CHAPTER ONE

Frogs, floods and famines

In 1991 in the South of England gardeners and naturalists reported a mass death of frogs in garden ponds, small lakes, commons and village greens. Scientists were unable to say what had caused their death on such a large scale, but hundreds of children and parents, many of whom had created a habitat for these creatures to thrive, were disturbed. The suspicions of the scientists, and the people who saw them die, was that pollutants in the environment, in the water and the air, had become too much for these sensitive creatures, which, like all amphibians, absorb substances in the atmosphere and water through their skins as well as their lungs. Perhaps the frogs represented an involuntary early warning. If they cannot survive in our gardens, how long will it be before the earth becomes too toxic for humans as well?

For many people around the world the environmental crisis is already a matter of survival, for themselves and their children: for millions of people in the Sahel region in Africa whose degraded lands will no longer support their livestock and crops; for the residents of Chernobyl in the Ukraine dying of cancer after a nuclear disaster which the industry had always said could never happen, and the sheep farmers in the Lake District who still cannot sell their contaminated sheep in the market eight years after the accident; for the land Dayaks and nomadic Penans of Sarawak in Malaysia whose ancestral home, the million-year-old tropical forest is being systematically and greedily cut down to be burnt as disposable chopsticks or waste construction materials in incinerators in Japan.

Opponents of environmentalism argue that the dangers are

overrated and that calls for a new ethic, or a new religious focus on the place of humanity in the natural world, are the result of the exaggerated picture of doom that ecologists and environmentalists have painted.[1] However, as we survey the range of impacts which human activities in less than a century have made on the planet and its ecosystems, it should become apparent that there is indeed a crisis, and a crisis of momentous proportions. The extent of the crisis seems to require not just new environmental regulations, or new technologies which make less impact on the natural world, though these are surely needed, but a radical change to the predominant direction of human behaviour in modern civilisation. As the global system of the money economy and industrial production and consumption reaches peoples in every corner of the planet, it is the very nature of that system, and of the life-styles which it sponsors, which are called into question.

CLIMATE CHANGE AND GLOBAL WARMING

The single most pervasive and potentially cataclysmic factor in the ecological crisis is that of climate change. Local climate change is already a feature of life in many tropical and sub-tropical regions. Formerly forested areas converted to grassland, cash-crop agriculture or concrete cities, undergo dramatic climate changes as the cooling effects of tree cover are removed. The tropical canopy acts as part of a micro-climate which recycles and controls both precipitation and sunlight by a combination of warming and cooling mechanisms so as to maintain temperatures and soil fertility at levels suitable for the great diversity of life forms to which the tropical forests are home. Once the forests are removed the natural cooling effects of recycled moisture are disrupted, precipitation decreases or becomes irregular and soil moisture is reduced as the capacity of the tropical ecosystem to absorb and recycle precipitation is diminished. Tropical cities of concrete buildings on a landscape dominated by asphalt become unbearably hot places to live without manufactured air-conditioning with its high energy consumption. Dried-up river-beds and brown denuded land-

scapes, such as those which surround Manila on the formerly lush tropical island of Luzon in the Philippines, are indicators of the devastation that this kind of local climate change can induce.

Such local climatic changes are in themselves warning enough of the dramatic and potentially catastrophic effects of human activity on local ecosystems and climate systems. However, the earth is now faced with a much greater change in its climatic system, not just in particular continents or regions but globally. The surface temperature of the earth is kept at an average of 15 degrees Celsius, giving a temperature range which is ideal for life, by a combination of gases in the atmosphere which produce a natural greenhouse effect. The warmth of the sun's rays is reflected off the earth's surface and trapped in the atmosphere and the air, and the earth itself is warmed. This natural construction of a climate ideal for life is what scientists identify as the greenhouse effect.

