

PLANETARY OVERLOAD

Global environmental change and
the health of the human species

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Contents

<i>Preface</i>	xiii
<i>Introduction</i>	1
1. First things	17
1.1 Introduction	17
1.2 Biological origins	19
1.3 Life on a restless planet	26
1.4 Future prospects	34
1.5 Summary	36
References	
2 The ecological framework	39
2.1 Environmental and ecological perspectives	39
2.2 Non-linear systems	47
2.3 Ecological ideas in human culture	50
2.4 Summary	53
References	
3 The health of populations	56
3.1 Persons, populations and public health	56
3.2 Health, wealth and environment	66
3.3. Human health within an ecological framework	72
3.4 Estimating the effects upon population health	75
3.5 Summary	78
References	
4 System overload: ancient and modern	82
4.1 Introduction	82
4.2 The decline of ancient civilisations	84
4.3 The human diet: 'evodeviation' and health	87
4.4 Energy use: environmental sources and impact	95

Contents

4.5	Acid rain	98
4.6	Environmental pollutants and ecosystems	102
4.7	Summary	104
	References	
5	Population increase, poverty and health	108
5.1	Introduction	108
5.2	Human ecology and population growth	113
5.3	Controlling population and alleviating poverty	122
5.4	Summary	128
	References	
6	Greenhouse warming and climate change	132
6.1	Climate change	132
6.2	Climate change and human health	143
6.3	Politics of climate change	167
6.4	Summary	169
	References	
7	The thinning ozone layer	174
7.1	The ozone layer	174
7.2	Direct health effects of increased ultraviolet radiation exposure	181
7.3	Indirect effects upon human populations	194
7.4	Summary	198
	References	
8	Soil and water: loaves and fishes	203
8.1	Soil: source of sustenance	203
8.2	Intensive agriculture	212
8.3	Food: hunger, food insecurity and malnutrition	215
8.4	Agriculture, food and health: other aspects	222
8.5	Water resources	225
8.6	Fewer fish for food?	231
8.7	Summary	233
	References	
9	Biodiversity: forests, food and pharmaceuticals	238
9.1	The benefits of biodiversity	238
9.2	Biodiversity and human health	243
9.3	Destruction of the world's forests	252
9.4	Summary	256
	References	
10	The growth of cities	259
10.1	Urbanisation and social change	259

Contents

10.2	Urbanisation and human health	266
10.3	The future: designing cities for healthy living	283
10.4	Summary	289
	References	
11	Impediments 1: conceptual blocks	294
11.1	Introduction	294
11.2	A lack of distance vision	295
11.3	The limitations of neoclassical economics	298
11.4	Summary	309
	References	
12	Impediments 2: relationships	313
12.1	Relations between rich and poor countries	313
12.2	Power relations and the Global Commons	318
12.3	Summary	323
	References	
13	The way ahead	326
13.1	Science: dealing with uncertainty	326
13.2	Policy initiatives	332
13.3	Social and political relations	334
13.4	Summary	336
	References	
	<i>Glossary</i>	339
	<i>Index</i>	342

Introduction

Homo sapiens has existed for less than one ten-thousandth of Earth's lifespan – and, indeed, for less than one-thousandth of the time since animal life ventured from the oceans onto the dry land. Humans are newcomers, with no special immunity against the usual fate of biological species on Earth: extinction. Indeed, it is just now becoming conceivable that within several generations the human species may face threats to its survival because of its disruption of Earth's life-supporting ecosystems.

Could humans, *really*, be an 'endangered species'? Isn't it more likely that any such threat to our survival would, at worst, be confined to certain hapless populations, and therefore would not threaten our species as a whole? Besides, we call other species 'endangered' when their population numbers *fall* below a critical level. Yet human numbers are assuredly not falling! Nor is human habitat shrinking. Indeed, we are commandeering more and more of the world's surface area and incoming solar energy for our own needs, and are now using (or preempting) an astonishing 40% of Earth's most basic resource, the incoming solar energy stored by terrestrial plants.¹ As we take control of more of this 'net primary production', via agriculture, pastoralism, forestry, land-clearing and urbanisation, there is less available to sustain other species. It sounds as if *they*, not us, are endangered.

