne, 2004, p.106) The US Navy's Trident submarines are controlled by Project ELF (Extremely Low Frequency Communication System). Who and what are subjected to this man-made electro-magnetic radiation? What are its effects? According to Nukewatch;"The Trident submarine fleet and its ELF activation constitute the costliest and deadliest weapon system in history". (Quoted in Caldicott, 2002, p.206)

During Operation Desert Storm, 14,000 DU shells were fired on the ground and more from the air leaving 564,000 pounds of DU. (Caldicott, p.151) Leukaemia moved from seventh most common cancer in 1989 to fourth in 1993. (Hall, 1996, p.195) "In 1997 uranium 238 was found in the semen of five out of twenty-two American veterans who had been carrying uranium fragments in their bodies since 1991." (Caldicott, 2002, p.153) This could explain "and increased incidence of congenital abnormalities in the offspring of veterans and also of the newborn babies in Iraq". (Caldicott, 2002, p.153) In the 78 day war in Kosovo in 1999, 31,000 rounds of uranium ammunition were fired, and in Bosnia in 1994-5, 10,800 shells were fired. (Caldicott, 2002, p.158) "[T]he local people do not understand the material." (Caldicott, 2002, p.159)

~~In the last 72 hours of the conflict between Israel and Lebanon in August, 2006, Israel used 90% of the total for the war of cluster bombs, which as we have seen are multiple and radioactive, 100,000 were left unexploded. Do those most in danger have any understanding of the dangers emanating from this new technology sold to Israel by the US?~~ Should makers of technological products that cause harm be responsible for cleanups and medical costs?

> The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) issued a report in 2000; this summarises the evidence and concludes that the hypothesis of a direct and linear response between radiation and harm done best fits the data. From the conclusions we could reasonably expect that the consequences of exposing the entire population of Europe to 10 millisieverts of radiation, about as much as would come from 100 chest X-rays, would be 400,000 deaths. (Lovelock, 2006, p.101)

The problem with radiation effects is that they do not develop, in many cases, until years or decades after exposure. This makes causal relationships more difficult to demonstrate with clarity. The effects of smoking as a cause of lung cancer faced the same problem and it took decades for acceptance of a causal relationship to be acknowledged by health authorities.

UK defense analysts estimate that following a nuclear attack, the population

> would stabilise at around six million – provided there was enough uncontaminated land to sustain farming, the radiation given off by the nuclear blast had not irreparably damaged the

> ozone layer and the dust thrown up into the upper atmosphere had not plunged the world into a nuclear winter. (Cawthorne, 2004, p.24)

There a lots of provisos!

> The Australian Government's 1994 Defense White Paper reaffirms support both for US nuclear weapons and Pine Gap's part in policing Asia and the Pacific to secure US and Australian strategic and economic interests. (Caldicott, 2002, p.207)

Aum Shinrikyo of the 'Supreme Truth' cult of sarin gas 'fame', bought an Australian property in order to mine uranium.

> The operation was eventually closed down by the Australian authorities, but not before sarin had been tested on a flock of sheep there. When one of the believers pointed out that killing animals contravened the precepts of Buddhism, she was reassured that all further tests would be on human beings. (Cawthorne, 2004, p. 152)

There are a number of antinuclear groups around the world: many are listed by Dr. Helen Caldicott in the The New Nuclear Danger.

> The work of Rosalie Bartells, Roman Catholic nun, scientist, and internationally recognized expert on low-level radiation, has documented how more than 1.3 billion people have been killed, sickened, or maimed by nuclearism over the past 55 years, and how pollution released from nuclear weapons operations has drastically changed the global environment and endangers all life forms. (Caldicott, 2002, p.222)

Caldicott tells us that as the largest US employer, the Pentagon employs 5.1M people and has agencies in 130 of the 178 countries of the world. (Caldicott, 2002, p.185) She calls for an end to its current agenda.

> The Pentagon needs to be virtually dismantled. Amalgamating with the United Nations, its military expertise needs to be used quietly and efficiently for peacekeeping operations around the world. (Caldicott, 2002, p.186)

She is concerned also regarding the way in which the young are educated. They grow up believing that the militarisation of space is both right and inevitable. This could be reversed.

> America has the power and resources to reverse global warming, to save the ozone layer, to prevent chemical pollution, to stop deforestation, to curb the human population problem, and

> to prevent the rape of space. The money that America invests in killing must now be redirected urgently to the preservation of life. (Caldicott, 2002, p.187)

This is not their present agenda. People of all nations need to heed her call. David Suzuki makes a similar call.

> If we can get this great entrepreneurial nation to devote even a fraction of what is spent on military budgets and homeland security to use energy more efficiently and find energy alternatives, there will be a revitalization of the economy with green initiatives. (Suzuki, 2006, p.323)

Suzuki tells us at the same time, however, that the American people are not ready to persuade their politicians that it is a time for change.

Caldicott has also written If you Love This Planet, and one of her concerns is the way in which governments are elected. She advocates proportional representation. (Caldicott, 1992, pp.198-200) Lovelock also touches on the role played by government. "Because our lives are so wholly urban, democracy ensures the election of governments almost entirely out of touch with the natural world." (Lovelock, 2006, p.206) His plea for the natural world goes further.

> We have to understand that the 'silent spring' did not come simply from poisoning by pesticides; the birds died because there was no longer space for them in our intensively farmed world. There are so many humans now aiming for a first-world lifestyle that we are displacing our partners on the planet, the other forms of life. (Lovelock, p.109)

We need to do more than stabilise greenhouse gas emissions-much more.

AUSTRALIA

There are more than 400 nuclear power stations around the world. After a period of quiet, new ones are now planned particularly in China and India. Australia has one at Lucas Heights to the south of Sydney, said to be for research purposes. Nuclear wastes are a problem and Australia has had enquiries concerning the disposal of low level waste. No state or territory wants to accept this waste, but the Northern Territory government has been overruled by Canberra.

Even in relatively nuclear free Australia, many Australians have suffered and still suffer from the effects of nuclear technology.

> Diagrams recently (1996) declassified by the Medical Research Council in the Public Records Office dating from early 1946 show that British doctors and scientists were fully aware that there was substantial residual radiation in the cities of Hiroshima and Nagasaki when the British Commonwealth Occupation Forces (BCOF) were sent in a few months after the two atomic detonations. (Lancet, 1996, p.620)

Australians and New Zealanders were among the BCOF. Some stayed as long as 18 months. Suzuki tells us that his mother's parents, who returned to Hiroshimo after World War II, were "dead in less than a year". (Suzuki, 2006, p.4)

One veterans' welfare officer in Australia comments that, of the seven teenagers who joined the BCOF, all but one is dead from cancer and the last survivor is in remission. Of 25 men who went on a course with him, only four are left, all in parlous health. (Lancet, p.620)

Nine British bombs were detonated in the wider Australian region in the 1950s – the legacy of contamination at Maralinga has received most press publicity. The Australian nuclear facility was established in 1958 and is being updated.

Between 1954 and 1971, 9120 tonnes of uranium oxide were recovered from 5 plants in the Northern Territory, SA and Queensland. Further exploration was encouraged under Harold Holt in 1967 leading to deposits being discovered at Beverley in 1969, Honeymoon in 1971, Olympic Dam in 1975, in SA and others in Queensland (Jabiluka in 1971) and one in WA. Mining at Olympic Dam and Jabiluka has taken place since then and also at Beverley. Moves to begin mining at Honeymoon are underway.

Australia signed the Nuclear Non-Proliferation (Safeguards) Act of 1987. Permits are required for possession and transport of nuclear materials such as uranium, thorium and plutonium. The control agency is the Australian Safeguards Office. (Year Book Australia 1988 pp. 592-637)

Australia has 30-40% of the world's uranium deposits with the largest source at Roxby Downs (Olympic Dam) and the second largest at Jabiluka, in or adjacent to the World Heritage Kakadu Area. Under the Labor Government, prior to 1996, about 2000 tonnes were exported per annum for less than $200M per annum. They intended to increase exports. The S.A. Government gets $12 per tonne (1996) in mineral royalties, which perhaps explains why that government has welcomed increases and a new mine at Beverley. At the same time

that same government rigorously opposed having a nuclear waste disposal site on their territory.

Naturally occurring uranium contains 0.7 per cent U-235 and that must be raised to 3% by discarding more than three-quarters of the U-238. It is said that the tailings contain 75-90 per cent of the mined uranium. Kakadu is in a monsoon area and some of the radioactive material must reach Magela Creek and ultimately the East Alligator River, contaminating large areas of this previously pristine wilderness. It has been suggested that the Roxby Downs mine is contaminating the Great Artesian Basin water in central Australia.

The ALP adopted a three mines policy in 1984. Australia exports uranium to 36 countries. Australia signed the Nuclear Non Proliferation Treaty (NPT) in 1972 and has a policy of selling only to other signatories, but Taiwan buys from Australia indirectly through BHP Billiton. Taiwan, India, Pakistan and Israel have not signed the NPT. China has negotiated a deal with Australia to explore for uranium in Australia. Caldicott tells us that we live in

> ... a world run by scientifically illiterate politicians who do not understand that nuclear power in its own right adds substantially to global warming, while leaving a deadly legacy of radioactive waste that condemns future generations to ... cancer, leukemia, congenital malformations and genetic diseases. (Caldicott, 2006, p.xi)

On one occasion John Howard did say that if uranium was as dangerous as Kim Beazley believed, then it should be left in the ground. How right he was!

Unfortunately, "[i]n a worst case scenario, we face a nuclear future. The only question is: do we go up in a series of mushroom clouds or perish by cancer caused by the radioactive contamination of the environment?" (Cawthorne, 2004, p.128)

Not only should uranium remain in the ground, where its rate of decay in minimised, but Australia should be a leader in reducing carbon emissions as well.

> In many poor tropical countries, water barrels on top of houses or stands are simply heated by the sun. How can Australia justify opposition to Kyoto when all its hot water could be provided by free, nonpolluting sunlight? With its vast desert expanses, Australia should be harvesting sunlight with immense solar collectors ... . (Suzuki, 2006, p.320)

The Australian government is now talking about carbon trading. If corporations have permits to emit a certain amount of carbon, usually in the form of carbon dioxide, then trading per se will not change the amount emitted. It is the emissions cap - the amount permitted to be released (and its enforcement) - that limits total output. Therefore, the permit issuer or the basis on which permits are issued seems to be more important than the fact of trading. Arguments in favour of trading claim that the system will drive innovation to limit carbon emissions. Surely, carbon taxes would do the same and perhaps more efficiently. Moreover, permit giving legitimates emissions, whereas carbon taxes provide negative feedback on emissions.

The Stern Review advocates carbon trading as a means by which greenhouse gas emissions can be reduced. Although Stern acknowledges that stabilisation of greenhouse gas levels must be our goal, carbon trading, as a means of achieving that goal, remains questionable.

In economic terms greenhouse gas (GHG) emissions are an externality. Costs are not paid by the present emitters; they will be paid by future generations, who will suffer the effects of actions taken now. Putting a tax or price on carbon could make some of the costs be paid now. C-trading is promoted as a means by which efficiency and distribution can be enhanced. The largest C-trading market is the EUETS (European Union Emission Trading System). It is currently debating the plans to be set in place beyond 2012. "The overall EU limit on emissions should be set at a level that ensures scarcity in the market for emissions allowances, with stringent criteria for allocation volumes across all relevant sectors." (Stern, 2006, p.xxiii) Stern refers to emissions banking, borrowing and auctioning. He emphasises the need for goals to be long term and clear so that stockholders know where they stand. There will be new markets for low-C technologies. Subsidies to energy producing companies, which currently amount to $250 B pa should be removed. Acts to subsidise the production of phosphate and nitrogenous fertilisers were passed in 1986. Mineral companies also receive tax concessions and subsidies in Australia and are aided by the State Mine's Departments. (Year Book, 1988, pp.573-576) The Stern Review calls for both governmental and private enterprise to increase efficiency in C-use, but tells us that to achieve stabilisation, there will need to be an 80% reduction in CO_2e output. "With the right incentives, the private sector will respond and can deliver solutions." (Stern, 2006, p.xxvii) A reduction of 25% needs to be achieved by 2050.

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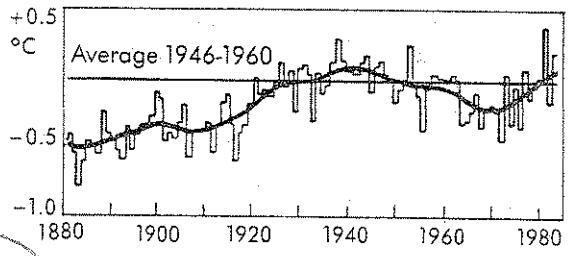


Figure 8

A hundred years of warming in the northern hemisphere. The figures shown are deviations from the 1946-1960 average, covering the first 25 years of the author's life.

(Source: Climatic Research Unit, University of East Anglia)

(Grinbin, 1998, p. 85)

Climate change, from an economic point of view, can be viewed as a market failure because costs are not factored into the process. Carbon taxes and trading could place constraints on its use, but coal will continue to be used. C-capture, C-sequestration or C-storage will have to be undertaken in order to reduce the impact of its use. These practices could increase its costs and add to the constraints on its use.

Carbon taxes are discussed by Monbiot. As he says, added taxes would hit the poor "harder than the rich" and would restrict the behaviour of the poor much more effectively than of the rich. He suggests a rationing system:

> ... we might decide that in 2012 the world should be producing no more the 5.5 billion tonnes. We divide that figure by the number of people we will expect to find on earth in 2012, and discover how much carbon everyone would be entitled to emit: it would be around 0.8 tonnes. Every nation would then multiply that figure by the number of people it contained, and this would become its national allocation. (Monbiot, 2006, p.44)

For this to work at the individual level, "[e]verything you bought would need both a cash price and a carbon price". (Ibid., p.45) If the government and industry took 60% of the allocation, then individuals would share equally the remaining 40%. Rations or credits could be exchanged. These 'icecaps', the new currency of greenhouse gas reduction, could be banked and drawn as needed.

There are problems with this proposed solution despite the fact that it appears to have been conceived with equity in mind. If governments are given the quota and the quota depends on population, population, instead of being acted on by negative feedback, serving as a potential control will be promoted by positive feedback. More population equals more carbon credits. If individuals had the full credits, then the feedback signals would work in the opposite direction. More population equals less ration per person. There would still be the possibility of problems within families if one individual could take from another or others, and some did so.

Any trading scheme will exacerbate problems due to inequalities in income distribution. In 1984, in Australia, the lowest decile had an average private income of $11.83 pw and the highest $1,136.91 pw. The lowest received $73.88 pw in direct benefits, $52.34 in indirect benefits and paid 30 cents pw in direct tax and $12.07 in indirect taxes giving them a total income of $125.13 pw and total benefits of $125.67 pw! The highest decile had a final income of $858.11 pw and were

paid total benefits of $124.58, almost the same as those in the lowest decile. Average weekly expenditure on fuel and power (not for transport) was $10.56 and for transport was $59. Those in the lowest 20% spent $19.98 pw on transport while those in the highest 20% spent $105.25 pw. (Year Book, 1988, p.369, p.373) Those who earn most already contribute 2 to 5 times as much to the greenhouse gas problem as those in the lowest bracket. Trading would allow them to continue to 'buy' and use the most. The same would apply to nations. The rich could buy and use more and the poor would be worse off.

The EUETS, which began in 2005, handed out carbon dioxide credits or emissions permits to big European companies.

> This handout was so generous that in May 2006, the British government's consultants calculated that power firms would be making a windfall profit from the scheme of around $1 billion, while doing nothing to reduce their emissions. The Emissions Trading Scheme is a classic act of enclosure. It has seized something which should belong to all of us - the right, within the system, to produce a certain amount of carbon dioxide - and given it to the corporations. (Monbiot, 2006, p.46)

This tells us that, to date, the EUETS has failed both in economic and in emissions reduction terms.

The carbon credits and ETSs proposed by Stern will simply add another layer of commerce to the economic system - a new dimension to the stock exchange, except that the units of exchange will be expressed in terms of greenhouse gas emissions' allowances, Monbiots 'icecaps', at least initially, before being converted into monetary entities as they are traded.

Stern does say that they must be allocated to ensure scarcity, but the greater their scarcity were, the higher their price would become. The biosphere is turned effectively into property by this process and the price of this property - this licence to pollute - would rise with each cut in allowances leading to a new kind of inflation and a new set of the privileged. Governments would print even more money to accommodate this inflation, providing industry with greater spending capacities. They would be looking for new areas in which to invest and most new areas of technological innovation also have their energy costs.

This idea of carbon-trading is no solution to the problem. It would not change company goals from focussing on profit to focussing on social and environmental needs. The world problem now is the same

or worse than when Falk and Brownlow sought solutions within the Australian context in 1989.