Most scientists and ecologists now believe that the amount of carbon dioxide – the most important of the naturally beneficial greenhouse gases – which human activity is currently generating, together with rises in other greenhouse gases such as methane and nitrous oxide, is leading to an enhancement of the naturally occurring greenhouse effect: this is the prognosis of global warming. The International Panel on Climate Change report that in the last 100 years, roughly the period of industrial activity on the earth, a real warming of the planet has taken place of between 0.3 and 0.6 degrees centigrade.[2] This warming is thought to have occurred as a consequence of the enhancement of the natural greenhouse effect. Two-thirds of this enhancement has come about through the burning of fossil fuels, which have increased the amount of carbon dioxide by 25 per cent since the beginning of the Industrial Revolution, and have increased the concentration of carbon dioxide in the upper atmosphere by 0.05 per cent per year, so that there is now 10 per cent more carbon dioxide in the atmosphere than thirty years ago.[3] 6 billion tonnes of carbon are produced every year by fossil-fuel burning, and a further 2.6 billion tonnes of carbon originate from the burning of forests. The production of

methane, the second most important greenhouse gas, has risen as a consequence of increased agricultural activity to feed the growing human population and of the rising demand for farmed meat, cattle and rice paddy being the primary sources of methane. Methane is also associated with natural gas and coal production.[4] Nitrous oxide, another greenhouse gas, is emitted in growing quantities from power stations, factory chimneys and car exhausts, while chlorofluorocarbons (CFCs), a manufactured product which has a warming effect 10,000 times that of carbon dioxide, have also further enhanced the greenhouse effect.

The forecasts of the IPCC of the future effects of global warming are sobering. They predict on the basis of a business-as-usual scenario – that is to say a maintenance of current levels of fossil-fuel burning and greenhouse gas production – that global mean temperature will rise at 0.3 degrees centigrade per decade for the next 100 years, leading to a rise of 1 degree centigrade by 2025 and 3 degrees centigrade by the end of the next century. The rise in temperature will be greater on land areas than over seas. The report highlights the possible effects of large increases in Central North America – the grain basket of the Western world – Southern Europe, the Sahel region of Central Africa and Australia. Central North America will experience a 2–4 degree centigrade warming in winter, and an increase in precipitation, while in summer it will experience a 2–3 degree warming and a 5–10 per cent reduction in precipitation. These predicted temperature shifts are theoretically enough to change the ecology of entire regions, and the IPCC predict a range of startling effects including the occurrence of tropical diseases in formerly temperate climate zones, increases in flooding in coastal zones, exacerbation of drought conditions in arid areas. Vegetation will not be able to adapt fast enough to the rapidity of climate change which is predicted in the next century and areas such as sub-Saharan Africa and Southern and Eastern Asia may see a one-fifth reduction in food production consequent upon increased heat.

Already the signs of the effects of global warming can be observed in a measurable global sea-level rise of 10–20 centi-

metres, in the retreat of a number of land glaciers around the world and signs of melting of the Antarctic ice shelf. The IPCC also point out that in the 1980s five of the warmest years were recorded since meteorological records began. The future effects of global warming are not easy to predict with precision. According to the IPCC one of the more predictable effects will be a sea-level rise of 6 centimetres per decade, leading to a 65-centimetre rise by the end of the next century. Ice equivalent to 5 metres of global sea level is currently submerged in the ice-floes of the Antarctic. If this ice were to gradually melt, and there are already signs that it is, the results would be even more catastrophic than the predicted steady sea-level rise. Coastal regions, ocean cities and islands such as Mauritius and the Maldives, would be affected by severe flooding and might eventually become uninhabitable. Ten per cent of the population of Bangladesh live on lands which would be regularly flooded with a sea-level rise of around 50 centimetres. Tidal cities like London, Venice and Bangkok, island cities like Hong Kong and Singapore, and river deltas such as the Nile, Niger, Yangtze, Mekong and Mississippi would be severely affected. At the same time the staple food-producing areas on many continents would be affected by temperature rises and precipitation loss in ways which could threaten world food supplies. On the other side of the equation, areas which are presently uninhabitable, or not susceptible to productive agriculture, might become habitable and productive with climate change. Some animal species would probably migrate to higher ground. Large areas of frozen subsoil in Northern Russia might become capable of sustaining new forests or farmlands. But great uncertainties remain in the prediction of the effects of climate change. At its worst climate change may pose a fundamental threat to the delicate balance of temperature, gases, vegetation and moisture which provide the conditions for life on earth.