Yet that is very much part of the problem. We humans cannot live apart from nature, remote from the great web of life. The emerging risks to human population health do not arise from local environmental contamination with direct-acting toxic chemicals, nor from a Malthusian outstripping of Earth's available material resources (oil, metals, timber, etc.). Rather, the risk arises from the disruption of natural systems because we are exceeding the biosphere's carrying capacity – i.e. we are overloading the planet's 'metabolic' capacity to absorb, replenish and restore. Through

our aggregate impact, various natural balances are tipping in directions that, if sustained, would make the world less able to support life. Some aspects of this overload, particularly land degradation, have occurred before on a localised scale. Most aspects, however, are the product of aggregate human activity in recent decades: increased emissions of greenhouse gases, damage to stratospheric ozone, depletion of aquifers and large-scale destruction of rainforest. These do not act by direct toxicity nor by exhaustion of non-renewable materials. Instead, they impair the productivity (soil, forest, oceans, biodiversity) or stability (climate, sea-level, ultraviolet filtration) of Earth's natural systems. John Powles has recently said of them: 'These effects are intrinsically difficult to predict and to counter, but this is now the main challenge facing those concerned with the health of human populations.'²

Fossil fuel combustion illustrates the above distinctions. Our earlier concern was over the resultant local pollution by noxious gaseous emissions which, at 'smog' concentrations, caused extra deaths. Subsequently, we became concerned that our energy-intensive society would run out of fossil fuels – oil first, probably. Today we realise that, even with emission-controlled smokestacks and proven reserves of fossil fuels that will last centuries, the problem we face is a quite different one. We are loading the atmosphere with a heat-trapping gas, carbon dioxide, that, eventually, will disrupt various of the biosphere's natural cycles, processes and conditions upon which we fundamentally depend for life-support.

Compared with the hunter-gatherer era, which predominated until a short 10,000 years ago, human numbers have multiplied one thousand-fold (including a massive ten-fold increase in the past 250 years) and our average, daily, per-person energy use is also about one thousand times greater. Our aggregate impact upon the biosphere is therefore about one million times greater than in those pre-agrarian days. We are consequently overloading Earth's capacity to absorb otherwise *non-toxic* waste gases, to replenish slowly-renewable resources such as soil and groundwater, and to sustain genetic and ecological diversity. It is these disruptions that comprise an unprecedented threat to our life-support systems.

This is unfamiliar territory. Historically, population health crises have had some immediacy about them: wars, floods, the Black Death, air pollution, cholera, smoking-related diseases and the AIDS epidemic. During 10,000 years of human settlement, there have been two major categories of environmental health problem, one animate, the other inanimate. First, there has been the age-old problem of contagious infectious diseases, associated with increased population density. A myriad

