ers for short-term gain. We would all be well advised to cooperate in providing the scientific information necessary and adequate international aid to make the preservation of this world genetic heritage possible and learning to make the forest a place where humans can reap the rewards of productivity in diversity.

The Eye of Hathor: Climatic Destabilization

Ancient Egypt provides us with a severe warning for our own time - a chilling saga of what was probably an earlier human-induced environmental crisis, leading to desertification, famine, and its eventual respite in the return of verdant fertility through society re-embracing the fertility principle. Hathor in her angry form as Tefnet sears humanity with her angry sun eye. The people are devastated and many die. Thoth the moon God, who pronounces the logos of wisdom (p 463), is sent to plead with her by the Gods of Egypt, out of concern for the fate of humankind. It is only by embracing her wildness and entreating her to re-assume her verdant form as the goddess of fertility and moisture, dispensing her life-giving waters from her sacred sycamore tree (p 465) that the world is saved and with it, frail humanity.

The Gaia hypothesis is a twentieth-century scientific concept which has also assumed the status of a living myth evoking the spirit of the primal Earth Goddess in the feedback cycles of the atmosphere. It states that the atmosphere of the earth is a feedback system which adapts to external changes in a self-correcting manner through the action of the biota itself. It applies naturally to the photosynthetic oxygen-containing atmosphere and also to ideas about cloud cover formation and several of the natural chemical cycles.

Emiliana huxleyi a coccolithophorid. Satellite picture of a 50 km.-wide bloom of coccolithophorid extending some 200 km. along the coast of Scotland (Margulis). The capacity of such biota to play a major role in CO2 fixation is an illustration of the Gaia hypothesis in action.

On the other hand it is characteristic of many such non-linear feedback systems that if they are pushed too far, bifurcation or catastrophic transition can occur, in which the system undergoes major oscillation and perhaps settles into a new and different stability state, as appears to have happened in previous epochs.

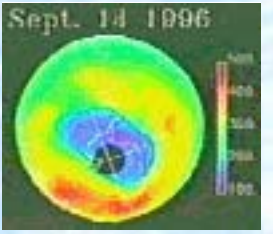
There are a much vaster array of globally deleterious effects that are happening to the Earth this century as a result of human impacts which may involve non-linear feedback or catalytic amplification. One non-linear change of particular

current concern is the ozone hole, in which the release of even small amounts of chloro-fluorocarbons into the atmosphere and the resulting high-altitude chlorine monoxide catalytically devastates the ozone layer which gives us protection from ultra-violet radiation.

A second more serious change is global warming induced by the release of gasses, particularly the massive amounts of carbon dioxide generated by the burning of non-renewable fossil fuels. Associated with global warming are rising oceans, increasing desertification of sensitive arid regions, loss of fertility of major habitats through rapid climate change, including freak storms and floods and changes in ocean circulation, such as an increasingly extreme El Niño oscillation in the Southern Pacific, which has desiccated tropical forests from the Amazon to Sumatra and Africa and interrupting the monsoon. A second similar conveyor process associated with the North Atlantic is critical for European weather.

There is significant risk that these changes because they are happening far to fast for plant species to adjust to will cause the death or decay of large forest areas as they move out of the climatic zone to which they are adapted. These changes could bring further changes which could exacerbate the very problems which precipitated them.

The Ozone Hole



The southern ozone hole at September 1996. “We have reached the bottom. All the ozone contained within the polar vortex area between 14km and 22km is destroyed. That's it. We cannot have lower values than that. There is no more ozone to be destroyed.”

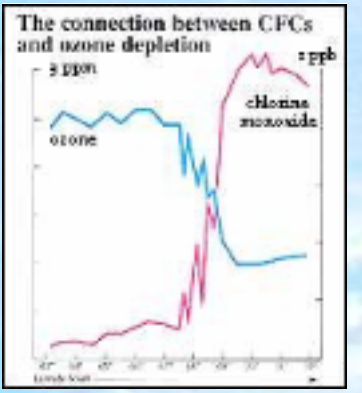
The release of chlorofluorocarbons (CFCs) into the atmosphere by refrigeration, air-conditioning and non-flammable aerosol propellants and plastic foams has had a devastating effect on the world's protective ozone layer. Chlorine and its oxide has catalytic destructive powers when CFCs are broken down in the stratosphere in which one atom of chlorine can catalyze the destruction of millions of molecules of ozone. The effect, which has a lifetime of the order of a hundred years began to cause a non-linear transition at the poles - the ozone hole. This has caused a variety of impacts including increases in skin cancer, cataracts, and radiation stress to polar flora and fauna.