> Beyond global warming is the whole thrust of technological development in Australia - which places too much emphasis on immediate market returns, and too little on creating a direction of development which meets social environmental needs over the long term. (Falk & Brownlow, 1989, p.231)

The world, Australia and corporations could adopt initiatives to reduce greenhouse gas emissions, but "[b]etween possibility and implementation lies a minefield of political and economic concerns and interests". (Ibid., p.233)

Plantations have also been promoted as a means to offset emissions, but this system is also flawed. When the earth was covered by natural ecosystems there was a carbon cycle, but land clearing has disrupted the carbon cycle, burning coal has disrupted the carbon cycle, and removal of fossil fuels from the earth has also disrupted the carbon cycle. Replanting some additional monocultures is not going to restore a properly functioning carbon cycle. Plantations may help to put some carbon lost from the biosphere back into the biosphere, but there are limits to the amount of carbon that can be held by the biosphere. Natural inputs should equal natural outputs or the rate of uptake should equal the rate of decay.

Tasmania has 40% of its forests reserved in national parks, but the carbon holding capacity of much of the rest of the island has been severely reduced due to urbanisation and pastoral activities. Methane is one of the greenhouse gases that increases in concentration with increases in sheep and cattle production.

The Draft refers to forestry sinks as being "valuable in offsetting greenhouse emissions from other sources". (~~Ibid.~~), but 200 years ago practically the whole state was forested. Planting trees helps restore part of what has been lost, but it takes hundreds of years for proper ecosystem restoration. Moreover, currently, forestry plantations are sprayed, possibly with chlorine releasing pesticides. These sprays also contaminate our waterways and threaten the health, particularly of the more vulnerable young, who rely on them.

(Draft, 2006, p.28)

Falk and Brownlow tell us that two-thirds of the forests of Australia have been removed since 1788; an even higher proportion of rainforest - 75% - no longer exists.

Reforestation, even to replace lost forest, would be a major project, desirable as it might be, but it would only go part of the way towards

restoring balance that has already been lost. To promote it as a solution to global warming is misleading. Reforestation needs to occur, but not to offset greenhouse gas emissions elsewhere.

Even if trees could be planted to offset emissions, the project would not deliver the results sought. If one hectare of trees can absorb 18.5 tonnes of carbon each year, then a plantation of 7 M square kilometres "would be required to reach ... a goal [of 5 billion tonnes of carbon], an area about the size of Australia". (Falk & Brownlow, 1989, p.120) An area the size of Australia would need to be forested each year to offset a worldwide production of 5 B tonnes per year. Even if half that produced were broken down by the biosphere, plantings to offset the amount added annually would soon cover the whole earth.

Reforestation should be encouraged to restore the quantity of carbon held by the ecosystem, but it is not a solution to the greenhouse gas emissions problem. Forestry practices add to the problem, due to both the depletion of the carbon sink, and the addition they make to greenhouse gas emissions.

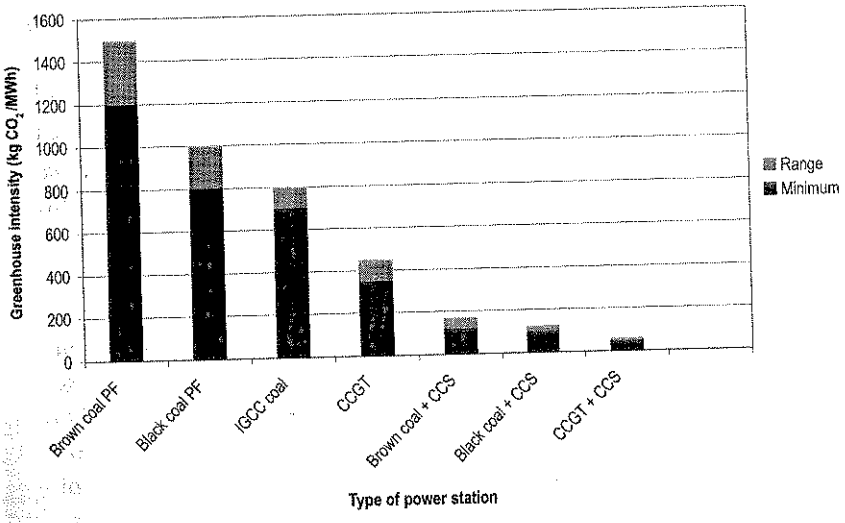
In Tasmania, the mainland species Eucalyptus nitens is replacing Tasmanian species as the preferred plantation tree, while overseas, concerns are being expressed due to the expansion of eucalypt plantations on to agricultural land.

> The tree is beginning to take over world forestry. Acreage has expanded from 1.4 million in 1955 to 10 million in 1980, and the UN Food and Agricultural Organisation (FAO) estimates that almost a half million acres are added each year. It already accounts for a third of world pulp production. (Tenner, 1996, p.158)

Trees removed from their natural habitats and pests can grow faster than in their natural home, but they have also become "a worldwide symbol of the intervention of international corporate agriculture". (Ibid., p.160)

> The structure of eucalypts had apparently been optimized for the slow rate of growth with the normal complement of pests. In their absence, the fast-growing trees were booby-trapped by the laws of physics ... . The miracle tree simply could not be used for lumber in America. The eucalypts had become problem trees because they had left their own pests at home in Australia. (Tenner, 1996, p.156)

Figure CO_2 emissions from various power stations with various fuels



Notes:

'PF' denotes pulverised fuel, the standard type of coal-fired power station.

'IGCC coal' is integrated gasification combined-cycle, a new type of coal-fired power station that is not currently competitive with PF types.

'CCGT' denotes combined-cycle gas turbine, the most efficient existing type of gas-fired power station.

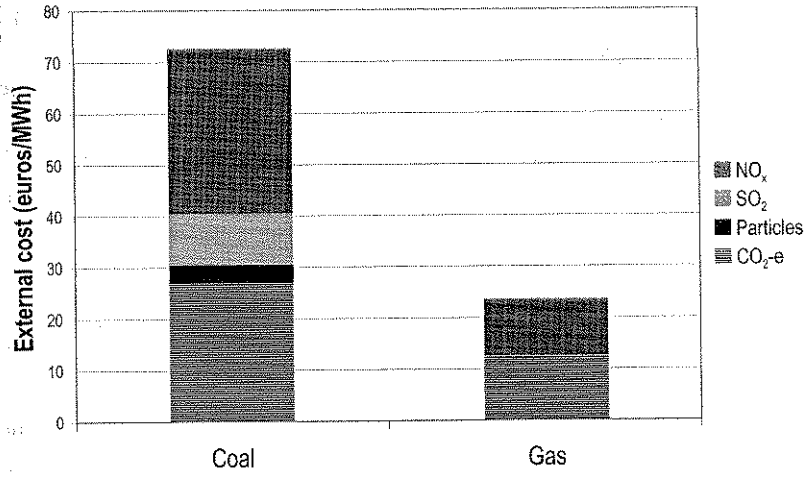
'CCS' denotes CO_2 capture and (underground) sequestration, discussed later in this chapter.

'Renewables' in this figure comprise wind power and certain types of bioenergy. Renewable energy has been assigned nominal CO_2 emissions under assumption that energy use for manufacturing power plant comes from predominantly fossil fuels.

SOURCES This author's results. Emissions from some specific Australian power stations were either obtained directly from annual or environmental reports of electricity generation utilities or, in cases where coal consumption data are published, by calculation using CO_2 emission factors of Australian fuels and point-source energy content of fuel (Australian Greenhouse Office, op. cit.). Emissions from hypothetical power stations with CO_2 capture and sequestration, from Freund & Davison (2002)[8] and other published desktop studies assuming capture of 80–90 per cent of CO_2 emissions.

(Diesendorf, 2007, p. 217)

Figure Typical damage costs of new baseload coal- and gas-fired power stations assuming average European conditions



Note: These external costs are additional to the economic costs of generation. 1 Euro = 1.23 US$ on 1 October 2004.

SOURCE Rabl & Spadaro (2000)

(Dessendorf, 2009, p. 223)

Table The world's largest coal producing and consuming countries, 2002

Country	Coal production (million tonnes per year)	Coal consumption (million tonnes per year)
China	1430	1060
USA	996	818
India	358	247
Australia	344	98
Russia	236	No data (former USSR: 612)
South Africa	223	130
Germany	210	371
Poland	162	136

SOURCE US EIA (2004), tables 25 and 14. The EIA data have been converted here from short tons to tonnes.

(Diesendorf, 2007, p. 214)

Table Percentage of electricity generated from coal in selected countries

Country	Year	Percentage of electricity from coal	Trend since 1990
Poland	2000	96	Steady at saturation
South Africa	2000	92	Steady
Australia	2000	78	Steady
China	1999	75	Small increase
India	1999	75	Increase
Czech Republic	2000	73	Steady
Germany	2000	53	Fallen slightly
USA	2000	52	Steady
Denmark	2000	47	Fallen greatly as use of gas and wind increase
Korea	2000	42	Big increase
UK	2001	37	Fallen rapidly since 1986

SOURCES International Energy Agency reports; US EIA (2004)[7]

(Diesendorf, 2007, p. 215).

Whether pests were the whole problem is perhaps debatable. Ecosystems differ in both biotic and abiotic factors and all interactants are part of the whole story.

Tenner tells us that the fire in Berkley, California in 1970 was "fed partly by eucalyptus litter", which is broken down in a properly functioning ecosystem, but not in this foreign environment. It is blamed also to some extent for the conflagration on October 21, 1991 in the same area; "eucalyptus trees had contributed fully 70 per cent of the energy released by burning vegetation in the fire", according to the calculations of a Berkley student. (Ibid., p.157)

Unnatural forest fires add to greenhouse gas emissions and problems surrounding climate change and they are fueled by plantations of exotic species which are maladapted to their foreign environment.

Plantations also change the water cycle: trees, like ourselves, are water-holders. Like us, they hold more water than carbon. But trees are more than that, they are agents of control; they help to keep the soil and atmosphere in balance.

Another proposed solution is sequestration. This already occurs to some extent. Gases such as carbon dioxide are pumped in for the purpose of getting oil or other products out. Of course, this locks up oxygen as well as carbon. Plants that have given rise to coal, oil and gas seem to have lost more and more of their oxygen as they age. Hydrogen is only 6 parts out of 100 in wood and is about 2.3 parts per 100 in anthracite by weight.

Wood	contains 44 parts oxygen to 50 of carbon.
Peat	contains 34 parts oxygen to 60 of carbon.
Coal	contains 15 parts oxygen to 80 of carbon.
Anthracite	contains 2.3 parts oxygen to 95 of carbon.

(Walshaw, 1956, p.446)

Interaction between methane, common in coal mines could convert some of the oxygen to water. Interactions and their time scales simply are not known. We may be doing more harm than good.

In order to produce a gigajoule of energy, coal containing 24.1 kg of carbon or natural gas containing 14.6 kg is burnt. However "[a] modern gas-burning power station turns about 52 per cent of the energy its fuel contains into electricity. The best coal-fired generators have an efficiency of about 40 per cent". (Monbiot, 2006, p.82) Carbon dioxide can be extracted from the exhaust gases of a power station. Ethanolamines "absorb between 82 and 99 per cent of the carbon dioxide. The chemical mixture is then heated to release the carbon, which is piped away for burial". (Ibid., p.85) Global carbon dioxide

output from power stations is about 10.5 billion tonnes of carbon dioxide a year. Natural gas reserves within geological formations "have remained stable for millions of year". (Ibid.) Escape from storage at sites where natural gas has been removed is said to be unlikely, but the forces acting at such depths are very different from those at the earth's surface. At depths below 800 metres "the pressure turns it 'super-critical': it behaves more like a liquid than a gas". (Ibid.) About 250 kilometres off the coast of Norway, "a million tonnes of carbon dioxide has been injected 1,000 metres beneath the seabed every year since 1996. (Oakeshott, 2006, p.37) According to Dr. Lincoln Paterson from the CSIRO, water is pushed out as carbon dioxide is pushed in. (Quoted in Oakeshott, 2006, p.37)

Carbon dioxide is a poisonous gas; 10-15% renders a human unconscious. Only 0.05% of its cousin, carbon monoxide is needed to prevent blood haemoglobin from carrying oxygen. "There has been at least one major natural escape where carbon dioxide was released from an African volcanic lake (Lake Nyos), asphyxiating thousands of people and domestic animals." (Ibid., p.38) The Climate Action Network of Australia believes that:

> Governments must establish a stringent legal framework for regulating geosequestration facilities that ensures the proponents of geosequestration assume complete legal liability for the full economic, environmental and social costs of leakage over the lifetime of the storage. (Quoted in Oakeshott, 2006, p.38)

Externalities are to become the legal responsibility of the corporation conducting the storage. Plans to store 420,000 tonnes of CO_2 per year at a depth of 2000 metres are part of a natural gas extraction plan in Queensland. (Oakeshott, 2006, p.39)

In the long term, heat, pressure, and chemical exchange might possibly convert some of the carbon dioxide into methane, depending in part on the composition of the surrounding sedimentary formations. The carbon dioxide might also be reduced to carbon monoxide.

Monbiot asserts that using carbon dioxide to extract oil or gas would lead to the release again of too much of it. He concludes that carbon capture and storage - by which he means carbon dioxide capture and storage - "while it cannot provide the whole answer - can be and must be one of the means we use to make low-carbon electricity". (Ibid., p.89) After looking at nuclear and rejecting it, Monbiot believes that "with sufficient political will, gas-fired power stations fitted with

carbon capture equipment could provide roughly 50 per cent of our [UK] grid-based electricity by 2030". (Ibid., p.99)

RENEWABLES

Many think that if carbon capture could cut emissions, the remaining solutions could lie with renewables. "While renewable technologies can dominate a landscape, this impact is surely less significant than the destruction of the biosphere." (Ibid., p.101)

One of the problems with electricity is transport. The first networks carried direct current electrical energy, DC, but since mass production, it has been carried as alternating current, AC. Monbiot now tells us that new technologies make DC cables preferable to AC cables. AC systems lose energy at a rate proportional to the distance travelled. New DC systems suffer an initial loss, but it does not increase with distance. "There is no inherent limit on the length of a DC cable. Already there is a line in the Democratic Republic of Congo that is 1,700 kilometres long." (Ibid., p.104) These new cables are "made of extruded polyethylene" - a product of the fossil fuel industry. Are they made of extruded polyethylene or coated with it - held within a sheath of it? Polyethylene is an insulator.

Polyethylene is a long chain polymer of carbons joined to each other; the other two bonds of each carbon atom link with hydrogen. Nuclear radiation converts

> ... polyethylene at high temperature from a liquid to a rubber like material. Without a high density of [molecular] crosslinks (requiring a very large dose [of nuclear radiation in the form of β-rays]) one cannot use irradiated polyethylene for high tensile strength at high temperature, but only to prevent it from flowing. This property is of considerable value in electrical cables, where one no longer has to fear that on a short overload the insulation will melt and flow away. (Charlesby, 1961, p.118)

Monbiot claims that this new method of transport could enable wind or solar generated power to be transported from further afield than before.

> For years, rogue environmentalists have been pointing out that solar electricity generated in the Sahara could supply all of Europe, the Gobi could power China, and the Chihuahuan, Sonoran, Atacama and Great Victoria deserts could electrify their entire continents. These people have been dismissed as

> nutters. The development of cheap DC cables suggests that they might one day be proved right. (Ibid., p.105)

We in Australia have heard the same proposal put forward from time to time. There are different forms of solar technology. Photovoltaic forms made up of panels like those found on the roof tops is one form; reflective dishes that direct sunlight to vaporize water into steam, which then drives a turbine to create electricity; or mirrors, which track the sun, can be used for the same purpose.

> The Australian government has shown great enthusiasm for a solar 'power tower' 1 kilometre high in the outback north of Melbourne, but I suspect its interest is prompted more by the prospect of building the world's tallest structure than by the project's commercial viability. (Ibid., p.106)

This may be more feasible than Monbiot implies. Transportation is one problem, but the other with wind and solar is that the supply depends on intermittent wind or, even in a desert, limited hours of sunlight. Use of these non-consistent sources means that there will still be a need for those types of generation that can produce consistently and most of these will continue to generate carbon dioxide. Thermal power generated from fossil fuels can be cut, but seldom eliminated from the overall equation.

"The greater the number of regions in which windmills are built, the higher the chances that some of them will be turning," (Ibid., p.113) but in order to utilise power from diverse wind sources they have all to connected to the same grid. There are problems with wind power. The blades are made of fibre glass, which ultimately becomes dangerous waste and may even be dangerous in the same way as asbestos to those associated with its manufacture or use. The forces they have to withstand are enormous and they can make a terrible noise. It is also the case that they create a kind of desert within the aerial biosphere.

At the moment, continents in the southern hemisphere are very slowly moving north and places like Tasmania, New Zealand and South America must become the favoured migration zones for birds that head south but not as far as the cold Antarctic. The orange bellied parrot is one species threatened with extermination and proposed wind farms have been rejected in attempts to save it. Wind farm operators try to redirect migration paths, but birds still suffer to some extent. No one mentions what happens in the case of insects. Wind power generation has its own advantages and disadvantages, but must

be considered as preferable to nuclear or coal. What is really needed is a reduction in consumption, not more and more technology.