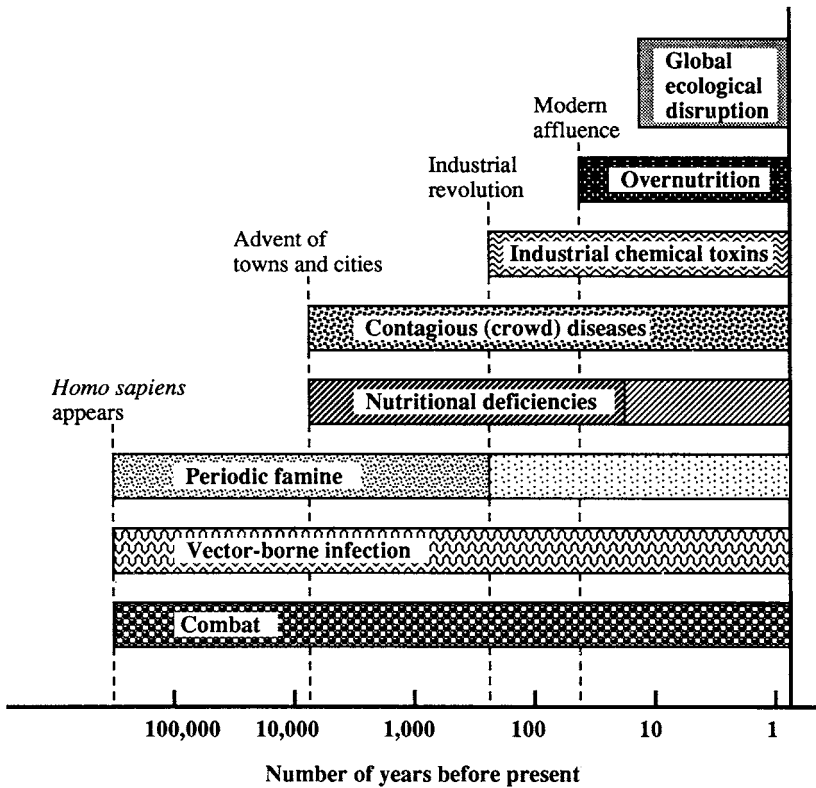


Figure. Emergence of the major categories of population health hazards during human cultural evolution.

of microbes survive by feeding on, and breeding in, humans, and some cause infectious diseases. We have found ways of countering many of those infections. Second, more recently we have been exposed to noxious chemical exposures resulting from industrial activity. We have learnt much about the toxicological effects of heavy metals, chemical pesticides, asbestos and assorted air pollutants, and we have begun to limit and control these exposures. Also, as shown in the figure, the agrarian and urbanised lifestyle has entailed a (sometimes precariously) reduced range of nutrients, followed, later, by the 'diseases of affluence'.

What now confronts us, however, is quite different. There may well be a convergence of population pressures, land degradation, climate change, depletion of groundwater and genetic impoverishment of breeding-stocks to cause significant food shortages next century. Human population health may also be adversely affected by such things as the increased spread of

Table. Possible adverse effects upon human health caused by global environmental changes.

Environmental change	Type (direct, indirect) and timing ^a (early, late) of adverse health effect			
	Manifestation	Direct, early	Direct, late	Indirect, early, late
Enhanced greenhouse effect	<i>Global warming and other climate change</i>	Heatwave-related illness and death Natural disasters: cyclones, floods, landslides, fires Increased risk of flash floods and surges	Inundation → social disorder, impaired sanitation, farmland loss	Extension of vector-borne infections Food shortages due to impaired agriculture Consequences of damage to foreshore facilities, roads, etc.
Stratospheric ozone depletion	<i>Increased UV-B flux at Earth's surface</i>	Sunburn, conjunctivitis Suppression of immune system → increased risk of infection	Skin cancer Ocular effects: cataracts, pterygium	Impaired growth of food crops and of marine microorganisms (base of aquatic food web)
Acid aerosols (from burning of sulphurous fossil fuels)	<i>Acid rain</i>	Effects on respiratory system (?)		Aquatic damage (reduced fish) Impaired growth of crops Impaired forest growth → reduced ecosystem productivity

Land degradation: intensive agriculture, overgrazing	<i>Erosion, sterility, nutrient loss, salinity, desertification</i>	Decline in agricultural productivity	Rural sector depression → migration to fringes of cities (see bottom row)	Exposure to pesticides and fertilisers (may also cause algal blooms)	Consequences of silting up of dams and rivers
	<i>Depletion of underground aquifers</i>	Lack of water for drinking and hygiene	Decline in agricultural productivity		
Loss of biodiversity	<i>Destruction of habitat</i>	Deforestation → disruption of local culture	Loss of potentially edible species		Deforestation → greenhouse enhancement
	<i>Loss of genetic diversity; weakening of ecosystems</i>			Loss of medicinals, and other health- supporting materials	Greater vulner- ability of crops and livestock. Reduced vitality of ecosystems
Other effects of overpopulation (particularly in poor countries)	<i>Proliferation of crowded urban slums (due to migration and high fertility)</i>	Infections Malnutrition Homelessness Antisocial behaviours	Social disorder Chronic toxic effects of environmental pollutants		Consequences of overload of local ecosystems