Major ozone-destroying chemicals and their uses [impact and uses]:

1. CFC-12 45% of impact, life 111 years, aerosols, foams, refrigeration, air conditioning
2. CFC-11 26% of impact, life 74 years, aerosols, foams, refrigeration
3. CFC-113, 12% of impact, life 90 years, solvents
4. CCl4, 8% of impact, life 67 years, solvents
5. Halon 4% of impact, life 110 years, fire extinguishers.

The history of the antarctic ozone hole indicates how non-linear effects can become actively suppressed. Awareness of the problem was delayed for several years because the first appearance of the problem adjusted out of the surveys as

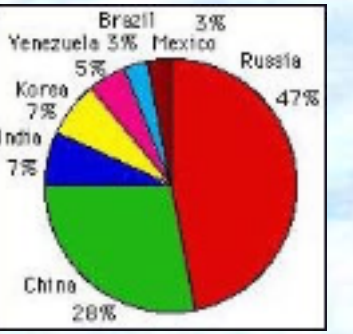
an experimental anomaly. Much later it was realized that the effect had become real and serious. The ozone in the seasonally still upper atmosphere in the polar spring suffers a catastrophic seasonal decline.



Latitude correlation between falling ozone (blue) and rising chlorine monoxide (red).

A similar, albeit less severe ozone hole has subsequently begun to develop over the arctic, probably suppressed in part by other atmospheric contaminants. Although this problem is now beginning to stabilize, as a result of international protocols banning the use of CFCs in developed countries after 1996, it will continue to cause increased cancers for another 50 years. Under the Montreal Protocol in 1988 and the subsequent London and Copenhagen amendments in 1990 and 1992, industrialized countries have agreed to phase out the production and use of CFCS, halons and a number of other ozone-depleting substances. Halons were largely banned after January 1994, and CFCs after January 1996.

Russia remains a major CFC producer



There is a continuing problem of clandestine manufacture and smuggling of CFCs centered on Russia, which remains a very significant producer despite agreements phasing out its use. A significant proportion is smuggled by criminals. An initiative by the World Bank to buy up and close down these clandestine factories for only $40 million lapsed from Western donor apathy.

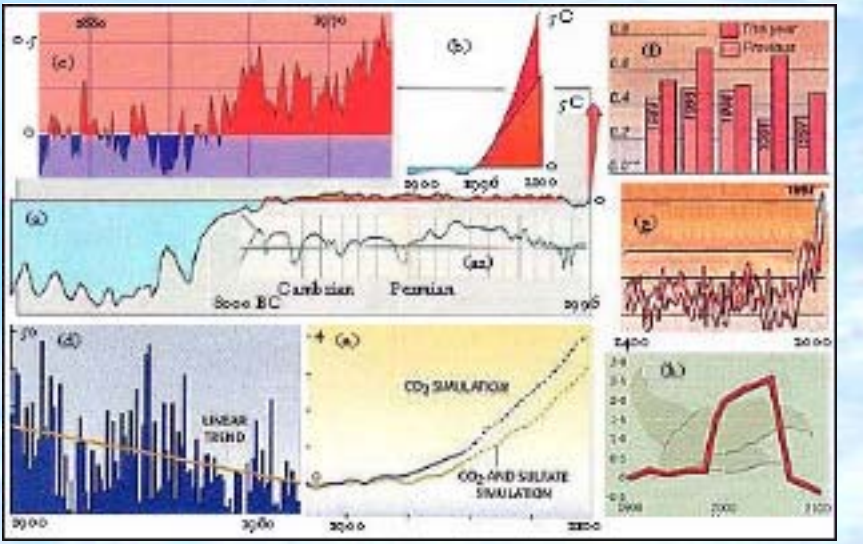
Global Warming and the Greenhouse Effect

Of much more long-lived potential for disaster however is the eye of global warming, which could rupture major biological life zones, flood coastal regions and have a lifetime of several hundreds of years. Scientists are now broadly agreed that the greenhouse effect is bringing about the greatest and most rapid climatic change in the history of evolution. It will have enormous consequences for all life on earth.

The Earth absorbs radiant energy at the thermal temperature of the sun's surface of around 5000 deg C but radiates it back into space at a much longer wavelength corresponding to our temperature of about 25 deg C. Some gasses such as carbon dioxide (CO_2) tend to reflect back this lower frequency radiation and thus trapping more of the heat, like glass in a green house, while allowing the light rays of the sun to come through. Natural levels of carbon dioxide make life possible: without them the average temperature of the planet

would be 30 deg C colder.