In the UK, power storage systems are used in order to respond to extra demand;

> They each consist of two reservoirs, one at the top of a mountain; one close to the bottom. When electricity is cheap, which means when demand is low, it is used to pump water from the bottom reservoir to the top one. When there is a requirement for a sudden surge of production, the gates of the top reservoir are opened, and water pours through turbines back down to the bottom. The pumped storage plant at Dinorwig, in North Wales, can produce 1.7 GW of power for five hours. It responds within fifteen seconds. (Ibid., pp.80-81)

Electricity use is generally much greater during the day than at night. Off-peak hot water systems are switched off at night; smaller systems with minimal storage, if used only when hot water were needed, would seldom need to be used at night. We could adapt our needs better to renewables' availability. "By altering the pattern of our demand ... [we] can, in effect, improve the reliability of ambient power." (Ibid., p.116)

Monbiot believes that

> ... the United Kingdom has sufficient renewable power comfortably to supply an average of 50 per cent of ... electricity ... the grid and the reliability of the electricity it carries, could survive if 50 per cent of the supply came from renewables. ... the carbon costs of generating it would be considerably smaller than the carbon savings. (Ibid.)

An electricity system running on 50 per cent renewables and 50 per cent "conventional generators fired up to meet shortfalls in supply ... would produce no more than 15 per cent of the carbon emissions currently released by ... electricity suppliers". (Ibid., p.117)

In addition to electricity, gas and wood are burnt to provide heat in many homes. According to Stock: "In 1975 half the deforestation in the world was to produce fuel for cooking and warmth." (Stock, 1993, p.129) Monbiot considers growing biomass as a renewable energy source, but energy crops would use enormous tracts of land, need quantities of water and would keep food production down. He concludes that energy crops should not be cultivated on more than 20 per cent of the land. (Monbiot, 2006, p.119) Moreover, "for every 10 kilo-

metres the [wood] fuel travels by road, the House of Lords calculates, 0.2 perc ent of its energy value is consumed". (Ibid., p.120)

MICRO SOLUTIONS

Ground-sourced heat pumps which pump water to a depth of 1.5 metres, where the temperature is 12°C, can draw heat from the earth. There are about 600,000 of these ground-sourced heat pumps in the US. (Ibid., pp.121-2)

Traditionally power supplies have been community or state supplied systems, but micro-generation might be a better answer to our problems. It would eliminate long-distance transmission cables and encourage a high degree of self-sufficiency. "Buildings instead of being passive consumers of energy, would become power stations, constituent parts of local energy networks." (Greenpeace quoted by Monbiot, 2006, p.124) "[S]olar panels in Europe take between two and four years to produce as much energy as is used in their manufacture." (Ibid., p.125) To pay for them in the UK would take about the same time as they would last.

Micro-wind has many problems. Turbines need wind blowing through areas that are both tree free and building free. Turbulence can limit their life span. Gas burning generators have also been devised for use in the family home. They generate both heat and electricity but still produce carbon dioxide. No solution is perfect so what about hydrogen? Hydrogen is present in the atmosphere as water vapour, but is present in the earth's crust at a level of less than 1%. When burnt in air (oxygen) hydrogen and oxygen combine to form water so energy is released without any carbon dioxide being produced. Hydrogen can be made from coal or natural gas (methane), but carbon dioxide is a waste product. It can be made from water by electrolysis, but the energy input must be as great or greater than that released. More energy is required to liquify or compress and store the gas. If it is piped, the pipes need to be very specifically designed. Hydrogen atoms are the smallest that exist and they can be leaked more easily than any others.

Though hydrogen gas as a fuel for cars "is three times as energy-dense as petrol in terms of weight, it is only one tenth as dense in terms of volume - at pressures of 5,000 pounds per square inch". (p.163) In other words fuel tanks for hydrogen powered motor vehicles will need to be larger and much stronger. "[N]o hydrogen storage system has yet been developed that is simultaneously lightweight,

compact, inexpensive and safe." (US National Academy of Engineering quoted by Monbiot, 2006, p.163)

Gadgets within our homes have become more numerous and add substantially to our energy bill.

> According to the British government, around one million tonnes of carbon emissions a year are caused by equipment in homes and offices left in 'standby' mode, plugged into the wall but not operating. This uses 2 per cent of all our electricity. And the problem could become worse, as the digital decoders - or set-top boxes for our televisions, which are rapidly becoming universal, are designed never to be unplugged. (Ibid., p.74)

Some homes have a meter with a switch just inside the door so that they can switch off all applications (except those selected) each time they leave the dwelling. (Ibid., p.77) Many of these gadgets are luxuries. Wouldn't society be better off without many of them?

Monbiot advocates the use of fluorescent light or LED (light emitting diode) bulbs and wonders why people still cling to the incandescent bulbs, but the latter are much safer for our health. He does add that "people can make sensible choices only if they know exactly what they are buying". (Ibid., p.75) That is exactly where problems lie; people don't understand how many of these products work and often they can't get the information needed in order to make a proper choice. As well as information regarding the frequencies generated, there should be information regarding energy use. In fact, every energy using device should be sold with labels explaining how much energy it uses (and how much was expended in its manufacture). Gas and electricity providers could include on their statements a print-out of carbon dioxide production arising from the amount of energy used.

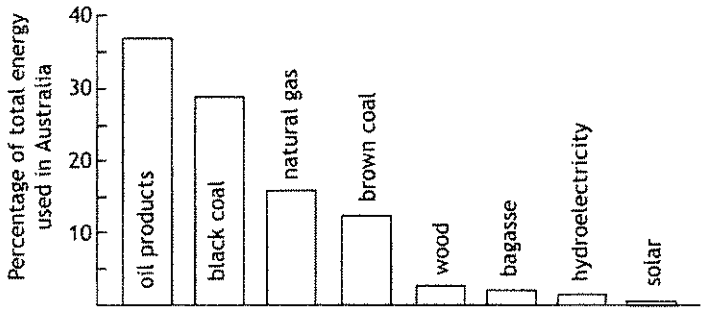
> In October 2005, a group of manufacturing countries, including the United States, China and South Korea, sought to persuade the World Trade Organisation that all energy labels are a 'barrier to free trade' and should be made illegal. The negotiations are continuing. (Ibid., p.75)

Freedom for consumers would, conversely, make energy labels mandatory. How else can they make an informed choice?

How much greenhouse gas in emitted from cigarette smoking? From burning cannabis? According to Tenner: "In 1995, cannabis was the biggest American cash crop in dollar volume, exceeding corn and soybeans combined". (Tenner, 1996, p.143)

There are forces pushing Australia to go nuclear. The government set up a committee to consider the proposal and a report has now been released. How much would such a scheme cost tax payers who ultimately pay the subsidies offered by governments where nuclear power is produced? What will happen to the waste? We are told the public still needs to be educated. Educated to what end? Do we want free knowledge seeking education or government directed education?

I have written this book to add my voice to those of people like Dr. Helen Caldicott, Senator Christine Milne and others who care for the health of you, of our nation, of our planet. Commercial interests must not be allowed to win this one.



Source of Energy (Bennett, 2005, p.5)

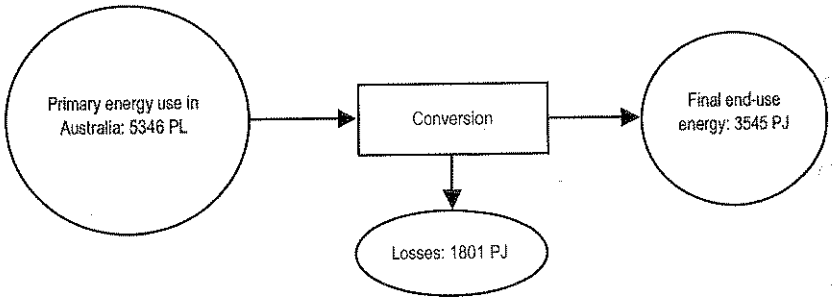
TRADE

In a sense there is biological trade. The coral polp supports the algae and the algae supports the polp. Mutualism and commensualism or interdependence are widespread in nature. The fig depends on the wasp that fertilises it and the wasp depends on the fig for its livelihood. Each depends on the other and would become extinct without it.

The first form of artificial trade was barter, where the goods exchanged were to some extent the result of human or technological work. Barter was initially between individuals, but in later times between tribes, towns, states or countries.

From an ecological point of view gravel in situ has value because it supports the life systems on and around or within it. From an economic point of view gravel in situ is generally conceived to have no value. It is not an item for exchange or for artificial use. When it is 'mined' for use in concrete it becomes both an item of exchange and a product for artificial use. It has been turned from an item of natural wealth within

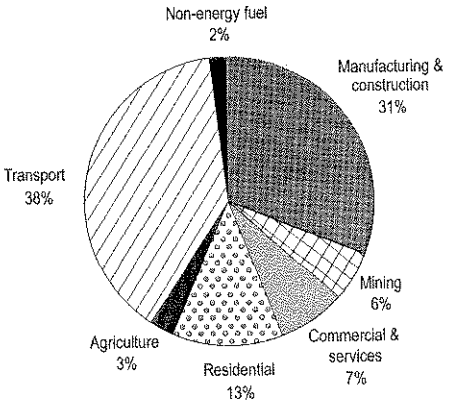
Figure Energy flows in Australia, 2003–04



SOURCE Wells & Donaldson (2005), table 40

(Diesendorf, 2007, p. 66)

Figure
Total final energy use by major sectoral group, Australia, 2004–05



SOURCE Wells & Donaldson (2005), table 43

(Diesendorf, 2007, p. 67)

ages, "by 2050 it would account for 50 per cent of ... carbon emissions". (Ibid., p.176)

Monbiot continues:

> If we tried to stabilize them at 450 parts (which is closer to my target) flying would produce 101 per cent of the carbon the entire economy was able to release. If the carbon emissions were multiplied by 2.7, to take into account the full impact of aviation on the climate, the figures would be 134 per cent and 272 per cent respectively (Ibid., p.177)

Jet aircraft are fuelled by kerosene which carries more energy by volume than hydrogen. (Ibid., p.181) Water vapour is one of the greenhouse gases produced when either kerosene or hydrogen is used, but hydrogen produces 2.6 times as much.

> ... a hydrogen-fuelled supersonic aircraft flying at stratospheric levels would be expected to have a radiative forcing [which means a climate-changing effect] some 13 times larger than for a standard kerosene-fuelled subsonic aircraft. (Royal Commission on Environmental Pollution quoted by Monbiot, 2006, p.263)

It seems therefore that the choice is between an aviation industry and climate change. The external costs are so great that the whole industry would have to be dismantled if they were taken into account.

Monbiot considers fast land travel (using ultra-high speed magnetic repulsion locomotives) instead of air travel, but cites results from a discussion paper by Professor Roger Kemp from Lancaster University:

> ... a journey from London to Edinburgh by train travelling at 350 kmph, Kemp's figures suggest, would consume the equivalent of 22 litres of fuel for every seat. An Airbus A321 making the same journey uses 20 litres per seat. (Ibid., p.184)

That doesn't take into account cost, safety or other significant factors.

Perhaps ocean travel ~~(ocean travel)~~ by passenger ship would produce better results? - But it doesn't. "Travelling to New York and back on the QE II ... uses almost 7.6 times as much carbon as making the same trip by plane." (Ibid., p.185) Neither speed nor distance can be kept. "If you fly, you destroy other people's lives." (Ibid., p.188)

Monbiot, however, paints only a partial picture; the problem posed by aircraft and rockets as ozone destroyers may be a greater danger than the disastrous picture already described by him. Bye-and-large

the effects of climate change affect some humans, not all. In fact, most writers admit that some could even benefit, in an economic sense, by being able to grow better crops even if the reverse is true for most. Ozone destruction, however, although largely polar, but substantially weakened up to 40°S in the Southern Hemisphere, must be letting through much more UV radiation. Every extra photon of ultraviolet light that enters the biosphere carries with it between 3 and 6 electron volts of energy. Mains powered electricity carries 240 electron volts. (Charlesby, 1961, p.108) If ozone concentration has been reduced by nearly five-sevenths (320-95 Dobson units between 1955 and 1995) and continues to be destroyed by airflights, then more and more of the life on this planet will be threatened. Skin cancers rose about 300% during those same years. Under normal conditions the ozone layer is thinner at the equator, where the more direct radiation from the sun breaks the molecules during the daytime, while the darkness of night allows the ozone to reform. If you fly, you may do more than 'destroy other people's lives', you may contribute to the destruction of many forms of life on this planet. "Unlike heating, lighting, travelling to work, building or shopping, aviation is not required to sustain civilization." (Monbiot, 2006, p.203) We could do without it. We need to either revert to planes of the kind that flew in the 30s and 40s or abandon the industry altogether.

In fact, the percentage of the population who fly is relatively small. Writing in 1974, Illich tells us that

> ... four-fifths of the mileage flown to conventions and resorts is covered year after year by the same one and a half per cent of the population, usually those who are either well-to-do or professionally trained ... . The speedier the vehicles the larger the subsidy it gets from regressive taxation. Barely 0.2 per cent of the entire US population can engage in self-chosen air travel more than once a year, and few other countries can support a jet set which is that large. (Illich, 1976, p.29)

Fares declined and passenger numbers grew, but after 11 September, 2001, they declined. Use at 1974 levels would be better than at present levels, but we should choose to minimise the use of airline transport as far as possible. Monbiot's warnings should be heeded.

TASMANIA

What percentage of Tasmanians use gas, natural gas, electricity, wood for cooking in their homes? What contributions does each make to CO_2e?

How much electricity is used by industry, retail, homes and other types of use? What contributions does each make to CO_2e?

What contribution to CO_2e is made by lawnmowers? To what extent could that be cut by planting different ground cover plants?

If costs in CO_2e terms are allocated 50:50 between departure state or nation and arrival state or nation for airline travel, what contribution does air travel make to total CO_2e?

Should governments be investing in Big Box developments at airports when airtravel creates such an enormously heavy load of external costs?

The Tasmanian government added an additional ferry to those running between Melbourne and Devonport to run between Sydney and Devonport in 2003, but sold it in 2006. Cheap air fares were one of the factors that contributed to its demise. There are also plans for 'Big Box' developments at Tasmanian airports. City traders fear a loss of retail sales as a result. Tasmania needs to develop greater self-sufficiency and be less reliant on imported products. Product transport needs to be minimised.

Tasmania depends to a large extent on tourism so that the findings that airlines and pleasure cruises are so CO_2e expensive raise problems and concerns. It is a pity that so many young people find it necessary to leave their place of birth in order to find employment. Their returns to their home state are not really in the same category as visits by tourists. Their need is real, whereas tourism is often pure luxury.

Aluminium is smelted in Tasmania; the plant was originally established by the government, and established here, (due to the price of electricity at that time being the cheapest in Australia), despite the fact that the ore is mined in Queensland. The Bell Bay plant provides employment, but what percentage of the industry CO_2e cost is due to that industry? How much processed aluminium do we really need? Is it a factor in the aetiology of Alzheimer's disease?

The proposed additional pulp mill (at the mouth of the Tamar would destroy additional forest, produce hazardous gases and threaten Bass Strait and other ecosystems. What would its CO_2e con-

tribution be on an annual basis taking all factors into account? What would its health costs be? Its external costs?

What do mobile phones cost in global warming terms? In health cost? Computer? Satellites? Internet?

We have already seen moves towards using less coal and replacing its use by gas. "Typically, black coal releases approximately 25 per cent more carbon dioxide than oil and 50 per cent more than natural gas for the production of the same amount of heat." (Falk & Brownlow, 1989, p.118) Some of the heat wasted during electricity production, about 60%, is now more frequently being used for other processes that are co-located.

The calorific values of some energy source materials are listed below, 1 BTh U = 252 calories.

Carbon	14,550	BTh U/lb
Sulphur	4,000	BTh U/lb
Methyl & ethyl alcohol	11,700	BTh U/lb
Benzene	17,100	BTh U/lb
Kerosene	19,800	BTh U/lb
Hydrogen	62,000	BTh U/lb
Wood	8,500	BTh U/lb
Peat	10,500	BTh U/lb
Coal	13,500	BTh U/lb
Petrol	19,400	BTh U/lb

(Walshaw, 1956, p.12, p.444, p.446, p.457, p.458)

Electric power generation in coal, gas and nuclear stations is achieved by generating high temperature gases. "In every kind of heat engine, heat is let down from a high level of temperature (T_1) to a lower level (T_2), and it is by so letting heat down that the engine is able to do work." (Walshaw, 1956, p.350) Walshaw also tells us that "[l]owering the sink temperature T_2 causes a greater increase in efficiency than raising the source temperature T_1". (Ibid., p.234) In a car, some of the heat is converted into work; some is carried away by the water cooling system; some by the exhaust gases, and some is lost to the surrounding air.

