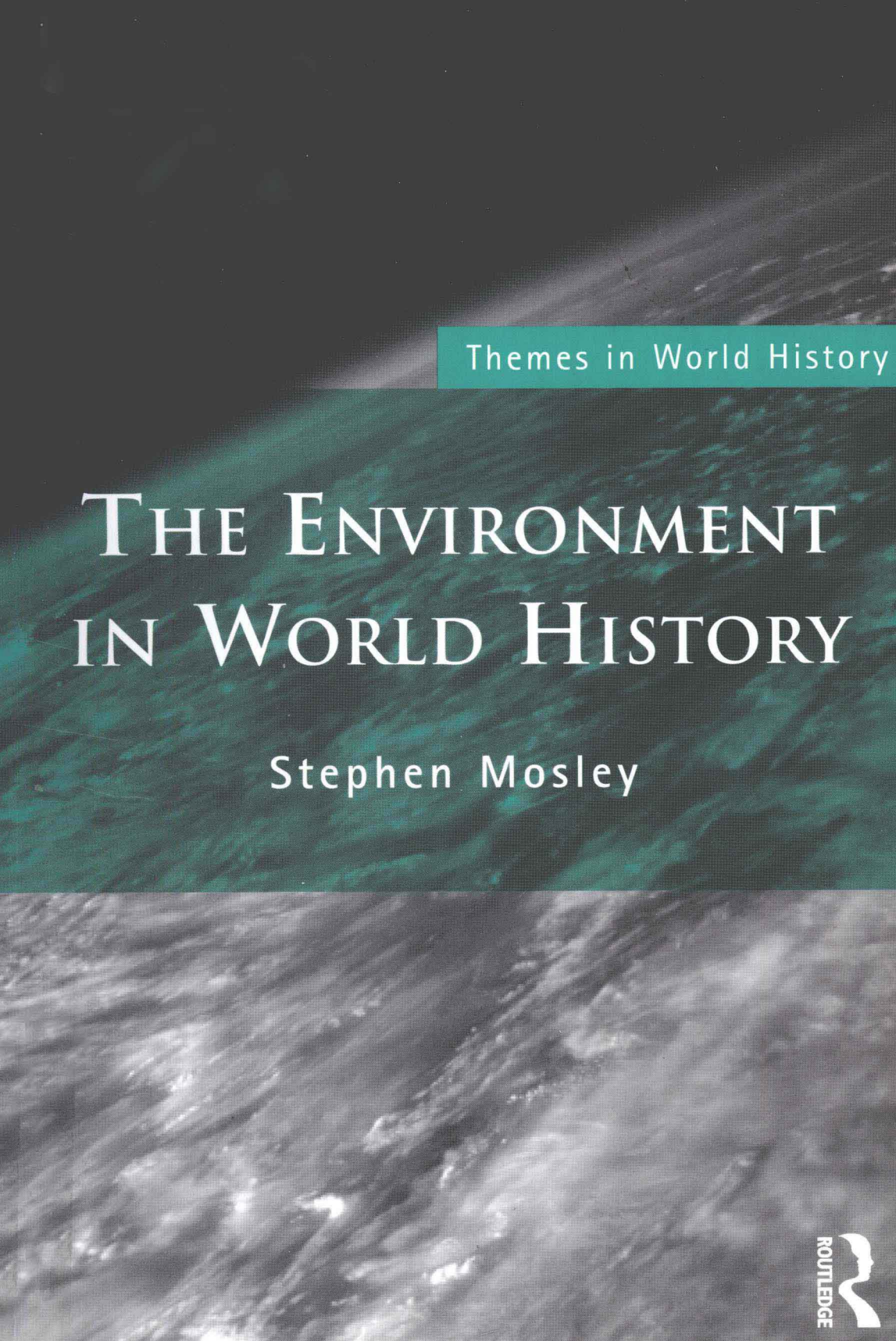
Themes in World History
THE ENVIRONMENT IN WORLD HISTORY
Stephen Mosley
ROUTLEDGE