In 1896 Svante Arrhenius coined the term ‘greenhouse effect’ and predicted that the burning of fossil fuels would increase the amount of carbon dioxide in the atmosphere and lead to a warming of the world's climate. In 1800 the gas was still at its pre-industrial level, about 280 parts per million (ppm). By 1900 pollution had already raised this level to about 300 ppm. It has now topped 350 ppm and is growing rapidly.

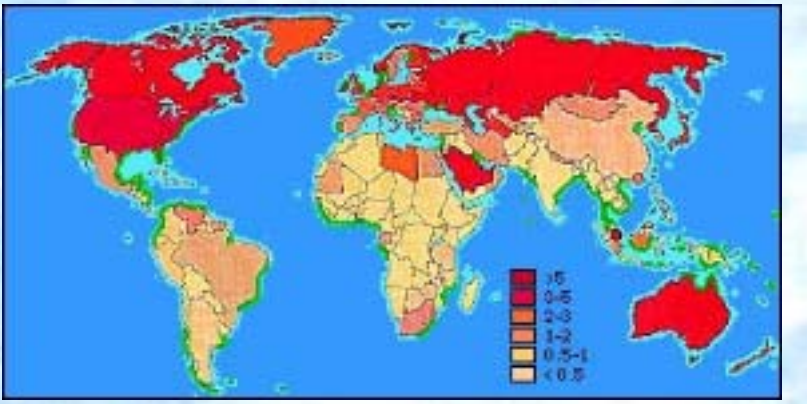


Past and predicted changes in temperature. (a) Since the last ice age, the planet has maintained a homeostatic balance of temperature (porritt 98). The inset (a2) shows the record back to the pre-Cambrian (Sci. Am. 94). The projected changes in temperature (b) are very much faster than historical changes and will leave many plant species in a warmer non-adapted life zone (Porritt 99). Temperate forests are likely to deteriorate or die and the appropriate seeds for regeneration will be a few hundred miles away. The detailed temperature variations (c) give a close-up of the recent changes (New Sci. 13 July 96). Falling days with frost (Roma Australia) confirm the warming trend. Simulations with and without the cooling effect of sulfates (e) illustrate two predictions of the likely warming. Many other non-linear factors are likely to complicate the picture (Sci. Am. May 97). (f) Shows latest data in which 1998 temperatures in January to May exceed all previous records. (g) 1997 records accentuate the accelerating trend (NZ Herald 15 Jun 98). (h) Likely loss of carbon fixation caused by damage to forests late next century could exacerbate the global warming crisis.

Every year some 24 billion metric tons of carbon dioxide are released, increasing by about 750 million metric tons a year. About four fifths comes from the burning of fossil fuels. The rest is from destroying vegetation, mainly the felling of forests. Trees fix carbon in the form of CO_2 when alive to form carbohydrate wood, but release it when they are cut down and are burned or decompose. Carbon dioxide accounts for rather more than half of the warming. It is joined by several other greenhouse gases. CFCs are responsible for about another quarter and the remainder of the greenhouse effect is caused mainly by

two other gases, methane and nitrogen oxides. Both are given off by fossil fuels and the burning of vegetation. Nitrogen oxides are also emitted by fertilizers and methane by termites chewing through rotting forests, swamps and rice paddies and from the carbohydrate-decomposing intestines of ruminants, such as cattle. Massive quantities of methane are caught in frozen areas of Alaska and undersea deposits as hydrates. Concentrations of these gases together are expected to reach the equivalent of 560 ppm of carbon dioxide, double the natural level, by the year 2030.

As an illustration, 1997 and 1998 have been the hottest years on record for a full 600 years, adding fuel to concern over global warming. For the five months to May 98 the world temperature has remained at an unprecedented 0.6 deg above the 1902-80 global mean. On a longer scale, the 1990s and 1980s were by far the hottest decades ever recorded; despite some moderating effects from the dust of volcanic eruptions. Over the last century, the world has warmed by between 0.3 and 0.6 deg C. No-one can yet be sure whether this is due to the greenhouse effect, or simply the result of natural variations in the climate, though it would be consistent with the increase in the polluting gases over the period. Despite some debate as to the exact extent of the changes and how detrimental their effects will be, the weight of scientific opinion is that the greenhouse effect is having an increasingly significant impact. A 1990, report by 300 world experts, reporting for the UN gave a “best estimate” predicting that by the year 2020 the world will, on average, be 1.3 deg C warmer than now, rising to 3 deg C warmer by 2070).