^a The designations 'early' and 'late' are notional, and indicate *relative* timing. (Based on McMichael, 1993.³)

vector-borne diseases like malaria (because of climatic change), increased deaths among the frail (due to more frequent heatwaves), increases in skin cancer, blindness and infectious diseases along with reduced terrestrial and aquatic food yields (all due to greater exposure to ultraviolet radiation), death, injury and disease due to the disruptions of altered climate and sea-level, and resurgent infectious diseases (particularly from urban crowding, poverty and squalor, and from changes in patterns of travel and in sexual and other behaviours). A summary of the *possible* impacts on human population health – encompassing direct and indirect effects, immediate and delayed effects, and local and global effects – is shown in the accompanying table.

So, why has the prospect of damage to this planet's natural systems not prompted more discussion about the impact on human health? One reason for this veil of inattention is that, relative to the more obvious environmental threats to economic productivity, aesthetic amenity and our favourite species of foliage, fur, feathers and fins, this category of threat to population health lacks tangibility and immediacy. As a public health issue it lacks the familiar, measurable and toxicological qualities of other environmental health problems. We have therefore only dimly perceived its implications for population health.

This book seeks to widen our field of vision. By considering the topic within an ecological setting, I hope to clarify the significance of global environmental change for human biology and health. Admittedly, there is much that is uncertain or speculative about the causes and consequences of global environmental changes. But the fact that there is much that we don't, or can't, yet know is not a reason to dismiss the possibility, nor to defer prudent social response. Scientists and policy-makers are going to have to learn to live with more uncertainty than in the past.

This point about uncertainty needs emphasis. Since it is not yet possible to make specific predictions and to forecast actual outcomes, scientists must deal with ranges of plausible scenarios. They may use *predictive* models to estimate outcomes for a given scenario, but that is not a *prediction* of what will necessarily happen. The UN's World Commission on Environment and Development (WCED) recognised this problem in its much-quoted report of 1987, *Our Common Future*. Noting that 'major, unintended changes are occurring in the atmosphere, in soils, in waters, among plants and animals, and in relationships among these', the Commission said:

The rate of change is outstripping the ability of scientific disciplines and our capabilities to assess and advise. It is frustrating the attempts of political and

economic institutions, which evolved in a different, more fragmented world, to adapt and cope.⁴

Even though many of these global environmental changes may entail effects upon health not previously encountered, we cannot defer social action until we 'know' those end-effects. By the time the health consequences of ecosystem disruption are clearly evident in human populations it may be too late to reverse or repair the damage. The dynamics of ecosystems do not obey the linear orderliness of physical systems; instead, they are influenced by feedback loops and critical loads. Limits, once exceeded, may (rapidly) lead to decline or collapse.

The content of this book

If I had to reduce my argument to a simple 1–2–3, it would be this. First, the *one* underlying problem is the entrenched inequality between rich and poor countries, which predominantly reflects recent imperial history, power relationships and the global dominance of Western industrial technology and economic values. Second, the *two* central manifestations of this inequality are: (1) rapid, poverty-related, population growth and land degradation in poor countries, and (2) excessive consumption of energy and materials, with high production of wastes, in rich countries. Third, the *three* possible (perhaps coexistent) adverse outcomes of those manifestations are: (1) exhausting various non-renewable materials, (2) toxic contamination of localised environments, and (3) impairment of the stability and productivity of the biosphere's natural systems. Of those three possible outcomes, the exhaustion of non-renewables seems unlikely (although topsoil, aquifers and stratospheric ozone are only slowly renewable!), localised chemical pollution will only become a systemic problem if it disrupts ecosystems . . . but the third would, by definition, be a threat to human (and other) life. Some of today's global environmental changes seem to portend that third outcome.

Overall, the book has three parts. It explores, first, the evolutionary and ecological backdrop to human biology and human population health. It then examines the possible impact of each of the main incipient global environmental changes upon population health. Finally, it considers the implications for human society – particularly the impediments to, and opportunities for, effective response.