Global warming is directly related to the industrial consumption of energy and the production of greenhouse gases in affluent industrialised economies. Two-thirds of global carbon emissions arise from fossil fuel utilisation for power generation, transportation, domestic heating, cement-making, gas and

coal-mining and industrial manufacturing. Most of these emissions still originate in the rich North, while the burning of forests, resulting principally from rural migration in the Third World as prime lands are enclosed for commercial farming, contributes one-third of the increase in carbon dioxide. By 2025 the projected population increase to 8 billion people will necessitate 60 per cent more fossil fuel consumption than now, and this assumes that most of these additional people will not attain Western levels of wealth and consumption. The World Watch Institute estimates that the world's 400 million cars alone emit 500 million tonnes of carbon dioxide into the atmosphere every year, or 17 per cent of the global output of carbon dioxide.[5] If all the millions of bicycles in China were swapped for cars at some point in the next fifty years, or if two-thirds of families in the South were to acquire refrigerators and electric light, then the prognosis for global warming would be even worse.

A vocal minority of scientists continue to contest the global warming theory. They believe it is a sign of the arrogance of contemporary humans to imagine that human activity is significantly affecting the climate system of the planet. The measured rises in global mean temperatures in this century, and the sea-level rises, can be explained, they argue, as consequences of the gradual warming which has been going on since the last mini-ice age in the sixteenth century, rather than as anthropogenic changes. Sceptics also point to the varying behaviour of the indicators of climate change. Thus even though glaciers are receding in many parts of the world, glaciologists have found that glaciers in South America are advancing again after receding for many decades. But although a minority of scientists continues to dispute it, the weight of scientific opinion is now on the side of the global warming hypothesis, as startling evidence of significant climate change continues to mount. In 1995 Norwegian scientist Ola Johannessen and his colleagues reported that an iceberg the size of Oxfordshire broke off from the Larsen Ice Shelf in the Antarctic, the Wordie Ice Shelf broke up and ice connecting James Ross island to the Antarctic Peninsula disintegrated.[6] Advocates

of the hypothesis had predicted that its first substantial effects would be observed in these two ice regions. As this book was about to go to press reports emerged of the latest findings of the IPCC which indicate a new consensus amongst scientists that global warming is already taking place, and new and much more apocalyptic fears that, unless drastic action is taken, global warming could accelerate out of control by the end of the next century.

The hypothesis that the climate is changing as a consequence of the extent and character of industrial and agricultural activity on the surface of the planet is a real possibility which not even the most sceptical scientist can rule out on present evidence. Some action has already been agreed at an international level. The Global Climate Convention, ratified after the United Nations Conference on Environment and Development, the 'Earth Summit' held at Rio de Janeiro in 1992, committed the largest producers of carbon dioxide and other greenhouse gases to stabilisation and reduction targets, despite fierce resistance from some of these producers, most notably the United States of America. But the small reductions agreed by the developed countries will be more than taken up by advancing development in less developed countries and global energy consumption and fossil-fuel burning will continue to increase. More radical change in energy production technologies and in energy use are needed.

POLLUTION

The potential environmental problems arising from the enhancement of the greenhouse effect point to the ambiguous character of that phenomenon popularly known as pollution.[7] Many 'pollutants' are in fact naturally occurring substances, such as carbon dioxide, whose concentrations in the atmosphere, waters or lands of the earth have increased as a consequence of human activity. The issue is whether this anthropogenic increase in the prevalence of certain substances in the world, and the introduction of manufactured substances, represents a real long-term threat to life on earth or to human

life. The possible threats to human and non-human life from pollution are many and various. The surface of the biosphere which sustains the only life forms known in the universe is no more than twelve kilometres from bedrock or ocean floor to airless space beyond the upper atmosphere. The damaging effects of pollution are recorded on this fragile 'skin' from receding and polluted water aquifers deep underground to changes in the gases of the upper atmosphere.

The discovery of a hole in the thin protective layer of ozone in the upper atmosphere in 1985 set alarm bells ringing in the scientific community. The precise identification of the ozone hole over Antarctica by a British scientist testing atmospheric gas levels with instruments on a balloon, and its confirmation by satellite evidence, led to an urgent scientific quest to identify the cause. The now widely accepted theory emerged that the depletion of atmospheric ozone which caused the Antarctic hole and a general reduction in atmospheric ozone from 2 to 11 per cent originated from human pollution of the atmosphere in the form of CFCs, which are used as refrigerants, aerosol propellants and plastic expanders. The hole is caused by increases in the amount of suspended chlorine in the upper atmosphere, which neutralises ozone. The existence of the hole locally reduces the greenhouse effect, which in turn results in the formation of ice clouds and ice particles which enhance the ozone depletion.[8] The widening hole over the Antarctic is appearing for longer periods every year and covering larger areas, while there is also now a seasonal thinning of ozone over the Arctic, which again is growing in size and duration year by year.