Estimated per capita emission of CO_2 in metric tons per person per year. Green coastal areas are threatened by rising oceans. Sample figures are Qatar 16.9, USA 5.2, UK 2.63, China 0.42, India 0.209 illustrating the excessive emissions made by developed nations and particularly the US, which single-handedly produced 23% of world emissions. Total outputs were USA 1135, China 480. Over 80% of Brazil's emission came from forest burning. The Sumatran peat fires are currently believed to be contributing as much CO_2 as Western Europe (King redrawn from 96 data).

The situation regarding global warming is clouded by a politico-scientific debate in which some so-called reputable scientists have continued to discount the extent of global warming or to allege that the benefits may equal the losses

on the basis of ancient warm periods such as the carboniferous. Much of this rhetoric seems either a defensive posture by the major energy-emitting corporations, including the oil industry or more subtly part of the utopian dream of endless technologically-inspired growth.

Greenhouse sceptics base the core of their case on four factors:

1. A supposed discrepancy between surface and satellite data. However New Scientist 15 March 97 reported that there may be calibration anomalies in the satellite data which may undermine the sceptic case that satellites contradict higher recorded surface temperatures.

2. A belief in negative feedback as opposed to positive feedback or bifurcation. Most of the debate is over different models used to predict how much warming will occur, the capacity of the oceans to absorb and sequester CO_2 through various organisms and the masking effects of other gasses such as sulfates and water vapor, which according to recent indications accentuates rather than moderates warming and methane deposits which could definitely make matters worse although atmospheric methane is currently decreasing. Fluoroform has also been implicated as having an effect 10,000 times stronger than CO_2. Forest clearance fragmentation has now been cited as a significant additional contributor in addition to that from tropical felling and burning. Regrowth of new forest gives only a temporary respite and may lead to gross damage to existing native forest some of which can be a net emitter of CO_2. Global warming may be exacerbating CO_2 emission in tropical forests at nights although there is also some evidence for increasing rates of tropical growth.

3. An alternative solar-based theory for a factor in global warming is that sun spot activity increases the solar wind, lowers cosmic ray input and this is has in turn been found to correlate with decreasing cloud cover and in turn increased global warming. A 'cloud-chamber' experiment has been suggested to research this link.

4. The use of uncertainties in the data to discredit data in conflict with their own analysis.

This is merely fiddling while ‘Rome burns’. The pessimistic environmentalists, by contrast, express grave concerns about many combined qualitative changes which could lead to bifurcation to a new climatic state, including melting polar ice caps, rising oceans, the massive loss of biodiversity from species carried out of their survival zones and exacerbating problems of the failure of the world's temperate forests.

More recently world governments attempted to come to terms with the political decisions required to come to terms with reducing energy inefficiency and dependence on fossil fuels. This has been again opposed by the major emitting industries. The 1997 Kyoto conference was widely described as a horse-trading session in which, despite Europe's dedicated efforts and preparedness to make an 8% reduction in emissions from 1990 levels by 2010, the US at first refused and then made a behind the scenes deal with Russia to buy up their significant shortfall in emissions caused by recession of Soviet industries. The US paper concession of a 7% reduction could thus on the basis of tradeable emissions

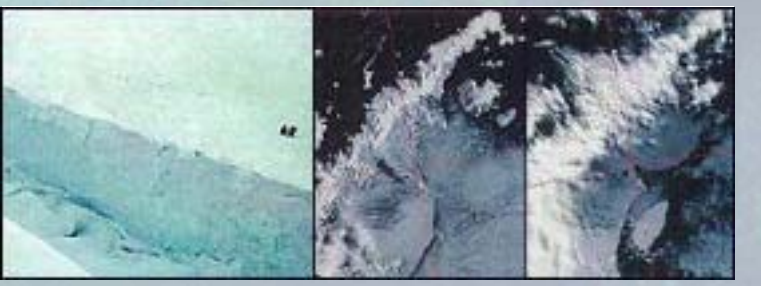
correspond to an actual 12% increase in emissions. Despite this the US has still to fully ratify this non-concession just as it is still to ratify the 1992 Biodiversity Convention. Of the developing countries China was also notable in its political clout on behalf of developing nations to serve its own political interests as an emitter. Such world political complacency in a year which saw Indonesian peat and forest fires emitting as much CO_2 as the whole of Western Europe is a case of potentially terminal irresponsibility. Little has changed since as the Buenos Aires global emission talks indicate in Nov 98.