In a little more detail: In chapters 1–4, I discuss the nature of the problems posed by ecological disruption. These chapters offer an evolutionary perspective on life and the emergence of *Homo sapiens*, and on the

consequent needs of human biology. The nature of ecosystems is explored, before considering how the sustained good health of a species is an expression of ecological balance. There is also some discussion of the concept of 'population health' and the difficulties in estimating the adverse health effects of ecological disruption. The ecological perspective is, in my view, crucial to our thinking about the future health of human populations in today's overloaded world. The long-term survival of every species depends on its continued access to energy, nutrients, water and respirable gases. For as long as we humans survive, we too are destined by our biological origins to be participants in an interdependent biosphere, taking in water and oxygen, and drawing a sustainable share of the net primary production from photosynthesising plants (i.e. biochemical energy) and of the nutrients cycling through the system.

Chapters 5–10 are the 'meat' of the book. In them I review, first, the underlying problem of excessive population growth, and then the five main categories of ecological disruption: climate change, stratospheric ozone depletion, land degradation and impairment of food production, loss of biodiversity and the burgeoning growth of cities. For each, there is an exploration of the origins of the problem, the social and political context, and a detailed discussion of the possible impacts upon human population health.

Chapters 11–13 step back from the ringside view of population health problems and discuss the underlying problems within a broader social context. Those chapters do not attempt to deal comprehensively with those complex questions, but they do seek to extend the dialogue in light of the evidence of the threats to human health. In chapter 11, some of the main impediments are explored. What do we mean by 'growth' and 'development'? Is the real world an embarrassment to orthodox economic theorists? What are the main impediments to understanding this potentially dramatic Public Health Problem? What are the intellectual assumptions or political values that obstruct societal response? Chapter 12 examines the impediments to international cooperation and ecological sustainability posed by the entrenched inequalities of wealth, trade and influence. It also examines the public health hazard of warfare, an ever more likely response to increased tensions over dwindling environmental resources. Military technology casts longer shadows over populations and ecosystems, while nascent intercountry tensions over supplies of water, fisheries and other 'commons' cast intersecting shadows.

Chapter 13 considers the prospects for moving forwards. Our scientific traditions are mechanistic and reductionist, and they militate against the

integrated approach that is now needed. We need to attune our science to the pervasive uncertainties and, therefore, to the precautionary principle. We have applied our science and technology primarily to mastering and exploiting the environment, not to sustaining it. Ecologically sustainable solutions will require over-riding various deeply-ingrained aspects of human evolutionary inheritance and several thousand years of culture and technology that have pointed us in non-sustainable directions.

Finally, a word on the referencing of 'factual' matter. There is much information being published about global environmental problems. I have quoted many figures and made many factual assertions. Not all are referenced, since to give references for everything would have brought its own form of overload. Wherever possible, in writing this book, I have corroborated figures and factual statements from several sources. Alongside the specialist scientific literature that I have referenced, there are various omnibus sources published by the World Health Organization (WHO), the United Nations (UN) and its many agencies, the World Bank, the Worldwatch Institute and others. Those are listed at the end of this chapter. I think that what is most important here, however, is not the factual *detail* (different sources give slightly different figures for many of the items cited) but the overall import of the analysis and argument.

Why this blind spot?

It is worth exploring further why we might think it implausible that the health, if not survival, of our own species could be jeopardised by global environmental change. For a start, the anthropocentric nature of the world's major cultures – particularly the dominant, technologically-oriented Western culture – obscures awareness of the ecological dimensions of human existence. Even so, the ominous *direction* of many of the global environmental trends is no longer difficult to see. The current trends in world population growth, in the widening wealth gap between rich and poor nations, and in the associated global ecological disruptions to atmosphere, soil and groundwater are all well documented. Are the spread of food shortages in sub-Saharan Africa and the recent downturn in the world's per-person cereal grain production early signals? (After all, no bells will be rung to signal the 'start' of abnormal trends; their existence is a matter of judgement, often in hindsight!)