The major focus of many concerned about climate change has been on reducing energy use. This can be done by using more efficient techniques in power generation, in industry, in the home, in transport vehicles, and by avoiding wastage. We should use natural light better and switch all lights not in use off. All appliances should be

unplugged when not being used. There are limits to the efficiency that can be achieved. According to the second law of thermodynamics "there is a definite limit to the amount of mechanical energy that can be obtained from heat energy". (Ibid., p.23) Whenever we generate mechanical energy due to temperature differences, we also generate heat that adds to the temperature of our surroundings.

The present rate at which greenhouse gases are produced, when fuels are burnt in air (oxygen), is higher than the rate at which they can be broken down by the atmospheric system or Gaia. The checks on their release that existed for millions of years were lifted when machinery allowing the exploitation of fossil fuels was invented and manufactured. A sufficient reduction in energy demand would reduce the stress on the natural system so that it could once again self-regulate greenhouse gas levels and restore the natural balances with which life on this planet evolved.

Governments need to work towards the restoration of balance; they need to advocate lower levels of energy use, not higher ones. "Energy corporations have played a vigorous role in helping shape government policy to meet excessively high expectations of future energy demand." (Falk & Brownlow, 1989, p.146) Environmental concerns blossomed in the sixties and seventies, but in the 1980s "monetarism fitted the needs of the largest corporations". (Ibid., p.165)

> Thus, whilst real differences exist between neo-Keynesian, monetarist and other economic perspectives, the attack on 'regulation' as such, and the search for the 'the free market', act not as genuinely attainable goals, but as appealing rhetorical devices. Their central function is as a tool of persuasion in the social tug-of-war over which forms of 'unfreedoms' and regulations are to be instituted, which are to be disbanded, and to what purpose. It is under the pressure of a decade in which that rhetoric has proved persuasive, that the success in the 1970s to regulate some of the most worrying features of economic transformation has been in many cases seriously undermined. (Ibid., p.167)

The greenhouse problem can be seen therefore as not simply a problem "of industrialisation but of the world market". (Ibid.)

Ever since Smith, and possibly before, the value of commodity depended on the labour expended on its production - resources per se had no economic value except as that from which economic value could be derived due to processes of value adding. Water was, at the

time Smith wrote, so freely available that anyone, who collected it in order to sell it would have been laughed at. That is no longer the case, although as Falk and Brownlow remind us, the biosphere and oceans are mostly unowned. They are in many, but not all respects, like the pre-industrial commons, shared areas. Overgrazing was for many generations prevented due to a "careful system of management that prevented it". (Ibid., p.168)

> The contemporary tragedy is that there is no system for 'stinting' the atmosphere and oceans. If some such system is not introduced, then each producer is likely to follow the logic of the market, placing private gain before the cooperative measures which could prevent damaging the biosystem on which all human activity depends. (Ibid.)

The frontier mentality and economic exploitation have not only seen the collapse of the system of commons, they have seen one resource after another rendered extinct or close to extinction. Seals were exploited until their populations plummeted; then whales were exploited until their population plummeted; fish of this kind, then fish of that kind, were exploited until their populations plummeted; forests and tropical rainforests have been exploited; fossil fuels have been exploited; exploitation has fuelled economic growth, but there are also costs. To state that there is a "tendency of the market to undervalue the virtues of preserving limited resources", (Ibid., p.169) is to understate the problem. Some of the effects of climate change due to greenhouse gases, ozone depletion, deforestation and so on can be modelled, but the outcomes in the long term remain unknown. The only valid goal is to start now to undo what can be undone of the effects produced by industrialisation during the last two centuries or so.

Mobiot discusses the call for increased efficiency as a means of reducing greenhouse gas emissions (GHGEs).

> In his book The Coal Question, published in 1865, Stanley Jevons showed that cutting the amount of coal used to produce a ton of iron by two-thirds 'was followed, in Scotland, by a tenfold increase in total consumption, between the years 1830 and 1863'. Since Jevons's book was published, the world's energy efficiency has improved by around 1 per cent a year. (Mobiot, 2006, p.61)

Thomas Newcomen's steam engine constructed "in 1712 had an energy efficiency of 0.5 per cent; a good diesel engine today turns

about 45 per cent of its fuel into useful work". (Ibid.) In 1712, there was a single steam engine; by 1928, more than 5M cars were produced annually. Output continues to increase exponentially.

"Car engines are far more efficient than they used to be, but over the past twenty years their fuel consumption has scarcely declined." (Ibid., p.62) The effect, made clear by Jevons, that increased efficiency leads to greater production or use - that energy use increases when efficiency increases - was later formulated as the Khazzoon-Brookes postulate.

In January 2006, the Asia-Pacific Partnership on Clean Development and Climate was launched.

> ... it sets no binding targets for reducing carbon dioxide emissions. Instead it relies entirely on developing and sharing new technologies designed to save energy and carbon. What the Khazzoon-Brookes Postulate suggests is that it cannot possibly work. (Ibid., p.63)

The Draft & Climate Change Strategy for Tasmania takes a similar line to the Asia-Pacific Partnership. They propose "to encourage the efficient use of energy by government, industry and the community" and assert that "energy efficiency is a low cost and effective means of significantly reducing demand". (Draft, 2006, p.27)

If increasing efficiency is not likely to lead to the results sought, then history has shown that cost increases do. Following the oil crisis in 1973:

> In the USA, the consumption of energy declined in relation to economic activity (as measured by Gross National Product) by 3.6 per cent each year from 1973 to 1984, and in OECD countries by 2.5 per cent each year over the same period. By 1987, energy use per capita in Western Europe, the USA and Japan declined to about 88 per cent, 77 per cent and 62 per cent respectively of the level at which energy had been consumed in 1972. (Falk & Brownlow, 1989, p.135)

Price increases led to a reduction in wastage and to increases in efficiency without any major increase in energy consumption. Of the solutions proposed to curb energy use or carbon use, it therefore seems that carbon or greenhouse gas emissions taxes imposed by government would be a more effective solution to the problem than attempts to increase efficiency as an end in itself, though they might

achieve that result as well. Caps and rations also have problems as outlined above.

The end to which energy efficiency has been directed for most of the industrial period had been economic in the sense that profits have been the focus of attention rather than the amelioration of the effects produced by energy use.

BUILDINGS

The Stern Review states that 8% of UK emissions arise from buildings. Monbiot tells us about the Passivhaus, which has "no active heating or cooling systems", but is totally insulated "even where the walls meet the ground or the roof - contact with outside temperatures must be interrupted by insulating materials". (Monbiot, 2006, p.69) He continues: "For the house is not a sealed box but the heat exchange systems are the only passes." (Ibid.) The house should be made of materials with a high 'thermal mass'. (Ibid.) Germany spends as much as 39% of its energy use on space heating. (Falk & Brownlow 1989, p.136) Super-insulation can, however, produce other problems.

> Acute episodes of asthma can be fatal; about 4,600 Americans died of attacks in 1990, double the number ten years earlier. But for most of the more than ten million Americans who suffer, the disease is a chronic one. (Tenner, 1996, p.104)

Tenner attributes the rise in asthma rates, at least in part, to better insulation and dust mites. Allergies from dust mites and cockroaches are more prevalent in tightly built housing where those species thrive. Carpets, drapes and vacuum cleaners add to the problem because "[v]acuuming can triple the density of suspended droppings". (Ibid.)

Monbiot's solution is not one I could endorse, despite the fact that it would cut energy use. He wants strong building regulations to move people in directions such as this, but there are much healthier ways to keep warm without either sealed houses or space heating. There is also the question of the extent to which concrete is used in the construction of these insulated dwellings.

CEMENT

Falk and Brownlow estimate that the use of 5855 kt of cement gave rise to 802 kt CO_2e in Australia in 1986-87. (Falk & Brownlow, 1989, p.205) Cement is produced from limestone and clay heated to 1450°C.

delete

Table 4.1: Total Carbon Dioxide Emissions in 2007
(in gigatons and percent of total)

	GT	%
Total	36	100
Fossil fuels	29	81
of which: electrictiy	11.5	32
industry	8	22
transportation	6.5	18
residential	2	6
commercial	1	3
Deforestation	7	19

Source: Author's estimates based on fossil fuel emission estimates for 2005 from International Energy Agency (2007), extrapolated to 2007 assuming that all categories increase by 2.3 percent per annum during 2005–7. Deforestation is estimated to be 7 GT per year, based on World Resouces Institute (2007) for the year 2000. Note that industry includes emissions from cement due to direct materials transformation as well as fossil fuel use.

(Sachs, 2008, p. 96)

Monbiot estimates that and average brick home with a concrete floor would use about 5 tonnes of cement which costs about 5 tonnes of CO_2e to produce. Cement, he thinks, "produces between 5 and 10 per cent of the world's man-made carbon dioxide". (Monbiot, 2006, p.199) Monbiot thinks that geopolymers could replace Portland cement, but what are they made from and what are their energy cost? Their safety?

Wood used in houses stores carbon and its use as a replacement for concrete in floors and walls would have merit in this regard and on safety grounds, but timber supplies are being depleted too fast.

Mobiot wants to pull house down and reconstruct them. I think we should take care of the houses we already have and cut reconstruction to a minimum.

Monbiot draws attention to the fact that carbon rations could disadvantage those who rent their homes since it is the tenant who pays the energy bills, but the landlord who determines the forms of energy that are supplied to the dwelling.

REGULATION

Sixty-eight per cent of carbon dioxide emissions from fossil fuels are produced in North America, Western Europe and the Russian region, while "95 per cent of the world's climate-related deaths are estimated to occur in the poorer countries". (Ibid., p.173) There are problems due to the difference in the economic and social conditions of the different nation states.

The Montreal Protocol (1987) has been lauded as a model for action on climate change. It led to the reduction in production of five CFCs and two halons but it does not restrict production of methyl chloroform or carbon tetrachloride and their production continues to increase. Writing in 1989 Falk and Brownlow record that:

> Third World countries are exempt from the conditions of the protocol for a period of ten years or until such time as per capita consumption of CFCs reaches a limit of 0.3 kgs per annum. (Ibid., p.190)

Producers such as DuPont and ICI were permitted to continue to export CFCs. China and India did not sign. China planned "to increase its production of CFCs to ten times its 1989 level by the year 2000". (Ibid.)

> Even if CFCs are banned totally by the year 2000, the concentration of stratospheric chlorine is likely to treble from its present

level, rising from 2.7 parts per billion in 1989 to 8.9 parts per billion by the year 2010. (Ibid.)

As I understand it, CFCs are still being made in China and India. Ozone levels had been depleted to 95 Dobson units by 1995. The Protocol was a plus, but not a big enough plus. The ordinary consumer knows very little about the products that they use or buy. Moreover, "[a]s the Ozone Trends Panel, a panel of over one hundred international scientists, has argued, the protocol ignores the spectacular 'greenhouse gas' properties of CFCs". (Ibid., p.192) CFCs have, at least in some cases, been replaced by HFCs (hydro-fluorocarbons) which contain carbon, fluorine, and hydrogen, The chlorine has been replaced by hydrogen, but the fluorine is still there and how it interacts with the components of the atmospheric system is almost certainly inadequately known and understood. One fact that may or may not be of significance is the fact that chlorine trifluoride changes its molecular shape or form at -60°C, the temperature to which the stratopause has now fallen - probably due to ozone depletion. Chemical reactions depend generally on the electrical properties of the atoms or molecules, but they can also depend on molecular form.

Falk and Brownlow list CO_2 equivalent outputs for Australia in the year 1989-7 at 729,314 kt. In 2006, the Draft Climate Change Strategy for Tasmania, released by the Tasmanian government states that Tasmania's emissions in 2004 totalled 10.7 Mt. "On a per capita basis, Tasmania's greenhouse gas emissions of 22 tonnes of carbon dioxide equivalent were well below the national per capita average of 28 tonnes." (Draft, 2006, p.12) Monbiot gives figures for per capita carbon dioxide emissions as China - 2.7 tonnes, UK - 9.5, US - 20. (Monbiot, 2006, p.xiii) The Tasmanian government figures for Australia were 564 Mt. This reads as if emissions were lower now than in 1986-87, but we are left wondering what gases in addition to CO_2 were counted and whether these figures give a complete picture. Were aircraft emissions included?

The figures given concerning carbon and climate change tend to be confusing for several reasons. There is a difference between carbon content and carbon dioxide content in the ratio of 3:11; i.e. carbon dioxide is three-elevenths carbon and eight-elevenths oxygen by weight. In addition, as we have seen, since there are other greenhouse gases, there is a heat holding measure, designated the carbon dioxide equivalent or CO_2e.

Stern, Falk and Brownlow and the Draft provide measures in terms of CO_2e, but the figures given above by Monbiot are it seems, in terms of just CO_2.

Monbiot considers what the world situation might be in 2030, but when he refers to a carbon sink, he is referring to carbon (C) content not CO_2 or CO_2e content.

> In 2030, the world's people are likely to number around 8.2 billion. By dividing the total carbon sink (2.7 billion tonnes) by the number of people, we find that to achieve stabilization the weight of carbon emissions per person should be no greater than 0.33 tonnes. If this problem is to be handled fairly, everyone should have the same entitlement to release carbon, at a rate no greater than 0.33 tonnes per year. (Ibid., p.16)

Monbiot, 2006)

The capacity of the biosphere to absorb carbon depends on the uptake of carbon dioxide by photosynthetic organisms or phytivores. Properly functioning ecosystems absorb and release carbon at the same rate, but when fossil fuels are burnt there is an overload of carbon dioxide. The earth's atmosphere was at one time mainly carbon dioxide, but when living organisms evolved the capacity to use that carbon dioxide in order to build sugars or plant foods, with the help of certain wavelengths of solar energy, most of the carbon dioxide was removed and replaced with oxygen, which is a waste product of photosynthesis - and nitrogen. Nitrogen levels depend in part on two broad categories of bacteria - those that are nitrogen fixing and those that dinitrify - those that release it. In a properly functioning ecosystem, the wastes of every species within the ecosystem become the food, or the products from which food is made, for other organisms within that system. Wastes within an ecosystem include products excreted, secreted or eliminated from the bodies of the species within the ecosystem. They also include organisms eaten due to an excess of fecundity, and those that die.

Fossil fuels or carbonized life forms date mainly from the Carboniferous geological period 360-285 mya. Vast forests of ferns and other plants and animals lived in swamps or warm seas and have been changed over time into coal, oil and gas. Quantities of carbon that nature put out of circulation has now been added to the biosphere millions of years after it was stored. During those millennia, life has adapted and ecosystems have adapted to an atmosphere where the level of carbon dioxide was only 0.03-0.04% by volume. Humans have increased its level from a healthy 280 ppm to an unhealthy 380 ppm.

Many of the swamp ecosystems that once existed have been destroyed by humans so that certain areas where fossilisation might still continue have been reduced or eliminated.

Monbiot's suggestion that we cut our emissions to 0.33 tonnes of carbon or 1.2 tonnes of carbon dioxide would be a move in the right direction, and might lead to stabilisation. Whether the target could be met is more than doubtful. Global media would have to be totally on side.

In order to meet this target, the US, Canada and Australia, the highest emitting countries, would have to cut emissions by 94%. Signatories to the Kyoto Protocol are supposed to cut emissions by 5.2% by 2012. (Ibid.) We are living way, way beyond the planet's means. Are you prepared to cut your emissions from 22 tonnes pa to 1.2 tonnes pa? Should you? We all should.

The Tasmanian Draft lists the contributions from different sectors: Land Use Change & Forestry - 3.2 Mt CO_2e; Agriculture - 2.4; Stationary energy - 2.1; Transport - 1.4; Industrial Processes - 1.1; Waste - 0.5. Given that Tasmania generates 90% of its power from renewables - wind and water - and provides 68% of Australia's renewable energy, its per capita production of greenhouse gases, when compared with that of Australia as a whole, seems high. The explanation seems to be in the emissions from Land Use Change & Forestry and from Agriculture. The table below compares Tasmanian outputs with those listed in the Stern Review.

	Tasmania	Stern
Power	20	24
Transport	13	14
Industry	10	14
Waste	5	3
Agriculture	22	14
Land Use	30	18

Emissions expressed as a percentage of the total.

The Draft draws attention to the fact that the Bell Bay Power Station has been converted from oil to gas and that the "roll out of natural gas will also help reduce greenhouse gas emissions". (Ibid., p.13) It also tells us that electricity consumption is growing by almost 3% pa. The focus of the Draft is much more on mitigation of possible impacts

than on any strong call for a reduction in emissions. In fact, although it proposes "to maintain and further reduce our low greenhouse gas emissions," emphasises renewable energy, expresses an interest in hydrogen powered vehicles, and carbon trading, no real targets are set and the primary need for the stabilisation of greenhouse gases in the oceans and atmosphere is not even mentioned. Neither are the ozone hole or the contributors to it mentioned. Moreover, the rhetoric that our emissions are already 'low' would almost certainly be disputed by most of the nations on the planet.