The depletion of the ozone layer weakens the protection the atmosphere provides to human and non-human life from the damaging effects of too much ultraviolet light. This weakening will result in an increase in human skin cancers and eye cataracts, an increase already measurable in areas nearest to the Antarctic. It will also have effects on human immune systems, and on plant and animal life, including the destruction of plankton on which the ocean food chain depends, and the blinding of fish and mammals exposed to increased ultraviolet

radiation. The human populations of Chile, New Zealand, Iceland and even Northern Scotland may soon have to begin taking precautionary measures if they are not to experience a significant increase in skin cancers. Evidence from the nearest city to the Antarctic, Punta Arenas in Chile, indicates that already 3.7 times the normal quantity of ultraviolet B radiation is reaching the earth's surface. Increasing blindness in cattle and sheep, blind fish in the Tierra del Fuego, changes in plant and mammalian life-cycles, and a growing incidence of cataracts in human eyes and of severe sunburn and skin cancers are already being recorded in this region.

The discovery of the Antarctic ozone hole, and the thinning of ozone over the Arctic, sharpened perceptions in the scientific community of the significance of pollution, and amongst the general public and politicians. One of the most hopeful indications of the willingness of humanity collectively to respond to the environmental crisis is the global agreement on ozone depletion known as the Montreal Protocol, which was concluded by thirty-six national governments in 1987. The agreement committed signatories to a reduction in the production of CFCs by 20 per cent of 1986 levels by 1993, and by another 30 per cent by 1998. It rapidly became apparent with further research that there was an urgent need to reduce production more quickly. A new agreement was signed by ninety-two countries in London in 1990, committing them to phasing out all CFC production by the year 2000, and to ceasing production of other ozone-depleting chemicals such as halons and carbon tetrachloride. An agreement was also reached on a subsidy for the cost of transferring CFC-substitute technology to Third World nations.[9]

Ozone in the upper atmosphere may be vital to life but its disappearance is an unseen and relatively recent phenomenon. Air pollution has a much longer and more visible history and is responsible for a much greater range of effects on the health of human and non-human species. Air pollution, like global warming, originates primarily from energy and industrial production processes and from human transportation systems. The most significant contemporary source of air pollution is road

transportation. Vehicle exhaust emissions, including carbon monoxide and nitrous oxides, petrol additives such as lead and benzene, and unburned fuel particulates from diesel engines, are linked with various diseases including asthma and bronchitis, with reductions in immunity to infection, with certain cancers and with damage to child development. Some studies have found an increased incidence of infectious disease amongst those living close to busy roads, while increases in childhood leukaemia and in the severity and frequency of asthma attacks are also thought to be linked with increases in road traffic emissions, though the precise causes of recent dramatic rises in the incidence of childhood and adult asthma remain unclear.

Industrial emissions are often removed from cities and their environs by tall chimneys but ultimately return to the lower atmosphere in the form of air pollution at places determined by wind pattern and climatic conditions. Oil and coal-fired power stations are the major source of sulphur dioxide and, along with vehicle emissions, of nitrogen oxides which return to the ground in the form of acidified droplets of water known as acid rain. The pervasive ecological effects of this kind of air-borne pollution are now showing up in the world's forests. The first indications of a problem in the forests were observed in the Plenderwald forests of Germany in the 1970s. Foresters noticed that pine trees were losing their needles, and branches were turning sickly yellow and brown instead of green, and then trees began to die. In 1982 34 per cent of trees in West Germany showed signs of damage and in 1988 52 per cent.[10] Some species such as silver fir were particularly susceptible and by the late 1980s 80 per cent of these had died in affected areas.[11] Ecological damage to forests was also observed in many other countries, including the United States and Britain, although government scientists were reluctant to recognise the problem, or to attribute it to air-borne pollution. There is still controversy about the causes of forest decline, but its effects are now observable on deciduous as well as coniferous trees. Leaf canopies are thinner than they used to be, leaves fall earlier and more quickly, trees grow more slowly, and tree roots are thinning. In many parts of the world trees are slowly dying.