It seems clear that we do not yet much understand the intimate relationship between ecological systems and the health of populations. Our

day-to-day personal health appears to be determined by immediate circumstances: family history, behaviours, type of job, locally-circulating viruses, luck on the roads and so on. Indeed, the dominant view of health and medical care in developed societies focuses upon the individual; we do not usually apply a population perspective. The essential ecological underpinnings of population health are therefore well beyond our field of vision; the potential adverse health effects of global environmental change are usually distant in time and place. Biological evolution has 'programmed' us, like all other species, to react most decisively to current problems rather than to future possibilities; a 'biological predilection for short-term gain' has been built into human biology by the process of natural selection.⁵

It is the combination of this instinct for short-term individual gain (which is widespread in nature) with human brain-power that, through its consequences, jeopardises the longer-term needs of the human species. So, to overcome today's global environmental problems we will need both understanding and moral fortitude to compensate for this genetically-endowed 'predilection for short-term gain'. I hope that this book will help to increase that understanding. But do we have the collective will to take effective, equitable corrective action? Thomas Berry, a theologian and cultural historian, observes that there has been 'no sustained religious protest or moral judgement concerned with the industrial assault on the Earth, the degradation of its life systems, or the threatened extinction of its most elaborate modes of life expression.'⁵ He is right to note the absence of institutional moral disapproval, but, if people do not understand the ecological predicament now confronting us, then it is ignorance rather than moral torpor that is the problem. (One hopes, somewhat against the evidence, that much of the prevarication and pursuit of national self-interest at the 1992 UN Earth Summit arose from a misunderstanding of the longer-term, ecological, implications of today's global environmental problems.)

Meanwhile, there are some signs that our understanding is increasing. In 1990, the UN's Intergovernmental Panel on Climate Change (IPCC) predicted that greenhouse-induced global warming would have various adverse consequences upon human health, human settlement and human social organisation. The Panel's report stated:

In coastal lowlands such as in Bangladesh, China and Egypt, as well as in small island nations, inundation due to sea-level rise and storm surges could lead to significant movements of people. Major health impacts are possible, especially in large urban areas, owing to changes in the availability of water and food and

increased health problems due to heat stress and spreading of infections. Changes in precipitation and temperature could radically alter the patterns of vector-borne and viral diseases by shifting them to higher latitudes, thus putting large populations at risk. As similar events have in the past, these changes could initiate large migrations of people, leading over a number of years to severe disruptions of settlement patterns and social instability in some areas... Global warming and increased ultraviolet radiation resulting from depletion of stratospheric ozone may produce adverse impacts on air quality such as increases in ground-level ozone in some polluted urban areas.⁶

These concerns were echoed in the subsequent work of WHO's Commission on Health and Environment.⁷ Will this new awareness grow fast enough to avert serious ecological problems? The revolutionary ideas of civic hygiene and infectious disease control took over a half-century to enter public consciousness, and to cause significant social change and public health gain. In a world of accelerating environmental impact we may have precious little time to embrace the idea of a sustainable biosphere as the necessary, non-negotiable basis of long-term human population health.

Reevaluating priorities

What is the cultural and social significance of today's global environmental problems? Far from having reached what, in Fukuyama's ecologically myopic assessment, is 'the end of history' (marked by the triumph of liberal democracy),⁸ we may well be entering a transitional stage in human history, moving 'between two worlds'.⁹ Having created, through modern technology, a seeming capacity to override local ecological constraints, we must now contemplate a social reformation that reestablishes an ecologically sustainable way of life. This will require us to look to distant horizons for solutions that, in both time and content, extend well beyond the puny reach of conventional political decision-making.

Currently, we exalt the goal of 'development', framed essentially in economic terms and dominated by the pursuit of an expanding gross national product (GNP). Within this framework our national accounting systems ignore ('externalise') the costs of environmental damage and ecological disruption. As we will see in chapter 11, this is a form of disguised deficit budgeting that eventually must lead to ecological crisis. The prevailing values of economic growth and material consumption, in industrialised countries of all ideological persuasions, have led us into much of our current environmental predicament. Although we may protest that those values and behaviours are the same in kind as those of

our ancient human predecessors, it is our particular generation, with its unprecedented population size and energy-intensive technologies, that is the first to overload the *global* environment.