On the other hand, they do recognise the importance of quarantine for protection of our crops and plan to increase vigilance. Councils are also being encouraged to participate in the cities for Climate Protection Program. Many municipalities became nuclear free zones in the 1970s and 1980s, and many adopted Agenda 21 after the Rio Environmental Summit in 1992. Should they work to protect their municipalities in all three of these areas?

Although the Draft mentions health issues and possible increases in diseases such as Ross River Fever, it doesn't tackle the problems of cancer or multiple sclerosis or ask whether their causal agents might be related to the same causal agents that are leading to climate change. Asthma and a possible increase in lung problems are mentioned.

In their 1989 book, The Greenhouse Challenge, Falk & Brownlow discuss the calls made at the Toronto and Hamburg Conferences in 1988. The latter later conference called for a "30 per cent reduction [in greenhouse gases] by the year 2000 and a 60 per cent reduction by the year 2015 for the major emitting countries". (Ibid., pp.206-7)

> Both conferences also called for complete elimination of all fully-halogenated CFCs by the year 2000 (as opposed to the 50 per cent reduction set in the Montreal Protocol.) The Hamburg Conference broadened this to elimination of the significant CFCs and halons by the year 1995 (a phase-out of CFCs by 1995 has already been agreed to by the government of Sweden). (Falk & Brownlow, 1989, pp.206-7)

Australia was "using 0.96 kilograms per capita [of CFCs] in 1986, more than the USA, the EEC, or Japan". (Ibid., p.209) The Montreal Protocol does not cover F22 which holds (per molecule) 1259 times the heat of a molecule of carbon dioxide. What has happened to CFC and ~~from~~ eon production in Australia? Has it followed Sweden? Freon 12 has the same structure as methane except that 2 atoms of hydrogen

are replaced by chlorine and 2 by fluorine. Halons are similar compounds. Halon 1211 has the same structure as methane except that one hydrogen atom is replaced by bromine and one by chlorine; as with freon 12, 2 hydrogen atoms are replaced by fluorine. Halons are between three and ten times more destructive of ozone than CFCs. "They were used in fire extinguishers. Preventing fires and explosions on earth thus produces an increase of ultraviolet radiation that in turn raises the risk of skin cancer." (Tenner, 1996, p.23)

Does the government monitor what is produced in this country? While there was a Wholesale Sales Tax, it was a tax paid on particular commodities which were monitored by the government and the government could raise or lower it, in order to have some control over demand, but when it was replaced by the GST, this form of control and possibly some of the records of what was made were lost. The GST is a tax on money, not a tax on commodities except insofar as the commodities are sold for a particular sum of money.

In 1989 in Australia coal represented 55% of emissions and contributed 1.65% to GDP. Falk and Brownlow investigated the effects of a 20% reduction in a given year finding that it

> ... would diminish total Australian output by $6299 million. Government revenues would decline by 0.29 per cent. Imports would decline by approximately 0.93 per cent and exports would decline by 2.77 per cent. As a consequence the Australian trade deficit would increase by $739 million (about 4 per cent of its deficit of $17.7 billion in the 1988-89 financial year). Overall GDP would be reduced by 1.05 per cent ($2764 million). (~~Ibid.~~, p.217)

Falk & Brownlow, 1989?

Coal producing companies that cut their production would probably want compensation. Even so this reduction could be achieved at a cost less than the proposed increases in defence spending or at a cost to tax payers of $6 per week.

Australian government budgets are no longer in deficit, but in surplus, and these have been quite large since the GST was introduced, so the government could choose to follow the path explored by Falk and Brownlow. These authors warn, that some could lose their jobs and that not all income groups are paid sufficient "to provide themselves and their dependents with the bare essentials for living". (Ibid., p.218) Those with high incomes are generally high consumers and high greenhouse gas emissions producers indirectly if not directly. "Clearly the burden for paying for the reduction of these emissions

should not fall disproportionately on those who can least afford to pay." (Ibid.)

> Only 12 per cent of energy is used directly in the home. Most energy flows first to the commercial, manufacturing and agricultural industries before it is consumed eventually in the form of commodities by purchasers either in Australia or overseas. (Ibid., p.219)

Some appliances such as refrigerators already have a grade or energy rating. This needs to be made universal.

Cutbacks in coal outputs would affect the companies that run them, but

> ...whilst it is true that BHP could afford the cost of cutbacks in coal, it is not true that the local miners or many others in the local community could. Many of the miners would be too old and would lack skills to find employment in other regions, and they would lack the capital to relocate. (Falk & Brownlow, 1989, p.224)

Those who can least afford it should not be expected to bear the costs.

> Like so much else about the greenhouse threat, the challenge that it poses ranges from a global threat to the lives of ordinary human beings. Any attempt to meet the challenge must account for the entire spread of issues that this raises. (Ibid., p.225)

Cutbacks would create unemployment; those that suffered could retrain, find new jobs or retire, but all those who have gained from their work over the years surely have a responsibility to see that none suffer any real physical or mental hardship due to the changes.

On the global front, export cuts would provide an unambiguous international signal of the seriousness with which Australia takes the greenhouse challenge". (Ibid.) Australia could cut exports most to those countries such as the USA, Russia, Japan and Germany that use the most coal per capita. Future exports might be threatened if importing countries did not reduce their own emissions by an agreed amount.

Royalties can be viewed as a form of carbon tax but if governments become dependent for income on these royalties, then they may encourage rather than discourage further mining of coal. The same problem could arise from carbon taxes.

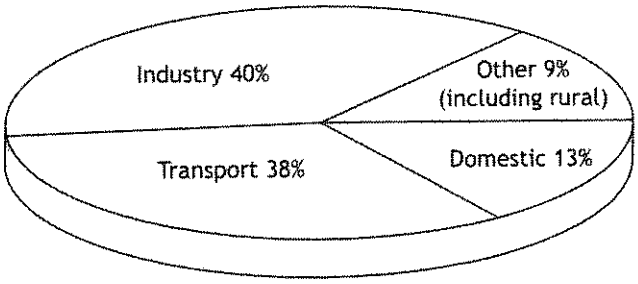
Most writers on climate change concentrate on fossil fuels as the agents of climate change. They call for more efficient use of energy,

for carbon taxes, carbon trading, and better city planning to reduce the use of the motor vehicle.

Ivan Toffler and many others have promoted the idea that more should work from home.

> Without doubt, the single most anti-productive thing we do is to shift millions of people back and forth across the landscape every morning and night. A waste of time, of human creativity, of millions of barrels of non-renewable fuel, a cause of pollution, crowding, and God-knows how many other problems! And the cost to the workers is even greater. (Toffler, 1985, p.26)

Cars are said to produce about 25 per cent of greenhouse gases. Electricity production is also a major producer.



Energy use in Australia (Bennett, 2005, p.5)

EXTERNALITIES

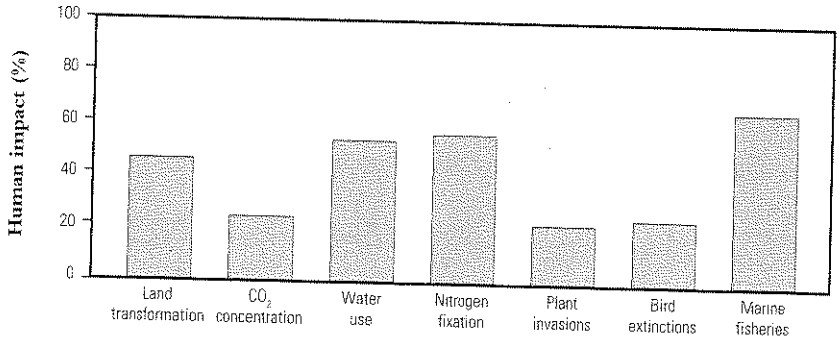
If we are going to reduce the impact of the effects of global warming by stabilising greenhouse gas levels as soon as possible, then the problem of externalities must be seriously addressed.

Government, industry, and environmental groups must combine to work out proper mechanisms to incorporate external costs into the market system. Hawken refers to the proposals put forward by the British economist, Nicolas Pigou in 1920.

> Pigou argued that competitive market places would not work if produces did not bear the full costs of production including whatever pollution, sickness, or environmental damage they caused. Pigou's solution was to impose a 'tax to correct maladjustments' on producers, a tax that would be comparable to the avoided cost of unborne expense. Pigou cited prematurely peeling paint on a house near a coal-fired mill as an example of an

delete →

Figure 3.3: Human Dominance or Alteration of Several Major Components of the Earth System



Source: Vitousek et al (1997)

(Sachs, (2008), p. 68)

> external cost that should be paid by the produces. He theorised that when the producer was forced to bear full costs, it would have incentives to reduce its negative effects, thus lowering those costs. (Hawken, 1993, p.82)

Rousseau made a similar proposal in the eighteenth century, suggesting that the use of carriages should be taxed out of existence.

Getting recognition of costs from both companies and governments can be difficult.

There are external diseconomies "of production ... when a productive action taken by a firm results in uncompensated damages to others," (Economic Principles, 2001, Topic 6, p.9) or external diseconomies of "consumption ... when a consumption action by a consumer generates uncompensated damages to others". (Ibid., p.10) Expressing these in economic terms means putting a dollar value on the costs, but how do you put dollar values on ozone destruction, cancer rates, and climate change? "The simplest way to deal with external costs is to pass laws that make them illegal." (Ibid., p.12) In order to make external costs illegal, the production of commodities that give rise to them would have to be made illegal. This source also notes that: "A tax on the metered discharge of the pollutant is likely to be better than taxing the industry product, because the incidence of the tax falls directly on the polluter". (Ibid.)

Coal is Australia's biggest export earner, but those who earn their living from coal or make a profit from its sale are not held responsible for the effect that the use of coal is having on the atmosphere. Consumers do not pay for the real costs of coal use. "The main function of green taxes is not to raise revenue for the government but to provide participants in the market place with accurate information about cost." (Hawken, 1993, p.167)

> Gasoline prices in the Unites States do not reflect the full costs of protecting oil supplies, maintaining a highway system, and cleaning the environment. Other nations, by imposing heavy gasoline taxes, force consumers to pay more of these costs. (Stock, 1993, p.140)

Coal and other organic sources are also used in other industries such as clothing, photography and plastics, and all use energy in their manufacture.

Taxes should reflect environmental costs so that the tax on coal, diesel and petrol would be greater than the tax on gas. A carbon tax

may not clean up the environment, but it could place restraints on the use of fossil fuels.

> There are two types of costs that need to be internalised. The first is the actual damage caused by one production system on another system, person or place ... . The second type of cost, harder to measure but equally important, is the cost to future generations, as in the case of global warming, deforestation, erosion, and depletion of ground water. Not surprisingly, most environmental harm – such as the harm caused by radiation, persistent pesticides, and clear-felling – cuts across the two categories. (Hawken, 1993, pp.82-83)

Resource depletion affects access by future generations. Each generation should only use what can be replenished. "Oil is a finite resource formed in the special conditions that obtained in the Mesozoic Era some 65 to 230 million years ago." (Cawthorne, 2004, p.165) Ideally, we should do all we can to keep as much coal, oil and gas as possible unmined. Exploitation now deprives future generations of the resource and threatens their livelihood with all the effects of global warming. As Lovelock says:

> Both fossil and bio fuels are quantitatively non-renewable when burned at the excessive rate we require for our bloated, energy intensive civilisation. As always, we come back to the unavoidable fact that there are far too many of us living as we do now. (Lovelock, 2002, p.72)

If health, storage and other environmental costs were factored in, nuclear power costs would be many times higher than their already high costs. Instead of subsidising the industry to the tune of billions, governments should be taxing it to the same tune. Only then would the industry the paying for some of the external costs.

N.B. Falk and Brownlow put forward the same view.

> The economics of energy are also dramatically distorted by the failure of pricing to take account of the external impacts of the activity. Whether it be the release of carbon dioxide to the atmosphere, or the problem of nuclear weapons proliferation or reactor accidents, these costs are largely hidden from producer and consumer, only to reappear in the future when climate is disturbed or nuclear war begins. (Falk & Brownlow, 1989, p.145)

Without proper payment for damage inflicted, environmental damage will continue.

Under present systems of pricing, the "market cannot distinguish between a piece of wood harvested sustainably from a forest and one harvested from a clear-cut that has destroyed habitat and future productivity." (Hawken, 1993, p.79) Unfortunately, the way we are behaving is very King Midas-like. We cut down our forests; we deplete our resources and exchange them for money - for Midas-gold. Once the forests are gone, they take centuries to restore and may never by fully restored if species are lost or added in the process. We are left with our 'gold', but we have lost our true wealth. We dam our rivers, irrigate and salinate our land, deplete the fertility of the soil - all for the sake of temporary currency. The need for restoration was noted by Hobson: "Where anything is taken out of the land in the way of fertility of soil or other natural powers, it must, where possible, be restored: the land must not be let down". (Hobson, 1934, p.155)

Falk and Brownlow also seek solutions to these problems in terms of restoration or restorative intervention.

> Here the aim is to reduce the stress on the natural environment which is destroying its capacity for self-regulation, and to restore the natural balances which will enable the biosphere to stabilise, and as a consequence, enable humanity to enjoy a more stable future. (Falk & Brownlow, 1989, p.140)

In order to do this, growth in energy demand will need to be kept in check.

If governments are the agents that must take responsibility for holding energy demand and greenhouse gas emissions in check, then they need to be "persuaded that this is the most politically viable path forward". (Ibid., p.161) National allegiance can distort the way in which global issues are dealt with. Global warming and ozone destruction are global problems with local causes. Their restoration requires action at all levels, the global, the national, and the local. A world-wide agreement between all nations to impose taxes on greenhouse gas emissions and ozone destroying agents is needed. If the tax were equal in all places, there would be nowhere for transnationals to move in order to avoid paying green taxes. World-wide international agreement would also overcome the problem concerning the power held by transnational corporations (TNCs). Already, by 1989, "of the 100 largest economic units in the world ..., half ... [were] nation states and the other half TNCs". (Ibid., p.166)

We tend to put our trust in governments rather than TNCs, but there are many who feel neither can be trusted. There are people who prefer to cast an informal vote than a formal one because they believe that no candidate can be ~~century and~~ trusted. The actions of governments ~~there is~~ often leave little to applaud. It was governments that supported the development of nuclear weapons, nerve gas and biological weapons. Governments funded nuclear tests and supported the nuclear industry. Governments permitted the emissions of pollutants into land, sea and air, time and time again. Governments have failed those whom they are supposed to represent. Part of the problem lies with the electors - they should not return candidates who fail them - but part lies with the system of voting which in most places is not democratic. All votes should be tallied as proposed by the designers of the Hare-Clark system or proportionally as in the Federal Upper House. Returning single candidates from each electorate could return a single party government if candidates in every electorate received 51% of the vote, and 49% would be unrepresented. Electorates should return at least 5 candidates per electorate so that the whole community is properly represented.

If governments are to collect carbon taxes in order to place a check on greenhouse gas emissions then their incomes will decline as emissions decline. The taxes act as a negative feed back on emissions but as positive feedback for governments and therein lies a problem. If the money collected were to be spent on restorative measures then a build up of money in government hands could be avoided. Reforestation and ecosystem restoration would be positive outcomes from such a policy.

Governments incomes will also increase when subsidies for companies that produce greenhouse gas or nuclear externalities are scrapped.

The atmosphere and waterways have been used as if they had an infinite capacity to absorb industrial wastes. Like the commons during pre-industrial times, a breakdown in responsible constraints on use, could lead to their destruction for use by any. Each greenhouse gas producer produces costs external to those paid for, and the costs are borne by all those who rely on the atmosphere for their protection.

... when acid rain is produced, when cancers increase from atmospheric carcinogens, or when the ozone is damaged, these costs are shared by all those who suffer them, not simply those who produce them. (Ibid., p.169)

We the people must make our governments cooperate to preserve our atmosphere, our waterways and our land - to preserve the bio-

sphere not just for humans, but for all living entities - not just for ourselves, but for our children's children and their children.

As Hobson makes clear, our real wealth depends on much more than national or private income.

> The scientific study of industry may show that certain acts of individual or national policy make for an increase of marketable wealth ... to urge this discovery as a sufficient ground for individual or national conduct, without taking into account other effects upon the public welfare which may or must arise from this commercially profitable policy, is evidently unjustifiable. For when a person or a nation is considering what line of conduct to pursue, he should take into account at one and the same time all the probable advantages and disadvantages. In a word, he should take for his criterion of conduct the wider standard of wealth which indentifies it with welfare. (Hobson, 1934, pp.16-17)

The use of fossil fuels and the population growth that has occurred since the beginning of the industrial revolution has destroyed much of the real wealth of the planet.