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Introduction

Environment and history

Throughout human history, people have played an active role in modifying their environments in order to survive. But for most of the past 4 million years, large-scale environmental transformations were produced by natural forces such as the drift of continents, volcanic eruptions and shifts in climatic conditions. These forces are still at work, but human-induced environmental changes have now begun to rival those of nature. According to the Millennium Ecosystem Assessment (2005), the first comprehensive global report on the health of the planet, humankind's ever-growing demands for natural resources are seriously damaging the ecosystem 'services' that support life. Of the twenty-four services it evaluated, such as fresh-water supplies, clean air, genetic resources and fisheries, no fewer than fifteen are being degraded or used unsustainably. Recent satellite images illustrate the dramatic impacts of human enterprise – farming, industry and urbanism – on forest, grassland, river and coastal ecosystems. These images reveal that croplands, dams, mines, roads, buildings and other developmental activities are reshaping the face of the earth at an unprecedented rate. While environmental change is inevitable, early *Homo sapiens* trod relatively lightly on the land. Today, our larger and more numerous 'ecological footprints' are clearly visible from space.

Since the late 1960s, space exploration has inadvertently helped to advance the cause of environmentalism. Iconic photographs taken by astronauts showing the earth as 'a sparkling blue-and-white jewel' suspended in the dark vastness of space heightened global environmental consciousness. The realisation that we all share one world began to take root. The 1960s were the seedtime for the modern environmental movement, particularly in North America and Western Europe. Inspired and energised by influential eco-writers of the day such as Rachel Carson, Barry Commoner, Paul Ehrlich and Garrett Hardin, the 'protest generation' forced the previously marginal issue of the environment into the political mainstream. On Earth Day 1970, for example, around 20 million people across America demonstrated against agricultural pesticides, industrial pollution, urban sprawl and other threats to the well-being of the planet. Three decades later, hundreds of

millions of people in 183 countries participated in Earth Day 2000. Reacting to both growing public pressure and advancing scientific knowledge, during the same period a series of international conferences, from the Stockholm United Nations Conference on the Human Environment to the Rio Earth Summit, saw governments agree to work cooperatively towards the goal of environmental protection. But acrimonious wrangling between the developed nations of the North and the developing nations of the South over the management of natural resources and the control of pollution emissions has meant that the primary aim of 'sustainability' is proving difficult to achieve. Nonetheless, the interconnectedness and planetary scale of our current ecological crises – biodiversity loss, deteriorating ecosystem services, climate change – have moved the environment to the top of the global political agenda.

The rise of the environment as a political issue encouraged the emergence of an innovative new field of historical study: environmental history. Born out of the activism of the 1960s and 1970s, environmental history analyses the 'role and place of nature in human life'. Its primary goal is to reveal how human action and environmental change are intertwined. Nature, instead of being merely the backdrop against which the affairs of humans are played out, is recognised as playing an active role in historical processes. To grasp fully the complexities of human–environment relationships, historical research is generally carried out at four levels:

1. understanding the dynamics of natural ecosystems in time;
2. examining the interactions between environment, technology and the socio-economic realm;
3. inquiry into environmental policy and planning;
4. exploring changing cultural values and beliefs about nature.

This interpretive framework, based on Donald Worster's ambitious model for 'doing' environmental history, prompts scholars to make connections between the different levels of analysis. However, there are currently few works that link all parts effectively. Rather than constituting a rigid schema, research on all four levels is perhaps best viewed as a general programme for study. Pragmatically, the vast majority of practitioners have chosen to focus on only one or two levels, particularly environment, technology and socio-economics, and changing attitudes to nature – as will this short study.

In making both humans and non-humans actors in an evolving 'global ecodrama', some organisational recasting of analytical frameworks is essential – especially when it comes to accounting for the role of nature. One of the most challenging things about environmental history is its interdisciplinarity. Influenced by the holism of ecology, from the outset it has been an inclusive and collaborative endeavour. As well as historians, the field attracts scholars from a wide range of disciplines, from historical geography

through to social anthropology and the natural sciences. Explorations of the ways in which climate, soils, forests, rivers and animals act as 'co-creators' of histories are blurring the traditional boundaries between the humanities and the sciences. To write nature into historical narratives, environmental historians must often work with both textual records and scientific data. Where documentary accounts are lacking – or unavailable – modern scientific techniques such as ice-core analysis, dendrochronology and palynology can unlock important information stored in 'nature's archives'. Ice cores, collected at both poles, provide a record of global carbon-dioxide levels and temperature fluctuations extending back hundreds of thousands of years. Dendrochronology, the study of tree rings, has been used to examine the relationship between agriculture and climatic cycles over the centuries. Palynology, the analysis of fossilised spores and pollen extracted from bogs, lake sediments and archaeological sites, can help to reconstruct histories of human settlement, forest clearance and crop introductions.