Effects and consequences

At first sight, changes of a degree or two not seem very much, but apparently small changes have dramatic effects. An increase of 2 deg C will produce temperatures last seen 125,000 years ago. A rise of 3 deg C would make the world hotter than it has been for the last 2 million years.

Past changes of this size took thousands of years and species could adapt. The greenhouse effect threatens to produce them in decades leaving plant species no time to set seed fast enough to move their habitats to compensate for climatic change. In the past, as conditions grew harsher, people moved to more congenial areas. On a crowded planet, divided by national frontiers, this is not possible and whole populations are likely to suffer.

Sea levels will rise as the world gets warmer because the heat will melt ice and expand the water in the oceans. Over the next century, levels could increase by a meter or more. Historical changes of sea levels have been vast. Only 400,000 years ago changes in ocean levels accompanied by the formation of coral reefs caused an ocean rise of 20 meters when the deposition of vast quantities of calcium carbonate caused the ocean to release CO_2 because although carbonate was deposited, the loss of calcium reduced the buffering capacity of the oceans. Such non-linear feedbacks illustrate the danger of assuming one can set off a global bifurcation and not expect significant changes. Although our polluted warmer oceans with frequent epidemics of starfish may not do likewise there is continuing debate about how significant the signs of warming are in the polar regions.



Left Larsen Ice sheets cracks appearing. Right satellite image January 95 shows the spidery-looking James Ross Island surrounded by water (top right): ever since the first maps were made 100 years ago, it has been connected to the Antarctic peninsula by an ice shelf. A satellite image taken shortly after, in February (right), documented further changes. The ice shelf has retreated; a 50-mile-long iceberg has calved; and the northernmost part of the shelf, just above the center of the picture, has disappeared, creating a plume of ice rubble (New Sci. 15 Feb 97, Jul 95).

Both the Arctic and Antarctic show signs of heat stress, although there is debate as to whether this is due entirely to global warming. Variations in global warming can occur as the result of a variety of local and global conditions, from El Niño to Mt. Pinatubo, whose eruption caused two years of temperature decline in the early 1990s, as well as fine sunsets from the atmospheric contaminants.

Sinking islands and deltas

A 1-meter rise in sea level could make 200 million people homeless. At particular risk are islands. Many of the people of Polynesia face a real threat of rising oceans because they are island nations with many low-lying coasts already ravaged by tropical cyclones. Global warming is likely to both raise the oceans and increase the severity of storms. The Maldives, the Cocos Islands, Tuvalu, Tokelau, Kiribati, the Marshall Islands and the Line Islands - face a similar crisis. 300 Pacific atolls and over 1000 Maldives islands are expected to disappear, but will become uninhabitable long before as storms wash over them and freshwater supplies become salt.

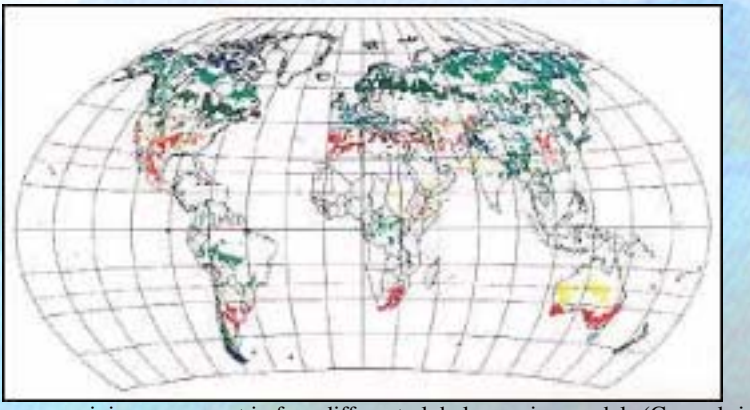
Rose Atoll - Pacific. Many such places will disappear from the planet (Ayensu 134). The corn belt (outlined) would shift NE (light blue). Stippled areas would require irrigation. Much of the Nile delta (green) would be submerged by only a 1.5 m rise, partly because the Aswan Dam has reduced delta silt deposits. A 3 m rise would include the brown area (Lean 95).