Orthodox economists anticipate the future by linear extrapolation of the past. They presume that the system is 'open'; besides, limits can always be pushed back with new technology (innovation, substitution and discovery). Theirs is the dominant paradigm in political and financial circles. Ecologists, aware of the complex, changeable and non-linear aspects of natural systems, perceive 'development' as being subject to the confines of the biosphere. Where the economist views ecological concerns as a subset of economics, to be dealt with market-place corrections, the ecologist views the economy as a subset of the global ecosystem. (Meanwhile, an ecologically-attuned minority of economists argues that economic practice need not be inimical to the environment, and that good ecological practice would be good long-term economics.)

Some of today's environment-damaging trends will take decades to slow and reverse. Decisions to desist from use of ozone-damaging chemicals or to eliminate the emissions that cause acid rain are *relatively* easy. In contrast, strategies for capping the growth of world population or for curbing the release of greenhouse gases are unprecedentedly difficult; and they strike at the value base of our society. Lasting solutions will therefore not come from the fine-tuning of markets nor from ingenious technical 'fixes'. The problems go deeper than that. The realisation that much of the environmental health impact will, eventually, bear on *everyone* – not just on the world's poor – should stiffen our resolve to act. The developed world has more resources with which to adapt to climate change, and more power to ensure access to food, water and fuel, should their supplies dwindle. However, in the longer term, we share a common global future. The rich countries of the northern hemisphere became noticeably more concerned about the effects of ozone layer depletion in early 1990s as it transpired that it was no longer a problem confined to the southern hemisphere! (Similarly, legislative reforms accelerated in nineteenth century England when it became clear that infectious disease epidemics, such as cholera and typhoid, were no respecters of persons, and that the smell of the Thames was pervading the Houses of Parliament!)

Returning to the general theme of this book, empiricists might object that past predictions of environmental doom have generally not eventuated. For example, predictions made in the 1960s of widespread famines in the 1980s did not materialise. However, it is important to stress that those earlier predictions were based on anticipations of resource

limitations (that is, supply-side constraints) whereas today's problems arise from exceeding the kinetic capacity of ecosystems to regenerate, transport, process and degrade. Globally, there are too many people doing too much too fast. That poses a new type of environmental problem.

The human species has the same ultimate dependence upon life-supporting ecosystems as do other biological species. However, we are a distinctive species with the latent capacity to understand, and therefore to avert, our own self-made macro-environmental problems. René Dubos, the microbiologist-cum-human-ecologist said: 'wherever human beings are concerned, trend is not destiny'.¹⁰ *So far*, he seems to have been right. We have the wit, but do we have the wisdom? By a mix of luck and political management we have averted nuclear war between the two superpowers during the latter half of this century. We could therefore be tempted to hope somehow to scramble through these global ecological problems. But scrambling will not suffice – and, anyway, we are leaving our run a bit late. The global environmental changes that we are setting in train will throw increasingly long shadows over Earth's ecosystems and, therefore, over human population health. They present a formidable challenge to our collective rationality, morality and will.

A note on terminology

There are over two hundred countries in the world today. There is no single satisfactory way of categorising these countries, in order to describe and compare. The main options are: developed versus developing; First World versus Third World; industrialised versus non-industrialised; North versus South; and rich versus poor. All such broad categorisations obscure the finer-grained differences. Classification in terms of economic 'development' begs a basic question about the desirable form and direction of societal development. That aside, variants such as 'less developed' and 'more developed', or 'overdeveloped' and 'undeveloped', shed little extra light – although they may protect national sensibilities. Meanwhile, the bustling small-country economies of East Asia (the 'tigers') are often referred to as 'newly industrialising'. Notions of the First, Second and Third Worlds emerged during the 1950s, as international communism expanded and as European powers shed or lost colonies.¹¹ In the first flush of independence, many post-colonial countries proudly identified with the aspirations of strong nationalist leaders like Indonesia's President Soekarno, who foresaw solidarity and economic progress for the newly liberated Third World. Much of that dream has subsequently tarnished.