Furthermore, the natural sciences provide valuable heuristic metaphors. For example, the concept of metabolism – adopted from biology – has been used profitably by urban-environmental historians such as Joel Tarr in tracing the linkages between the city and the countryside. Drawing on the ideas of the ecologist Eugene Odum, Tarr has likened modern cities to 'parasitic' living organisms, dependent for their survival on inputs of clean air and water, fresh food, fossil fuels and construction materials, and the removal of harmful outputs of waste. The study of resource flows and waste emissions has begun to reveal the long-term impacts of urban living on the wider environment, especially after the Industrial Revolution, tracking the 'ecological footprints' of cities such as Paris, Pittsburgh, Chicago and Manchester deep into their own hinterlands and beyond. Undertaking research in environmental history, then, entails a willingness to press into service data and concepts from both the social and natural sciences. Although still undertheorised, the interdisciplinary ethos of eco-historical research is transcending the academic borders that separate 'nature from culture, science from history, matter from mind'.

Historical studies of socio-environmental change can be written on any scale, from the macro to the micro. But given that political boundaries and ecological boundaries rarely coincide, in environmental history the familiar organisational framework of the nation-state is not always an apt unit of analysis. Regional and local-level approaches, centred on different types of rural and urban 'ecosystems' – coastal, forests, grasslands, riverine, market towns and industrial cities – can often produce more coherent case studies of how societies and environments shape and reshape each other over time. Since the 1970s, work at the meso- and micro-levels has progressed rapidly and expanded worldwide, especially in North America, western Europe, South Asia, Africa and Australia. More recently, scholars have also begun to explore the history of human–nature interactions in Latin America, Russia,

China and Japan. In the space of three decades, a comprehensive literature spanning the globe has developed, encouraging a small but growing number of academics to internationalise their research and to write comparative macro-scale environmental history. As 'everything connects' in nature (climate change illustrates this point well), from an analytical point of view adopting a 'Big History' approach obviously makes good sense. Environmental transformations, while often differing widely from one region to another, are increasingly recognised to be interrelated: a host of regional-scale changes all over the world cumulatively placing unsustainable pressure on the biosphere (the ecosystem of the entire planet). World-environmental historians, by drawing attention to the international transfer of plants, animals, microbes, agricultural practices and industrial technologies, as well as global patterns of trade, migration and settlement, have begun to trace the common underlying causes of ecological problems at both the regional and biospheric levels.

Some of the most important and interesting work now being done in world history is concerned with understanding and contextualising environmental change. This book aims to make the results of recent research in this area accessible to students and their instructors. At this point, however, one or two caveats about the project are in order. In a short, synthetic work of this type, it is not possible to cover the whole range of human–environment relationships over time and space. Rather, the book will survey several of the main themes in world-environmental history – deforestation, species loss, soil erosion and the pollution of air, land and water – using case studies drawn from Africa, England, India and North America to illustrate the bigger picture. The need to be concise also means that there is little discussion here of natural disasters unprovoked by human activity, such as earthquakes, volcanic eruptions, or El Niño events. What follows then charts the history of human interactions with nature from circa 1500 to the present (with the occasional look further backward) – a period when patterns of environmental change began to diverge significantly in scale and intensity from those of the past.

Periodisation and patterns of environmental change

Studying the relationship between humankind and the environment can also mean having to rethink systems of periodisation, which in environmental history are often defined by natural processes rather than conventional political markers. Many important works deal in 'deep time', beginning, for example, with the breakup of the supercontinent Pangaea – from which the present continents were eventually formed – some 180 million years ago. Timescales routinely encompass millennia and even geological eras, challenging historians to engage with chronologies that reduce the human lifespan to the mere blink of an eye. In addition, exploring history in deep time

unquestionably provides us with a more humble view of the human role in historical processes. Writing over fifty years ago, Fernand Braudel stressed the slow rate of change in human–nature relations over *la longue durée* in his magisterial history of the Mediterranean, a history shaped by the ever-recurring cycles of the seasons, the deep-seated rhythms of rural life and the interdependence of people and place. To a considerable extent he saw nature as stable and unchanging, setting the limits to growth for human societies through its influence on land use and economic organisation. But more recently, in the light of growing threats to the sustainability of the ecosystem services we depend on, and new scientific insights that reveal nature to be unstable and chaotic, environmental historians have tended to privilege change over continuity in their work.