Many more people are at risk from the flooding of deltas and other low-lying coastal areas. Some areas are already subsiding, making them doubly vulnerable to the rising sea. Four fifths of Bangladesh is made up of the delta of the Ganges, Brahmaputra and Meghna rivers: half is less than 4.5 meters above sea level. Over 110,000 people died in a single monsoon flood in 1991. Studies suggest that up to 18 per cent of Bangladesh could be under water by the year 2050: by 2100 this could rise to 34 per cent. The Nile Delta - twice as densely populated as Bangladesh - is sinking rapidly, because the Aswan High dam traps the silt that used to replenish the land. By 2050, up to 19 per cent of Egypt's cultivable land could disappear - rising to a quarter of both cultivable land and population by 2100.

Disruption of Productive Cropland and Natural Species

The effect of rising oceans is likely to be overshadowed by the impact of global warming on harvests and natural habitats. As the world heats up, the local patterns of rainfall and climate will both change and be subject to increased fluctuation, severely disrupting food production. The American Midwest, which helps to feed 100 nations, may see its harvests cut by about a third. The United States, it is thought, will still be able to feed itself, but exports to the rest of the world could fall by up to 70 per cent. New land will open up in Canada as the weather warms, but

the soils are too poor to make up the loss. Greece and Italy are expected to be very badly hit and harvests may decline less seriously in France and Germany. Britain, the Netherlands and Denmark should benefit, at least initially; harvests will increase greatly in Sweden, Norway and Finland, while improved grassland in Iceland may be able to carry two and a half times as many sheep as at present. Developing countries will be hardest hit. Areas that are already dry - like Tunisia, Algeria, Morocco, Ethiopia, Somalia, Botswana, eastern Brazil and parts of Asia - will probably dry out even further. Some relatively wet regions, including Central America and Southeast Asia, are also likely to suffer.



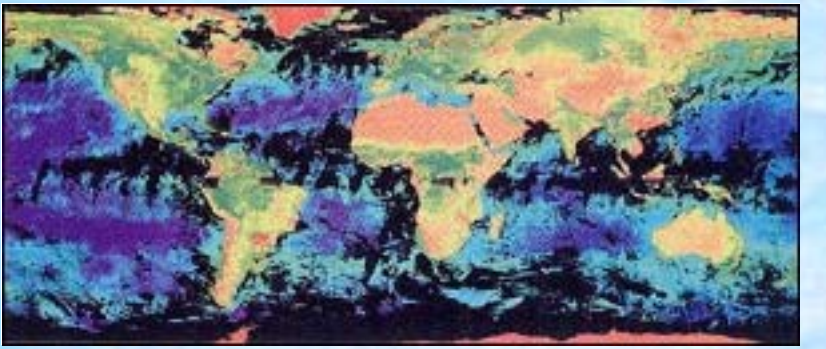
Life zones remaining sacrosanct in four different global warming models (Groombridge).

A sinister example of deleterious effects occurring later in the next century is the loss of temperate and tropical forests and their carbon storage. Global warming is predicted to cause a massive "dying-off" of tropical vegetation after 2050. The devastation will mean that the 2 billion tonnes of carbon that are currently soaked up by rainforests every year may remain in the atmosphere, further accelerating global warming. The loss of temperate forests is a very serious potential threat to further runaway global warming as the carbon they represent becomes released through decomposition. The possible loss of temperate forest species from whole regions of the globe is an area of major concern because they are likely to be carried into too warm a climate too fast to remain viable and have too little time to spread their seeds an adequate distance to survive elsewhere.

With every rise of 1^{o} C, plant and tree species will have to move about 90 kilometers polewards to survive, many will simply not be able to spread fast enough. The strain will be greatest in the higher latitudes because they will heat up fastest; winter temperatures in latitudes between 60^{o} and 90^{o} are expected to warm up more than twice as fast as the global average, and the Arctic tundra may disappear altogether. Some species of beech (Nothofagus) can still be located on the portions of Gondwanaland which later separated to form the southern continents. These only move their habitat by about a meter a season. Such species cannot possibly keep up with the pace of change which is over 1000 times faster than during the onset of natural periods of global warming or cooling.

Changing rainfall patterns will compound the ecological disaster, while rises in sea levels will swamp coastal habitats. As trees and plants die out and habitats disap-

pear, so will the animals that depend on them. As the world's wilderness areas shrink and are increasingly hemmed in by agriculture and development, species will find it ever harder to move and as the world continues to get warmer there will be no available habitats for species to reestablish themselves.