In his book The Acquisitive Society, R.H. Tawney tells us that:

> ... the 'industrial revolution', though catastrophic in its effects, was only the visible climax of generations of subtle moral change. The rise of modern economic relations, which may be dated in England from the latter half of the seventeenth century, was coincident with the growth of a political theory which replaced the conception of purpose by that of mechanism. (Tawny, 2004, p.9)

Tawney

This change removed the idea of working for a common end which had held together the social fabric in earlier times. Private rights replaced natural rights.

Industry should perform a function for society, but its goals have been redirected.

> Men will always confuse means with ends if they are without any clear conception that it is ends, not the means, which matter - if they allow their minds to slip from the fact that it is the social purpose of industry which gives it meaning and makes it worth while to carry it on at all. (Ibid., p.46)

Means and ends both matter, but if ends are properly determined, then the means by which those ends can be achieved can be better evaluated.

Industry exists for humans, not humans for industry. But industry has been "elevated from the subordinate place which it should occupy among human interests and activities into being a standard by which all other interests and activities are judged". (Ibid., p.45)

Tawny defines a Profession as "a trade which is organized, incompletely, no doubt, but genuinely, for the performance of a function". (Ibid., p.92) He believes that industry should be organised, like a profession, for the performance of a social function.

> The difference between industry as it exists today [1920] and a profession is, then, simple and unmistakable. The essence of the former is that its own criterion is the financial return which it offers to its shareholders. The essence of the latter, is that, though men enter it for the sake of livelihood, the measure of their success is the service which they perform, not the gains which they amass. (Ibid., p.93)

Working for ends determined by shareholders is not the same as working for ends shared with other workers and the consumers or customers for whom the service or product is provided. Organisations with such ends force workers to work for ends contrary to their own natural ends. They are flawed. All workers should share responsibility for the products of their labour and the uses to which they are put. Cutting processes up into bits does not cut responsibility also up into bits. The maker or doer of part of a thing or process is also one of those who shares responsibility for the whole. These days, group after group deny the responsibility is theirs and attempt to pass it to other groups who are equally unwilling to accept it.

Workers are, in part, responsible for the products of their work and therefore, are also, in part, responsible for the externalities produced due to the production process, but, at the same time, under today's arrangements, the design, quality and prices of the goods produced are determined by boards or management. Workers need to be more than "merely servants executing orders;" they need to be organised so that they "have a collective responsibility for the character of the service, ... their industry". (Ibid., p.138) Do workmen still regard "the claim of the capitalist to be the self-appointed guardian of public interests as a piece of sanctimonious hypocrisy?" (Ibid.,) If corporations served public interests they would be leaders in cutting greenhouse

gas emissions and in calling for a halt to the use of nuclear technology. Workers need to define the common ends towards which they work and seek to establish means by which industry can be made to see the value of those common ends. Included in those ends must be a concern for the environment - for reducing externalities.

After the Act establishing joint-stock companies was passed in the US in 1862, globalisation was given greater impetus, the land lost its workers to the city, and labor unions gave support to the Democrat political party. President Rutherford B Hayes warned: "This is government of the people, by the people and for the people no longer. It is a government of corporations, by corporations and for corporations." (Micklethwait & Wooldridge, 2003, p.2) And that is what we have become under governments in Australia.

So long as "the basic questions being asked by modern investors, managers and workers" are restricted to "What does this company do? Why do I work here? Will it make money?" (Ibid., p.11) there is little hope for the restoration of the biosphere - little hope for Gaia.

Externalities are discussed in economics text books but what some teach is questionable. Claims that there is an "optimal level of pollution" and that "an optimal solution does not exist with zero pollution," (Economic Principles, 2001, Topic 6, p.15) are hardly encouraging. The problems arise partly from attempting to put monetary values on pollutants, amenities and products with negative social outcomes.

WASTES AND RECYCLING

There are now new kinds of waste that did not exist until they were made by human technology. The nuclear industry produces wastes that cannot be recycled.

We evolved with natural radiation; about 50 radionuclides occur naturally. We did not evolve with the hundreds or thousands that have been made by human technology; we did not evolve with and are not adapted to these. We have no sensory apparatus with which to detect their presence. Once they are made, they cannot be destroyed. We can't undo what has been done. Plutonium-239 will take more than 200,000 years to decay to a level that is a thousand times less radioactive than now. All we can do is store them or leave them alone, and mark the area as unsafe - as taboo. Radioactive materials only decay at a set rate innate to each isotope, so that all we can do is let nature take its course. If they are left undisturbed, an equilibrium state will

eventually be reached where decay at the original radioactive level matches the production of the stable end product, atom by atom, at the other end of the decay sequence. Minimum interference minimises radioactive output and pollution.

Technological radioisotopes are products with an enormous inestimable external cost. Every atom that decays produces a chain of ionisations which do damage to organic molecules and threaten the lives of many individuals of our own and other species. Radioisotopes from the bomb tests of the fifties and sixties still come down with the rain that we welcome in most other respects.

If costs included externalities, all nuclear technology would be rendered economically unviable and would be abandoned. We can't fix or undo what the nuclear industry has already done and actions that result in negative outcomes that can't be undone should be stopped.

Power, currently generated from nuclear sources, must be replaced by solar or wind. All countries should put taxes on the use of radionuclides that are so high that no company would in future attempt to mine, transport or use radionuclides. They would then be acting in the best interests of themselves, their countries, and the world.

When nature was in ecological balance, every element was recycled and held at its appropriate level due to the complementary roles played by the different organisms comprising the system. As John Postgate wrote in 1954:

> ... atoms of carbon, hydrogen, oxygen, sulphur, phosphorus, calcium, iron, magnesium, cobalt, and so on would be undergoing cyclical transformations, none of which would occur in a world without living things. It is on these cycles of chemical transformation that the economy of life depends: if a step in the nitrogen, sulphur or carbon cycle ceases to occur, as may sometimes happen in certain limited environments, the element concerned rapidly accumulates in a biologically useless form, and creatures living in such an environment either die or become dormant until conditions change. Conversely, where these cycles take place readily and continuously, living things flourish, indeed the speed at which these cycles occur is a measure of the vital activity going on in an environment. (Postgate, 1954, p.58)

Human technological products are agents that disrupt these cyclic transformations.

> Experts estimate that if the developing world could halt population growth and apply the most energy-efficient technologies currently available, it could achieve a standard of living enjoyed by Europe in the 1970s using only 10 per cent more energy than at present. (Stock, 1993, p.125)

Population growth has not been halted and fossil fuel use has not abated, but all countries need to look at the problems they face due to population growth.

Replacing fossil fuels by nuclear power is no solution.

> ... the nuclear power industry for many years argued that it could provide a clean, safe, and inexpensive form of energy. Critics of their claims asserted that the industry did not include in its cost estimates of the expense of decommissioning those plants or the thorny, expensive problem of how to store, guard, and protect nuclear waste for a period longer into the future – in the case of plutonium, over 200,000 years – than that encompassing the whole past history of civilization. Who has been proven correct in their predictions? (Hawken, 1993, pp.83-84)

US Senator Mike Gravel writes in the forward of Berger's book Nuclear Power, the Unviable Option:

> This book lays out the possibility of irreversible radioactive contamination, and it explains how nuclear pollution could threaten the genetic integrity of life on earth. It shows why our civil liberties would probably be curtailed to keep plutonium out of the hands of terrorists. And it tells why the proliferation of peaceful nuclear reactors will lead to the proliferation of nuclear weapons. (Berger, 1976, p.157)

As we have seen, nuclear weapons continue to be designed, manufactured and used, leaving areas of the earth contaminated for millenia.

> To see how much nuclear power really costs, it is necessary to total the costs of all its 'routine' health effects now and in the future, its risks of catastrophic accidents and nuclear bomb liberation, and its subsidies, including safety ... research, fuel enrichment, waste management, and nuclear insurance. (Berger, 1976, p.157)

The US government has subsidised the nuclear industry to the tune of billions (Hawken, 1993, p.89; Null, 1982, Ch.9) – at taxpayers' expense – and the taxpayer is left with the health costs as well. Lovelock tells us that

the UK government is "prepared to pay over 60 billion" to decommission the UK's stocks of plutonium and nuclear power installations. (Lovelock, p.103)

Presently existing life on earth is not adapted to the kinds and levels of radiation experienced since 1945; the costs are incalculable and long term. Nuclear in not an option. Australia must cease mining uranium and leave all radionuclides in the earth. Income derived from its sale could all too easily backfire. Radioactive decay is minimised when left unprocessed.

It is difficult to be certain which of the problems discussed poses the greater threat to life on earth, but the dangers from the use of nuclear power and from the destruction of the ozone layer need better recognition, and both are associated with global warming and climate change.

Dangers from uranium use pose an enormous threat, largely because they continue to accumulate. The rate of decay of plutonium is very small, so that as more continues to be produced, it simply adds to that which already exists. The stockpile grows and grows and the danger does the same. This must be stopped. The only way it can be stopped is if all nations leave all remaining uranium and thorium in the ground; if radioisotope mining ceases.

Radioactive substances, weapons and processes, pesticides, coal tar additives and many other products of human technology continue to be produced. Their harmful effects are all too often dismissed. The causes of the increased rates of cancer are not the focus of attention. Often knowledge is incomplete. Money is valued above safety. Should all weapons be taxed? Should all pollution left by weapons and all medical expenses of civilians injured be the responsibility of the weapon makers? Weapons users?

Use of radionuclides as power sources for space vehicles - rockets and satellites - poses an additional double threat due to both radioactivity and ozone destruction. Air borne nuclear missiles constitute a similar danger.

There are scientists who want to solve global warming by making bacteria to destroy carbon dioxide and/or water.

> The problem would be controlling them once they got outside the lab. They might eat all the carbon dioxide in the atmosphere, preventing photosynthesis, causing mass famine and switching off the greenhouse effect. Or they might dissociate all the water, leaving the planet parched, and filling the atmo-

> sphere with an explosive mixture of hydrogen and oxygen that would go up at the slightest spark. (Cambourne, 2004, p.139)

The precautionary principle and the recognition, in general, of the disruptive effects of technological products with which neither we nor the rest of life evolved, should teach us that the general consequences arising from such use can only be negative. We need to protect our biosphere and save it from further despoilation.

Other nonrecyclable waste - all non-biodegradable technological products should be phased out. Some chemicals, pesticides and plastics do not biodegrade; some of these are toxic, some carcinogens. Those already existing should be stored as safely as possible. Hawken suggests that state owned 'parking lots' to be hired by the polluter, could be used for all toxic waste materials and waste products that nature can't decompose and recycle. This is a much safer solution to the problem than incineration, which does not destroy radioactivity, but spreads it in a form that can affect the respiratory or breathing system, and incineration can also produce worse toxins than those that were originally fed into it. Storage payment would be the responsibility of the producer of the non-recyclable material -in perpetuity.

No nation should permit the manufacture of products with which the system of nature cannot cope. The only permissible level of production of any item of commerce should be that at which all elements involved in the whole process are able to be ecologically recycled. We must learn to live with nature and not act against her. Paying for external costs would provide the right kinds of signal in order to achieve this end.

Reuse is possible for some non-toxic products whether recyclable or not. No new non-recyclable products should be made, but some already made could be re-used. Reuse requires standardisation; global standardisation of containers and their reuse would cut greenhouse gas emissions. There would need to be a container tariff sufficiently expensive to ensure return, and in the case of glass, to ensure proper care was exercised that no breakages occurred.

Cars or equipment could be designed so that components could be reused. Again, standardisation could facilitate greater reuse and energy savings. Hawken tells us that: "When you buy a television set today, you are purchasing 4,000 chemicals, 10 to 20 grams or mercury, and an explosive vacuum tube. There is no safe place to dispose of a television." (Hawken, 1993, p.68) He continues: "A television is not toxic waste , however, if you return it to Sony to be assembled into another television." (Ibid.) Monbiot tells us that "large plasma TVs

consume five times as much electricity" as these older models. (Monbiot, 2006, p.82) "Designers must factor in the future utility of a product, and the avoidance of waste from its inception." (Hawken, 1993, p.71) If manufacturers were forced to accept responsibility for the wastes they produce, then it would be in their interests to make an effort to reduce it - in fact, to eliminate it.

> By reformulating its products, changing processes, redesigning equipment, and recovering waste for reuse and recycling, 3M has been able to save $537 million. During the fifteen-year period, it reduced its air pollution by 120,000 tons, its wastewater by 1 billion gallons, its solid wastes by 410,000 tons. (Ibid., p.60)

Dematerialisation and nanotechnology - minimise the use of materials. Less goes further. This looks like a move in the right direction, but what about energy costs? These can be enormous and they must be factored into our system of accounting if it is to function properly. This is one of the areas in which new products with which we did not evolve are being produced. Their breakdown products and their interaction with the other components of the environment into which they are introduced can only be known after they are made. The circumstances under which each humanmade product is biodegradable can only be known after the product is made. Its impact on Gaia can only be produced after production. CFCs were not made for the purpose of destroying the ozone layer, CFCs had properties sought by their producers, but they also had properties unknown to their producers, and the same it true of every technological product. We act in ignorance. We know this, but we do not know that. There are those who believe it is better not to act at all if we act in ignorance of the full consequences of our actions. Hence the precautionary principle. If we can't undo the harm caused by a product, we should not make the product. If its possible harm is unknown then we also should not make the product.

> As Hextall-Smith explains:
>
> Formerly, when a quite new kind of action was proposed, we felt we must not let it go on till we were quite sure it was safe ...; now we feel we may let it go on until we are quite sure it is dangerous. This attitude increases in danger as the resources at our disposal increase in power. (Hextall-Smith, 1958, p.38)

Hextall-Smith was concerned about the use of nuclear materials and that concern has not lessoned, but others that arise from biotechnology and nanotechnology have been added to it.

School children are taught about the carbon cycle and the water cycle, but their understandings need to be extended to take into account the effects human technology has on these cycles of nature. Disease is minimised in systems in ecological balance and global warming will change disease patterns. They need to understand that real wealth has little to do with banks and the stock exchange. Prices do not reflect costs and we need government taxes and regulations to ensure that costs are high enough to pay for repairs to systems that have been harmed due to their production. Proper economic regulation requires the introduction of appropriate negative feedback systems which would act to minimise energy use and prevent waste by ensuring that all items produced were biodegradable.

If companies or manufacturers had to accept responsibility for the waste they produced, then it would be in their interests to make an effort to reduce it - in fact, to eliminate it. Some companies such as 3M are already making big changes in this direction. To restore balance, we need to measure costs or impact and devise an economic system where prices reflect true costs. Our ever increasing use of energy has allowed what we term 'economic growth', but the use of this energy has left a legacy of resource depletion and waste accumulation, upsetting ecological balance. Whether that balance can be restored is a moot question and as Severn Suzuki tells us "if you don't know how to fix it, please stop breaking it!" (Suzuki, 2006, p.283)

Reduced use of other forms of energy use, all of which have some deleterious effects, can only be assured if energy users are reduced – if population growth is halted as a first step. More people use more energy and all energy use for artificial purposes has negative consequences whether due to radioactivity, ozone destruction, greenhouse gases or extra heat production. The real and greatest problem humans face is population control.

When things were normal or natural, the frequencies allowed through the atmosphere and the amounts of greenhouse gases that were present were in balance so that the temperature of the earth was maintained within the limits facilitating life.

Humans have manufactured technological products, which now allow more radiation in and allow more degraded radiation to be absorbed. Although said to be small in comparison with the energy received from the sun, the heat generated by human energy systems is

also part of the equation. We therefore know that humans contribute to the problem in at least three realms viz. ozone destruction, greenhouse gas manufacture and energy manufacture.

All forms of energy manufacture contribute to global warming in both of the last two areas. Greenhouse gas emissions and energy use have been the main targets of those concerned with the climate change issue. We live in a consumer society and everything consumed is an energy user so the chief target has been the rate of consumption.

In order to cut energy use or the rate of consumption we can cut the use per person or the number of persons who are users – or preferably both. If we cut energy use by 50% as some advocate as a possible target, but increase population by 100% in the same period, we continue to add to the problem at the same rate as now, but the effects of these additions may not continue to be additive beyond a particular threshold. They may cause instability of a new kind.

Consumption, population and a greater focus on reducing the use of ozone destroyers are all components of any solution to the problem of climate change and among the ozone destroyers we need to question the continued use of any form of nuclear energy, of halogen elements or compounds and the effects of lasers.

The effects of climate change, of nuclear radiation and of ozone destruction are already being felt by life on earth. Ice is melting, ocean currents are changing, weather is changing, and with it habitats are changing. Health problems are a continual problem for governments with hospital waiting lists and health costs escalating. Nuclear radiation and UV radiation both ionise components of living cells and serve as carcinogens and mutagens. Health costs are a symptom; we need to look at causes and treat them.