The choice of a relatively short temporal framework for this volume, taking up the story roughly where Braudel left off in the sixteenth century, focuses our attention on a particularly turbulent period in the changing human–nature relationship. When viewed over the past five centuries, rather than a very *longue durée* perspective, it is the speed with which humankind has altered the 'faces and flows' of the global environment that is remarkable. Starting with Columbus's 'discovery' of the New World in 1492, by the late eighteenth century European explorers had re-established contact between the long-isolated ecosystems and peoples of the Americas, Afro-Eurasia, Australasia and the Pacific islands. European expansion overseas brought about a fundamental reorganisation of the world's ecology, an Environmental Revolution, which affected the everyday lives of most of its inhabitants. Transoceanic exchanges – the increasing traffic in plants, animals, microbes and people around the world – were to alter the face of the earth.

The ecological impacts of early globalisation are difficult to overestimate. Restoring contact between the previously isolated Old and New Worlds exposed millions of people to unfamiliar disease-causing microbes to which they had no genetic resistance or acquired immunity. Deadly 'virgin soil' epidemics of smallpox, measles, influenza and other Eurasian diseases reduced Amerindian, Australian Aborigine, New Zealand Maori and Pacific island populations to a fraction of their former numbers. Although figures are hotly disputed, academics generally agree that indigenous New World populations suffered exceptionally high levels of mortality as a consequence of 'microbial unification': 90 per cent or more in some cases. One commentator has conservatively estimated that infectious diseases unwittingly spread by European exploration, trade and colonisation claimed around 56 million lives worldwide. However, with the possible exception of syphilis, the confluence of disease pools that followed the 'Columbian exchange' and the later 'Cook exchange' introduced no agents of disease that significantly raised European mortality rates.

Unplanned 'biological warfare' cleared the way for European settlers to reshape New World landscapes and to make them more like the Old. They

planted wheat, barley, rice and other customary food crops in depopulated colonies and established large herds of domesticated European animals such as cattle, sheep, goats and horses. Lacking natural predators or aggressive competitors, most flourished in what Alfred Crosby called the 'lands of demographic takeover': Argentina, Australia, southern Brazil, Uruguay, New Zealand and much of North America. Wholesale introductions of Old World species crowded out native flora and fauna, resulting in both the homogenisation and simplification of ecosystems. By 1900, the temperate zone regions of the Americas and Australasia had been transformed by settlers on a grand scale into 'neo-Europes': biological replicas of their homelands. Just as importantly, from the sixteenth century onwards, highly productive New World food crops such as maize (corn), potatoes (white and sweet) and cassava (manioc) also crossed the oceans and spread vigorously throughout Afro-Eurasia, providing the nutritional foundations for population growth (especially in Europe and China).

Humans have moved species around for as long as they have migrated. But in the early modern period, seaborne European empires – Iberian, Dutch, French and English – both accelerated the pace and extended the range of biotic exchanges. Oceans became 'intercontinental highways' for the world's flora, fauna and microbes, rather than barriers to their movement, making possible rapid environmental change on a genuinely global scale. The Age of Sail brought with it a terrific expansion of the human capacity to alter the visible face of virtually every terrestrial ecosystem from, for instance, forest cover into animal pasture, or grassland environments into wheat fields. Land-use change is still ongoing and, to date, somewhere between 35 to 50 per cent of the earth's land surface has been radically transformed by human activity. Yet the single most important development within our chosen timeframe was the harnessing of fossil fuels, the environmental impacts of which – while often less obvious – were more profound, causing potentially catastrophic changes in the bio-geo-chemical flows that sustain the biosphere.