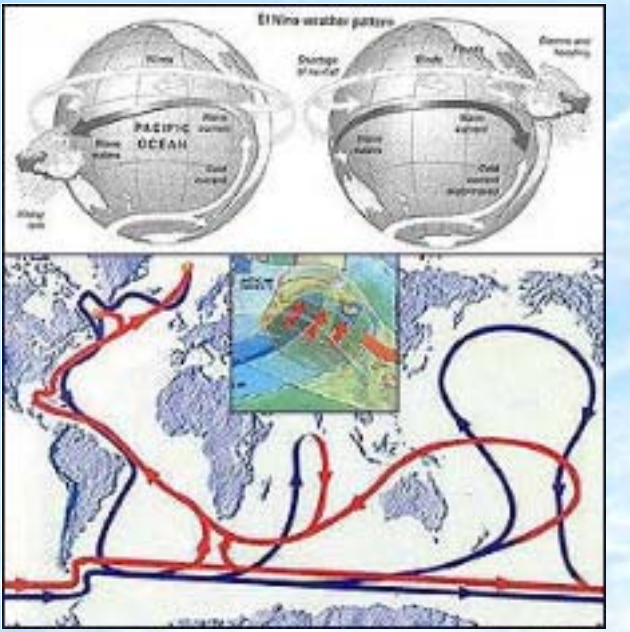
Satellite images of plant life on Earth. The Sea-viewing Wide Field-of-view Sensor (SeaWiFS) monitors the absorption of light by chlorophyll, used in photosynthesis on both sea and land (New Scientist 18 Oct 97).

El Niño, North Atlantic Oscillation and the Chaotic Weather

The discovery of chaos was first elucidated in Lorenz's 1960s meteorological example modeling atmospheric circulation (p 2). The butterfly catastrophe of Lorenz (p 3) - that a butterfly in Hawaii could become the nucleus of a subsequent tropical cyclone in Tahiti - remains the quintessence of the sensitive dependence on initial conditions that characterizes chaos. We thus do not have to look further than the weather to understand how chaotic climate change may occur in unpredictable oscillations and abrupt changes in the frequency of events such as El Niño.

El Niño, the Southern Oscillation with an intermittent frequency of some 4 to 7 years, is associated with the excessive warming of water in the Eastern Pacific just south of the equator. It is associated with an atmospheric pressure inversion between Tahiti and Darwin Australia which peaks at Christmas, giving El Niño the name of the Christ child. Although El Niño has been with us for centuries and previous droughts in the Amazon believed to be associated with the Southern Oscillation have been described in the archaeological record, the end of the century has been associated with an increasing series of severe El Niños, the last of which in 1997 triggered widespread forest fire damage in the Amazon and Indonesia, disrupting ecosystems from Africa to the Galapagos.

Although it is debated whether accentuated El Niño is a direct consequence of global warming, its association with warm bodies of water and increasing severity are both consistent with the predicted effects of global warming in simulations which indicate anomalous changes in global weather patterns. Signs of a hardening of the southern oscillation have been felt a switch from the severe 1997 El Niño to an almost as devastating La Niña in 1998, which has precipitated widespread flood and hurricane.



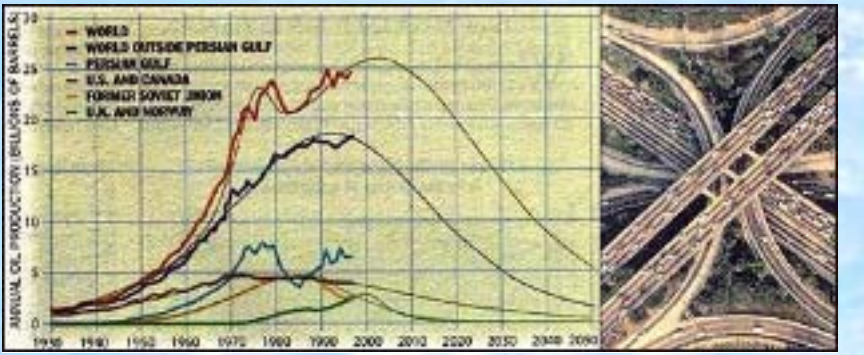
Above: The usual La Niña pattern allows cool antarctic water to feed the Peruvian coast. Warm waters moving west feed the Asian monsoon. The Southern oscillation of El Niño (right) interrupts this with a body of warm water which moves Eastward across the equator. The monsoon is delayed, Peruvian fisheries fail from lack of nutrient, the Amazon becomes desiccated (NZ Herald). Below: The North Atlantic ocean conveyor is part of a global circuit (New Sci. 8 Feb 97). It moderates arctic air flow over Europe (centre) (Sci. Am. Nov 95). Global warming could carry the limit of the conveyor south causing freezing winters in Europe.