Lovelock seeks to equate Gaia with natural selection, and rightly so, since both serve as a system of negative feedback controls or constraints. In fact, Lovelock uses the same metaphor, the governor of the steam engine, to describe Gaia as Alfred Russel Wallace used to describe natural selection. (Lovelock, 2006, p.36, Wallace, 1858) However, one of the major features of life, that evolutionary theory explains, is its adaptedness. We, and the rest of life were adapted to radioactivity at its 1890 level before humans knew of its existence; we are not adapted to its use as a technological product. The same applies to the use of pesticides, nitrates and a myriad of other technological products and devices. They act against Gaia, not with her.

Lovelock also mentions that there are naturally occurring carcinogens, emphasising in particular that there are plant carcinogens and that oxygen itself can serve as one. This is true; but life evolved with natural carcinogens and with oxygen. If kept in their right places and right proportions, as natural selection sought to do, their actions are in accord with Gaia, not against her. Both Lovelock and the Green movement seek to promote the natural rather than the technological, and rightly so. Moreover, there is strong evidence to show that before, industrialisation, cancer was a rare disease. (Goldsmith, 1998)

Lovelock's statement that Gaia should come first and humanity second – that we should act in accordance with its principles – must be applauded. (Lovelock, 2006, p.121) It is also the case that: "The humanist concept of sustainable development and the Christian concept of stewardship are flawed by unconscious hubris." (~~Lovelock~~, Ibid., p.137) He sees "the Earth's declining health as our most important concern". (~~Lovelock~~, Ibid. / ~~2006~~, p.1) Jarad Diamond also dismisses 'sustainable development' as an oxymoron.

delete 2006,

Caldicott advocates that energy efficiency should be increased; that consumption should be cut, that cogeneration, using industrial heat sources should be encouraged; and that existing nuclear energy resources should be replaced primarily by the use of solar and wind power.

> Presently there are 27 wind farms operating in Australia. In 2003 enough wind power was generated in Australia to supply electricity to the equivalent of every house in Canberra. It is predicted that by 2010 wind power will create 9300 jobs, introduce almost $10 billion into regional Australia, and create enough power to run 2.3 million households, cutting CO_2 emissions by 15 million tons. (Caldicott, 2006, p.184)

Hot water systems are a major energy cost. We could shower under unheated water in many places and boil a single quantity of water for washing up, and wash our clothes in cold water.

If we don't change the way in which we live and if carbon dioxide and other greenhouse gases continue to accumulate in the troposphere then a critical point leading to restructuring in some Gaian characteristic(s) is inevitable. As Teilhard states:

> ... no physical agent can grow indefinitely without reaching the phase of a change of state. For a more or less long period, things simply vary, without ceasing to remain recognizably themselves. And then at a given moment a complete recon-

> struction of the elements becomes necessary ... (Teilhard, 1969, p.87)

If energy continues to be fed into a system, ultimately a point of reorganization will be reached, possibly after a period of chaos, as the system moves from one equilibrium position to a new one.

But systems can also be destroyed by continued energy inputs. Many of us have heard the story of how a frog will jump out if placed in hot water, but will stay put if placed in cold water to which heat is added slowly. As Suzuki says: "The relevance of that frog as a metaphor to humans who cannot sense thinning ozone, rising atmospheric temperature, background radiation, or toxic chemicals, is obvious". (Suzuki, 2006, p.354)

As long ago as 1931 Teilhard writes:

> Too much iron, too much wheat, too many automobiles - but also too many books, too many observations; and also too many diplomas, technicians and workmen - and even too many children. The world cannot function without producing living beings, food, ideas. But its production is more and more patently exceeding its powers of absorption and assimilation. (Teilhard, 1969, p.37)

Already at that time, when the earth's population had not reached 2B, Teilhard considers that "the density of population on the earth is reaching saturation point". (Teilhard, 1969, pp.73-4) More energy, more people, more food, more cities and more industries have added to the problems inflicted on the earth. But nuclear technology, global warming and ozone destruction are additional factors that are threatening Teilhard's 'Spirit of the Earth'.

Those concerned that the earth system, Gaia, is being stressed must acknowledge the causes of that stress. Human use of energy and technology is upsetting the balance that once existed in the stratosphere where ozone destruction during the day equalled ozone construction every night; it is upsetting the level of radioactivity impinging on life within the biosphere, and it allows the continued growth of a single species population - the human - at the expense of others, and the ecosystems in which they live.

Governments that allow ozone destruction, radioisotope use, and encourage population growth, are not acting for the good of their nation. If democracy delivered proper government, those of every nation mining uranium, those of every nation using nuclear power,

those of every nation allowing the use of ozone destroyers and those of every nation not seeking to limit the growth of the human population, would be voted out. It is up to us.

There is also a problem with weaponry that needs to be understood. Humans and every other animal species need food and nature or Gaia bequeathed each species with the biological tools and the biological behaviour needed in order to supply their needs. When humans make artificial weapons, they don't develop with them any appropriate biological behavioural constraints. Evolution is a very slow process and neither humans, nor the rest of life, are adapted to the technological weaponry of humans.

When a human or other animal is shot by a gun or killed by human artificial weaponry, it also suffers in ways never experienced in a natural state. Evolved behaviour patterns minimise both trauma and injury. The natural kill is a work of art; the artificial kill is cruel and crude.

Human warfare is worse and gets worse still with each succeeding generation.

George Megalogenis' report 'Nation in Search of its Niche', The Weekend Australian, September 2-3, 2006 tells us that "The world has to find room, and food for another 2.5 billion people between now and 2050".(Inquirer, p.21) He quotes the US economist, David Bloom, who notes that disaster has not followed as predicted by Thomas Malthus at the end of the eighteenth century and again by others at the end of the 1960s.

As he says, the carrying capacity of the planet AS IT RELATES TO HUMANS has expanded. (**My emphasis.**) What is not mentioned is at what cost. Human population and human use of energy have both grown exponentially. It is our use of energy that has enabled more and more of the earth's surface to be turned into monocultures that will feed humans. "Without fertilisers derived from oil or natural gas, the agricultural output of the world, would halve." (Cawthorne, 2004, p.162) But even in countries such as the UK where the birth rate is 1.64 per female, 90% of its food is imported. (Cawthorne, 2004, p.162) If they had to feed themselves they could only support one tenth of their present population, and the food they do produce may use oil-based fertilisers. At the same time, ecosystem after ecosystem has been destroyed by agricultural developments and the abundance of many other life forms has been diminished.

The warnings of Malthus, Carson, Erhlich, Caldicott, and others need more than ever to be heeded now. A proper morality would teach that ecosystem destruction is morally wrong and that the preservation of ecosystems is morally right. In properly functioning ecosystems, species populations are held in dynamic balance. Energy input is from the sun and captured by phytivores, that are fed on by vivivores, who get their energy secondhand. Detritivores also get their energy second or thirdhand as they decompose the wastes. In a properly balanced ecosystem energy inputs equal energy use and the elements of life are recycled. Natural selection maintains balance; inputs equal outputs.

In his article, "Cancer: A Disease of Industrialization", Zac Goldsmith tells us that "economic growth as a process is itself inextricably linked and in some ways dependent upon societal sickness". (Goldsmith, 1998, p.73) Rather than being told the truth, we are told that the "undisputed cancer clusters surrounding virtually every nuclear power plant are coincidental ..." (Ibid.)

> A close look, however, at what few traditional, pre-industrial societies exist paints a very different picture. Few studies have been carried out, but those that have show almost a nonexistence of the disease among those whose lifestyles have remained virtually unchanged for millennia. (Ibid.)

Goldsmith cites evidence from studies of Eskimos, Alaskans, Hunzas and South American Indians which clearly indicate that cancer did not exist. Mortuary records in England "from 1860 to 1867, indicate a very remarkable increase in the death rate from this disease [cancer]". (Ibid., pp.93-95)

Apologists teach us to idealise a model of society

> ... which has utterly failed us on so many counts – it is totally unacceptable, indeed politically incorrect to praise the only model for society which has proven a success – traditional pre-industrial society. (Ibid., p.99)

Is it the case that nobody cares? That we want cars and rockets with their carcinogens, ozone destroyers and greenhouse gases? Pesticides with their carcinogens and ozone destroyers? Nuclear power with its carcinogens, ozone destroyers and greenhouse gases? Lasers and space weaponry? Traditional people were much happier than we are and their populations were stable. They viewed their relationship with the land, the sea and the air – with Gaia – as important; they worked

with nature, not against her. We need to relearn to do the same – to love Gaia.

Instinct and intuition give us a better sense of being one with reality.

> It is in contrast to the defiant attitude that we seem to assume when in science we treat facts and things as outside, external, discrete existences, which we range before us, analyse, discriminate, break up and re-combine. (Wildon-Carr, 1911, p.46)

Henri Bergson tells us that "it is for life that knowledge exists", but life itself "is directly known". (Wildon-Carr, 1911, p.46)

> Life is not known as an external thing, apprehended by the senses under a space form and a time form, fitted into frames or shaped in the moulds that the intellect uses, but is directly known. The intuition of life is knowledge of reality itself, reality as it is in itself. (Wildon-Carr, 1911, p.47)

Humans interfere with the earth's climate in some way or other with almost every activity they undertake. Unnatural fire upsets nature to some extent. Chemicals containing chlorine or bromine that have been added for more than 150 years act as catalysts for the destruction of ozone in the stratosphere. Among these are bleach, water purification agents, pesticides, lights, photographic materials, dry cleaning fluids and anaesthetics. Aircraft and rockets also release ozone destroying agents. As well, they also release greenhouse gases and some compounds serve both as greenhouse gases and ozone destroyers. Energy production and motor use are major contributors to the accumulation of greenhouse gases.

We are told that the North Koreans have adopted a policy of working in nature's hours and not using artificial lighting during the night. Daylight saving has long been a subject of debate in Australia, but if we adopted it for the whole year, it would contribute to our efforts to conserve energy. Daylight is distributed more evenly around the hours 8-4 than the traditional 9-5. It isn't only direct energy use that we need to reduce – it is also the use of all objects which require artificial energy for their manufacture. Items could be priced more closely to reflect energy input. This would provide a better indication of their true costs.

Many of the technologies we use contribute negatively to our own health, to the health of other forms of life, and to the health of our planet or Gaia – all at the same time.

It is in the interests of every nation to reduce the use of the technological products that are upsetting Gaia and our weather systems for

the double reason that the same products are at the same time directly affecting our health and costing nations billions.

In Future Tense written after the Howard government won the 1998 election, Mike Streketee claims that: "The ultimate test of the success of a health system is the health of the population". (Streketee, 1999, p.118) He refers to the fact that life expectancy has increased and coronary heart disease has declined over the last three decades, but does not mention cancer. He does tell us, however, that health expenditure rose from 7.5% of GDP in 1976 to 8.5% of GDP in 1996, that the proportion of GPs per unit of population rose by 37% between 84-5 and 96-7, that government spending on hospitals during that same period rose by 40% in public hospitals and by 131% in private ones. Over the same time, medical benefits costs "rose by a real 81 per cent" and "pharmaceutical benefits by 120 per cent". (Streketee, 1999, p.122) Cutting the use of compounds containing the first three halogens, fluorine, chlorine and bromine as well as radionuclides will cut greenhouse gases, cut ozone destroyers, and cut health costs.

Our own health, the health of the troposphere and of the stratosphere are all part of the same equation. Looking after the health of Gaia will at the same time help in looking after our health as individuals.

INITIATIVES

Monbiot tells us that "the governments of the United States and Australia have done everything in their power to prevent the talks from suceeding or even from taking place". (Monbiot, 2006, p.213) In their talks on climate change, the rich nations want the poor nations included in agreements to reduce greenhouse gas emissions, while the poor nations want greater cuts from the rich nations, whose output is so much higher on a per capita basis. Countries should live within their means and keep their populations at levels that they can sustain.

Monbiot declares that no one will act because the others are not acting. They fear that action will lead to losses.

Falk and Brownlow paint a different picture. Despite the fact that the problem is global and cannot be solved by the actions of any single nation, it is, they believe, single nations that must lead the way. More energy can be conserved, more renewables can be used, efficiency can be increased, agricultural and industrial production can be restructured to produce less greenhouse gas emis-

sions, transportation systems can be minimised and car use can be reduced - it is unilateral initiatives that must lead the way.

> Once taken, a unilateral initiative allows the government or organisation which has demonstrated its integrity by taking it, to speak in the international arena with greatly increased authority. (Falk & Brownlow, 1989, p.199)

Already, different countries add different taxes or excise duties to petrol. All countries could move their taxes to the level of those imposed by the highest taxing nation.

Values need to be changed so that we all work towards the goal of environmental restoration.

> Before them is the greenhouse threat with which they must engage. But that threat rides on a range of problems: the divisions between nations; the inward-looking dynamics of many institutions; the short time frames for governments; the tendency of the market to discount the future; the desire to dominate and control the natural world; the uncritical preoccupation with the image of a 'free market'; the tendency to consider all innovation to be 'technological progress'; and the comparative blindness of the market to the damage done to that which is not owned. (Ibid., p.250)

Many different groups share a concern ~~share a concern~~ regarding greenhouse gases and climate change. Those concerned with the preservation of forests, with equity, with the actions of the chemical industry, with fossil fuel use and with the need to control population all focus on aspects that surround the issue.

Cooperation, consultation and collaboration need to guide action.

> How can economic interaction be regulated to require institutions to adequately value public resources? What barriers stand in the way of implementing these, and how can they be overcome? How can the process of decision-making about technology be brought closer to ordinary people so that they can participate in a meaningful way in shaping the world they will live in? (Ibid., p.252)

It is not only physical targets that must be met. In order to meet them "features of our social and technological organisation" will have to be reshaped. (Ibid., p.257) Our love for nature - for Gaia - needs to be rekindled and used to guide our actions and rethinking.

This proper way to proceed is not that advocated, however, by many others. Monbiot claims to aim for a 90% reduction in GHGs, but he proposes technological fixes and more use of technology. Most governments also call for a reduction in GHGs and for new technologies. Cuts for GHGs should be welcomed, but, as shown by Jevons and others, greater efficiency often leads to greater production and any increase in technology would very likely do the same. For these reasons, those who state that all can be fixed without cuts in output, should not be taken seriously. Their agenda is still economic growth and continued economic growth will not lead to the restoration of proper balances within the biosphere. Their values are economic not ecological.

The agenda of green groups, who call for forest preservation, equity, reductions in fossil fuel use, in certain kinds of manufacture, and in population, is not an agenda based on self-interest, although its adoption would preserve the kinds of things they value most, but on an understanding of our need to value the whole of life and everything that sustains it. Their values are ecological not economic.

We need governments, corporations and people with ecological agendas rather than economic ones.

CONCLUSIONS

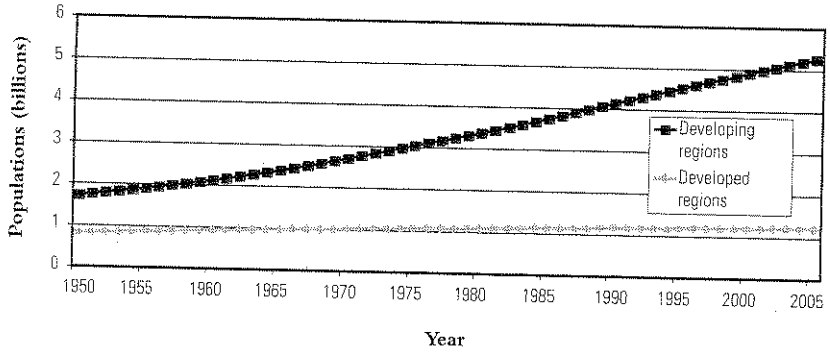
Prime Minister Hawke gave an undertaking in July 1989 to legislate to "require the phasing out nearly all CFC and halon use by the end of 1994", (Ibid., p.232) but the Ozone Protection Act 1989 was accused of reflecting "the Government's inability to withstand pressure from the chlorofluorocarbons industry in formulating Australia's ozone action plans". (Australian Conservation Foundation quoted in Falk & Brownlow, 1989, p.234) Senator John Coulter from the Democrats voiced his dismay. Clearly, promises were not kept and neither the following Keating or Howard governments are likely to have made improvements. Did they? If regulatory methods have failed, then greenhouse gas taxes need to be used to provide negative feedback on their production and use.

Despite this, the ozone problem has, to date, been treated with more concern than the climate change problem, though the former is, of course, part of the latter.

Many will say or think that so far neither problem has had any real effect. Those who suffer from floods or droughts or even skin cancers are often ignorant of their possible causes and even if they attribute

delete

Figure 7.1 Human Population in the Developed and Developing Countries from 1950 to 2005



Source: Data from UN Population Division (2007)

(Sachs, 2008, p. 162)

their suffering to these causes they can't prove the cause/effect relationship. The possible dangers from asbestos had been recorded by the first decades of the twentieth century, but recognition of a casual relationship took more than half a century to be achieved. The correlation between smoking and lung cancer was known, similarly, for many decades before a causal relationship was established, sufficiently for its recognition.