A second coupling between ocean and atmosphere, the North Atlantic conveyor which moves warm water up to the Arctic from the tropics is essential in moderating European weather from the severe effects of the wind flows off the Arctic ice sheets. Model predictions suggest that global warming could move the limit of the conveyor south, which would precipitate severe winters as were sometimes seen in the middle ages.

Energy Fixation and Depletion of Non-renewable Resources

The world has depended on oil to power the explosion of industrial technology across the planet, which has hastened the development of giant cities and urban sprawl which requires massive amounts of transport emissions to get populations to work and to process the food they require to survive and heat their homes in cold countries. This both drives global warming and the greenhouse effect and causes much of the world's air pollution and pollution by a variety of non-biodegradable products of the oil industry from solvents to plastics. Many of these cities, typified by Los Angeles depend on the automobile and massive per capita emissions just to get food to the supermarket shelves and people to work. Even social contact depends on gross emission. Such badly-designed cit-

ies may become doomed in the future.



Analysis of world oil production indicates that we are already reaching the limits of oil production and that a permanent decline will set in during the next decade (Sci. Am. Mar 98). Massive efforts of technological re-alignment are required to convert the free-way-based emission culture into a sustainable transport economy based on renewable energy. Badly-designed cities like Los Angeles are likely to suffer.

This profligate use of non-renewable resources is accompanied by shocking lack of initiative in researching and utilizing cheap renewable sources of energy which will smoothly dovetail into the changing face of world cultures as the cost of oil begins to rise with scarcity. The illustration below indicates that we are rapidly approaching the crunch point regarding oil reserves, where the price will start to climb as scarcity begins to set in.

Although wind and solar generation has been established as a viable means of power production even on an extensive scale as these illustrations show, renewable forms of energy production which do not increase CO_2 are continually postponed because it is temporarily cheaper to use non-renewable CO_2-forming fossil fuels, but integrating alternative power sources to the grid make them cheaper immediately, because they can provide relief from peak costs (Sci. Am. Sept. 95).

We do have viable renewable technologies but these will take massive development and are generally not so well suited to transport uses as they are to providing electrical supplies to homes. Since we cannot continue to use these non-renewable resources indefinitely, by far the best long-term investment strategy is to develop renewable energy technologies constructively now and save as much of the non-renewable resources as possible for the future to avoid a genuine chemical scarcity emerging for later civilizations. To remove in one or two generations fossil chemical reserves that have taken hundreds of millions of years to accumulate is selfish greed without parallel - an act of treason to our own forebears. The fact that an effective transition to renewable energy technologies has not yet happened shows the tragedy of the commons continues to apply to our non-renewable resources, to our folly. Humans are now utilizing a majority of the photosynthetic energy of the planet for their own purposes. The photosynthetic basis of economics is the accursed share unless we use it wisely.

Population Exploding

Although world population growth is now beginning to slow as a result of social factors associated with the media, increasing education and role of women in society, the exploding population and its consequences in inevitable human impact on all aspects of the biosphere has been described as the most serious crisis ever to face the planet. Indeed Anne and Paul Ehrlich, authors of “Population, Resources and Environment” and “The Population Explosion” have described population as the issue around which all the others pivot, without which saving the environment cannot be seriously achieved:

“People can learn to treat growth as the cancer-like disease it is and move towards a sustainable society. The rich can make helping the poor an urgent goal instead of seeking more wealth and useless military advantage over one another. Then humanity might have a chance to deal with all those other seemingly intractable problems. We shouldn't delude ourselves: the population explosion will come to an end before very long. The only remaining question is whether it will be halted through the humane method of birth control, or by nature wiping out the surplus” - Anne and Paul Ehrlich (Porritt 119). This conflict of views is illustrated by the criticism expressed by Nafis Sadik, executive director of the United Nations Population Fund, at Pope John Paul's 1996 statement that hunger is not linked to over-population, saying the world's future food needs would be inextricably linked to demographic changes. Desmond Morris has succinct comment on the role of religion (p 529).

The world's population is now about 5.9 billion and still expanding very rapidly, despite a marginal slowing in the late 1990s. Every day we share Earth and its resources with 250,000 more people than the day before; every year, there are about another 90 million mouths to feed. It is the equivalent of adding a Philadelphia to the world population every week; a Los Angeles every two weeks; a Mexico every year; and a US and Canada every three years.