The causes, or at least some of the causes, of ozone destruction and climate change seem to many to be adequately established, but action to repair the system seems difficult to set in motion. Suzuki's frog might be the best metaphor by which to describe our plight. Nobody really understands the systems within the atmosphere and biosphere, but systems that were once in balance need to be returned to balance - they need, as the Stern Review proclaims, to be stabilised. Some of the science of stabilisation is known. Every chemical reaction can be stabilised at a point where components are broken down and made at the same rate, but the conditions under which stabilisation occurs are different for every set of reactants. Every change in initial and boundary conditions will change what is made and what is unmade and the rates at which the processes proceed.

But even the science that is known is difficult to disseminate so that people understand the need for changes in our way of living. There is inertia, ignorance and moral failure. "The obstacles lie not so much in the technical practicality as in the social resistance." (Ibid., p.243) There are still people who smoke and still companies and stockholders who profit from the addictions of the smokers. Corporations and their shareholders are supported by the sale of ozone destroying gases and greenhouse gases or products that give rise to them. They might be cooking themselves and their fellow humans - indeed much of the life in the biosphere - but their mind set focuses on money not esoteric or scientific problems such as ozone destruction or greenhouse gas build up.

What is needed is in Falk and Browlow terms 'restorative intervention'.

> Rather than aiming to conquer and simplify the natural world to a human blueprint, the technology we need to construct will have to preserve and maximise the viability and physical and biological diversity of the living world in which humans are both partners and guests. (Ibid., p.241)

Girardet tells us in 2004 that our population "now substantially exceeds the planet's capacity to sustain its consumption of renewable resources." (Girardet, 2004, p. 115)

Trade unions should work to protect jobs, pay, and the safety of employees, but they should also work for 'restorative intervention', because workers will suffer far more in the long term if further destruction is permitted to occur. Harvesting forests provides jobs, but the timber carries with it many or even most of the nutrients of the ecosystem in which the trees played such an important role, and future harvests will deplete nutrients even more. It is in the interests of all Tasmanians to preserve Tasmanian soils and to do so we need to preserve our forests. It is not in our interests to give away our wealth and deplete our soils. When trees are grown in plantations for commercial profit their natural function in compromised and replaced by the artificial human directed function of providing profits for shareholders. Natural functions need to be restored and artificial functions need to be replaced. Governments, like corporations, tend to be guided above all else by monetary concerns. More and more they take on the role of economic management with less and less concern regarding the sources of their income. The role of councils as service providers is also questioned by economic advisers.

The calls from people like Rachel Carson., Paul Ehrlick and Barry Commoner have been drowned in the decades following the sixties by those of economists and managers. Perhaps they have not been totally drowned - Greens did emerge and do hold seats in many parliaments and David Suzuki had spread our concerns, but though very positive influences, others still hold the reins of power.

If the goals of institutions were redirected to the ends of providing goods and services as a service to their customers and of providing jobs so that workers have sufficient to live, then the customers and the workers should be major players in deciding on the structure and functions of the corporations for which they work. Concerns for environmental problems could be properly assessed in such an environment, but when the goal of institutions is money making, the environment and indeed many people become externalities. The externals need to be converted into internals. A reverse of many of the values that underlie the economics of the military industrial state needs to take place. At an individual level, as things currently stand, we need to think and think again before we buy. Do we really need the item? What will it do to the greenhouse gas problem? Who do we support when we purchase the item? Should we support them? Should the item be made? We need to think carefully "about what we value,

about how our world is to be organised, and how we will live". (Ibid., p. 258)

Ivan Illich considers our energy options. Although he wrote during the oil crisis of the seventies, the questions we need to ask are still the same.

Well-being can be identified with high amounts of per capita energy use, with high efficiency of energy transformation, or with the least possible use of mechanical energy by the most powerful member of society. (Illich, 1976, p.16)

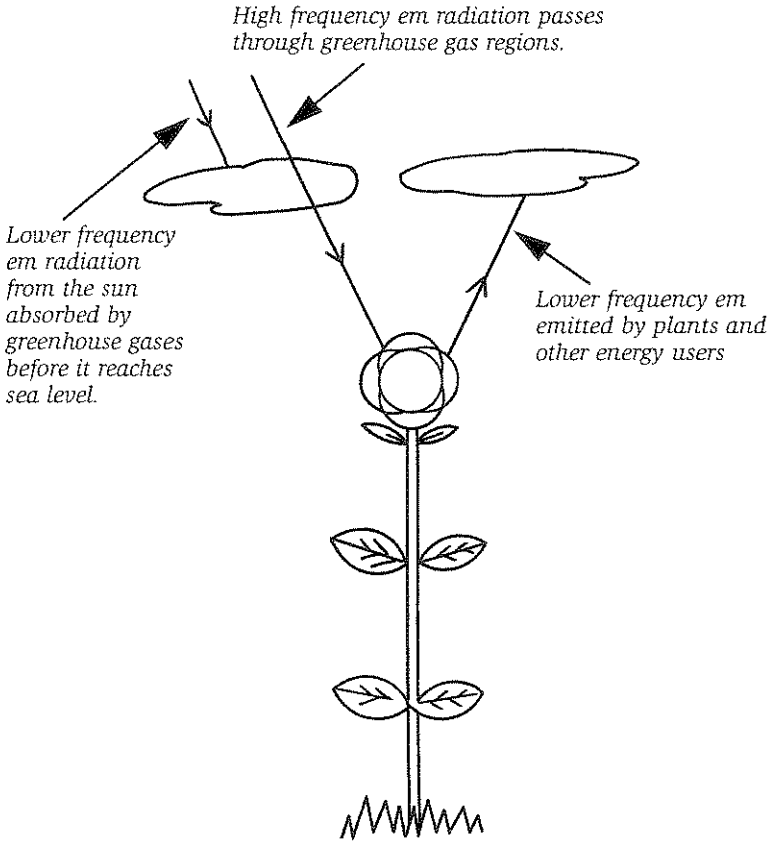
High per capita use will require tighter and more energy expensive management as some fuels become scarcer and environmental problems bite back harder. The "second would emphasize the retooling of industry in the interest of thermodynamic thrift", (Ibid.) but though the bicycle may be the zenith of transport efficiency, there are limits to the possible efficiencies achievable in other areas and costs as well. "The possibility of a third option is barely noticed". (Ibid., p.17)

There are discussions about ecological limits, but real cuts to energy use are 'out of the question' for the vast majority of writers and commentators. Illich recommends the use of the bicycle, but nature gave us legs and our own source of metabolic energy. The possibility of becoming our true selves should be an option worthy of proper consideration. Our whole history of energy exploitation needs to be rewritten with an opposite scale of values. Instead of applauding the discovery of the wheel, the ball-bearing, the steam engine, the internal combustion engine, CFCs and so on, we should see each of these inventions as an agent of destruction; of ecological destruction, of social destruction, and of psychological destruction. They are, rather than agents of progress, agents of degradation and disharmony. We should question the economic, political and social structures that have led us to engage in such a massive exercise in self-deception. We need to turn back history rather than promoting more of the same at an ever increasing rate.

The greenhouse gas effect is seldom explained adequately. Each greenhouse gas traps radiation with a set of frequencies peculiar to itself. Carbon dioxide traps far less heat than methane, halogenated hydrocarbons or nitrous oxide and some of the greatest trappers hold it for a century before they break down.

The greenhouse effect is due to the fact that electromagnetic radiation of higher frequencies loses energy as it interacts with components

of the biosphere and is degraded to heat energy frequencies which are then trapped by greenhouse gases.



Plants trap energy from sunlight and build it into themselves emitting lower frequencies of em radiation than those absorbed.

Many of the technological greenhouse gases also destroy ozone, which was reduced to just 95 Dobson units in 1995 from 320 in 1955. It would have been even higher in 1855 before the abundance of chlorinated hydrocarbons and freons were made. Ozone is also destroyed by rockets and planes.

As ozone is destroyed, the frequencies that it once absorbed pass through to the biosphere, degrade, and are captured as heat by greenhouse gases. Ozone was also destroyed by nuclear tests and by CFCs still liberated from nuclear power plants.

talists and Marxists have done with our knowledge of the necessities as determined by the laws of nature.

Despite this, they almost seem to adopt the ethic of working with nature, by imposing her laws as she would, as their agenda for the reconstruction of society.

> A wrongly organised society, founded on exploitation, make its members slaves to historical necessity, and simultaneously prevents them from devoting sufficient effort to the remaking of nature ... . Under socialism, historical necessity has been apprehended and the laws of history are applied in practice. (Ibid., pp.266-7)

The view is more clearly expressed as follows:

> Freedom implies no annihilation of objective necessity. The latter can never disappear. Once man has apprehended objective necessity, it stops being external to him. It becomes the intrinsic content of his convictions. (Ibid., p.267)

On the one hand they call for humans to act in accordance with the laws of history and at the same time they see them as leading to progress. The 'successes of scientific and technological progress' are referred to with a call for "an international system of conservation measures involving all, or at least all the industrially advanced countries". (Ibid., pp.271-2)

Population growth is discussed and condemned "as an external evil threatening innumerable calamities, such as famines, war and so on.

> ... overpopulation is not a law of nature. It does not appear because there are too many people but is due to the conditions of production under capitalism. Capitalism constantly produces a surplus-population. Economic crises, chronic unemployment, destitution are not at all the effects of overpopulation, but are, indeed, it causes. (Ibid., pp.272-3)

The story is, of course, much more complex, but at the same time it is well documented that the birth rates are much higher in the less well off classes than in those that are more affluent. They are right to state that 'over-population is not a law of nature'; populations are checked in natural populations by the action of natural selection.

Their ideas concerning the laws of history are based on the idea that "historical periods are differentiated, above all, by the modes of material production on which they are founded". (Ibid., p.274) The modes of production depend on this ability to control nature and on

relationships between people and nature and between people themselves. "The productive forces include people and the means of labour, i.e. the objects and instruments of labour." (Ibid., p.276) Science and technology keep providing us with new instruments of labour and labour has to learn new skills to use them. "Man produces new objects with new properties not existing in nature." (Ibid., p.277) Productive forces, as well as products, change over time, and produce new pollutants with unknown consequences.

Australia plans to introduce an ETS. In a sense, we already have a carbon tax on petrol, although it is, in another sense, one of the few taxes we have on what economists refer to as 'negative externalities'. Motor vehicles cost more than the oil and petrol that run them. They cost the community for roads and their maintenance, for police and their maintenance, for signage and its maintenance, and so on. There are also the medical costs due to benzene and other carcinogens. Many of these infrastructure and health costs are paid for or subsidised by government so that petrol ~~prices~~ tax helps pay for them.

An ETS fixes emissions provided there is compliance, but the market sets the price. Carbon taxes fix the price but their effect on emissions can only be known with certainty after the market responds. Advocates suggest that they begin low (to prevent economic disruption) but be continually increased until CHCs (and temperatures) are known to have stabilised. If there are fines for non-compliance with ETS caps there are likely to be government costs for legal wrangles and enforcement. There are of course taxes which are also not always paid, but the GST is a tax which seems to be almost universally collectable. The same kind of tax could be added per unit of CO_2e used in producing each item. Power companies could collect it from users by adding a CO_2e GST for every unit sold, so power companies and CO_2e producers pay upfront, while consumers pay indirectly. Each item should be labelled with its CO_2e expenditure during production and use.

Setting emissions caps may be expected to produce results predicted from modelling, but the level of production at which stability can be maintained can also only be known for certain once it is attained.

Labors Green Paper has been released (July 2008). It tells us that the CO_2 level was 384 ppm in 2005, that Australia produced 576 tonnes CO_2e in 2006 and that about 50% breaks down or is absorbed. Their goal is to cut 2000 levels by 60% by 2050. But if we cut levels by 50% build up rate will be reduced (halved) but build up will not cease. The goal has to be stabilisation.

Present proposals will fail to achieve a satisfactory goal.

Appendix 1

Hello. I'm Severn Suzuki, speaking for ECO, the Environmental Children's Organisation.

We are a group of twelve - and thirteen-year-olds trying to make a difference — Vanessa Suttie, Morgan Geisler, Michelle Quigg, and me.

We raised all the money to come five thousand miles to tell you adults you must change your ways.

Coming up here today I have no hidden agenda, I am fighting for my future.

Losing a future is not like losing an election or a few points on the stock market.

I am here to speak for all generations to come; I am here to speak on behalf of the starving children around the world whose cries go unheard; I am here to speak for the countless animals dying across this planet because they have nowhere left to go.

I am afraid to go out in the sun now because of the holes in the ozone; I am afraid to breathe the air because I don't know what chemicals are in it; I used to go fishing in Vancouver, my home-town, with my dad, until just a few years ago when we found the fish full of cancers; and now we hear about animals and plants going extinct every day — vanishing forever.

In my life, I have dreamed of seeing the great herds of wild animals, jungles and rain forests full of birds and butterflies, but now I wonder if they will even exist for my children to see.

Did you have to worry about these things when you were my age?

All this is happening before our eyes, and yet we act as if we have all the time we want and all the solutions.

I'm only a child and I don't have all the solutions, but I want you to realize, neither do you — you don't know how to fix the holes in our ozone layer; you don't know how to bring back an animal now extinct, and you can't bring back the forests that once grew where there is now a desert — if you don't know how to fix it, please stop breaking it!

Here you may be delegates of your governments, business-people, organizers, reporters or politicians, but really you are mothers and fathers, sisters and brothers, aunts and uncles, and all of you are somebody's child.

I'm only a child yet I know we are part of a family, 5 billion strong; in fact, 30 million species strong, and borders and governments will never change that.

I'm only a child yet I know we are all in this together and should act as one single world toward one single goal.

In my anger, I am not blind, and in my fear, I'm not afraid to tell the world how I feel.

In my country we make so much waste; we buy and throw away, buy and throw away; and yet northern countries will not share with the needy; even when we have more than enough, we are afraid to lose some of our wealth, afraid to let go.

In Canada, we live the privileged life with plenty of food, water and shelter; we have watches, bicycles, computers, and television sets.

Two days ago here in Brazil, we were shocked when we spent time with some children living on the streets, and here is what one child told us: "I wish I was rich, and if I were, I would give all the street children food, clothes, medicine, shelter, love, and affection."

If a child on the street who has nothing is willing to share, why are we who have everything still so greedy?

I can't stop thinking that these are children of my own age, that it makes a tremendous difference where you are born.

I could be one of those children living in the favelas of Rio, I could be a child starving in Somalia, a victim of war in the Middle East, or a beggar in India.

I'm only a child yet I know if all the money spent on war was spent on ending poverty, making treaties and finding environmental answers, what a wonderful place this Earth would be.

At school, even in kindergarten, you teach us how to behave in the world — you teach us not to fight with others; to work things out; to respect others; to clean up our mess; not to hurt other creatures; to share, not be greedy.

Then why do you go out and do the things you tell us not to do?

Do not forget why you are attending these conferences, who you are doing this for — we are your own children.

You are deciding what kind of a world we will grow up in.

Parents should be able to comfort their children by saying, "Everything's going to be all right." "We're doing the best we can," and "It's not the end of the world."

But I don't think you can say that to us anymore.

Are we even on your list of priorities?

My dad always says, "You are what you do, not what you say."

Well, what you do makes me cry at night.

You grown-ups say you love us, but I challenge you, please make your actions reflect your words. Thank you.

(Suzuki, 2006, pp.281-284)

Appendix 2

Declaration of Interdependence

THIS WE KNOW

We are the earth, through the plants and animals that nourish us.

We are the rains and the oceans that flow through our veins.

We are the breath of the forest of the land and the plants of the sea.

We are human animals, related to all other life as
descendants of the firstborn cell.

We share with these kin a common history, written in our genes.

We share a common present, filled with uncertainty.

And we share a common future as yet untold.

We humans are but one of thirty million species
weaving the thin layer of life enveloping the world.

The stability of communities of living things depends upon this diversity.

Linked in that web, we are interconnected —
using, cleansing, sharing and replenishing
the fundamental elements of life.

Our home, planet Earth, is finite; all life shares its
resources and the energy from the Sun,
and therefore has limits to growth.

For the first time, we have touched those limits.

When we compromise the air, the water, the soil and the variety
of life, we steal from the endless future to serve the fleeting present.

THIS WE BELIEVE

Humans have become so numerous and our tools so powerful
that we have driven fellow creatures to extinction,
dammed the great rivers,
torn down ancient forests, poisoned the earth, rain
and wind, and ripped holes in the sky.

Our science has brought pain as well as joy;
our comfort is paid for by the suffering of millions.

We are learning from our mistakes, we are mourning our vanished kin, and we now build a new politics of hope.

We respect and uphold the absolute need for clean air, water and soil.

We see that economic activities that benefit the few while shrinking the inheritance of many are wrong.

And since environmental degradation erodes biological capital forever, full ecological and social cost must enter all equations of development.

We are one brief generation in the long march of time; the future is not ours to erase.

So where knowledge is limited, we will remember all those who will walk after us, and err on the side of caution.

(Suzuki, 2006, pp.275-277)

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