The Industrial Revolution, stimulated in part by European success in turning 'empty' landscapes around the world into productive agro-ecosystems, marked the transition from traditional to modern societies and economies. In the late eighteenth century, humankind began to break free from the constraints of what has been called the 'biological *ancien regime*'. Traditional agrarian societies relied mainly on renewable energy and resources – wood, water, wind, human and animal muscle – to earn a very modest living from the land for all but a privileged few. Forests kept households supplied with firewood and construction materials, while charcoal was widely utilised for smelting metals to produce tools, utensils and other handcrafted goods. Textile industries such as linen, cotton and wool depended on the products of fields and pasture. Not least of all, traditional farming required high labour inputs, fertile soils and clement weather to produce the bountiful

harvests that were the key to human well-being. Life's necessities – food, fuel, clothing and shelter – all came from the land – land worked primarily by human muscle-power, with some limited assistance from windmills, waterwheels and draught animals. As people were unable to capture and convert into useful forms more than a fraction of the energy available on earth, within the biological *ancien régime* there were limits on both the size of populations and the productivity of the economy. The switch to fossil fuels during the industrial era changed all that.

The invention of an efficient steam engine in the late eighteenth century, the electric motor and the internal combustion engine in the nineteenth century, and the gas turbine in the early twentieth century, lessened people's dependence on wood, water, wind and muscle power and made possible the exponential growth of economies and populations. These technological innovations, prime movers of the Industrial Revolution, promoted and required the harvesting of a 'new' subterranean fossil-fuel 'acreage': coalfields, oilfields and gasfields. Hitherto unimaginable stores of energy, accumulated over hundreds of millions of years, suddenly became available for human use. Agricultural societies had to meet their needs from within a finite acreage of woodland and farmland. Even with good farming techniques, recurring energy and resource shortages impeded their development. For example, clearing forests for agricultural use reduced the amount of wood available for fuel, construction and making charcoal. As long as economies were mainly based on muscle-driven agriculture and biomass energies their productive capacity remained relatively low, while the share of the population who were poor and rural remained high. Access to inexpensive and seemingly inexhaustible fossil fuels, albeit unevenly distributed around the world, broke the shackles of the biological *ancien régime* and restructured ways of living. Originating in Britain, industrialisation spread throughout Europe, North America, Japan and then the wider world. Drawing on energy stocks deposited in prehistory, the Industrial Revolution allowed modern societies to replace animate power with mechanical power and accelerated the pace of resource extraction, production and consumption.

The most visible sign of escalating economic activity was the rise of great industrial cities and agglomerations such as Manchester, Pittsburgh and Germany's Ruhrgebiet, based on the large-scale production of cotton textiles, iron and steel. There were few major cities within pre-industrial societies, their size and number held in check by the low productivity of their hinterlands. In 1800, no more than 7 per cent of the world's population lived in urban environments. Today, the proportion of the world's population living in cities has passed 50 per cent. In the booming cities of the Industrial Revolution, factories and furnaces vastly improved productivity over artisanal levels, supplied a growing range of affordable, high-quality goods, and brought a measure of affluence for most urban workers. There was an explosion of consumerism after 1850, symbolised by the department store,

radiating out from the affluent cities of north-western Europe and the USA. Industrialisation also imposed a new rhythm on social life, with machines and clock time, rather than the natural cycles of days and seasons, dictating the quickening pace. In agriculture, labour-saving machinery released rural workers from the land, and artificial fertilisers (derived from fossil fuels) brought higher and more reliable crop yields, which underpinned ongoing urban-industrial growth. Over the past two centuries then, the control of fossil energies has enabled *Homo sapiens* to become a predominantly urban species – but at a high cost to the environment.

Industrialisation allowed humankind to use fossil fuels and other resources at prodigious rates. Table 1.1 below shows the dates by which 25 per cent, then 50 per cent, then 75 per cent of various human-induced environmental impacts were reached (calculations assume a baseline of zero for 10,000 BCE, and 100 per cent change as of 1985).

In recent centuries, industrial society has altered not only the faces of the earth, but also the flows of key elements – particularly phosphorous, nitrogen, sulphur and carbon – through the biosphere, with serious ecological consequences. Forest clearances have transformed land cover over vast areas and have accelerated species extinctions as suitable habitat shrank. Increasing freshwater withdrawals from rivers and lakes for irrigation, industrial and household use have disrupted the hydrological cycle. At times, the flows of major rivers, such as the Nile in Africa, the Colorado in North America and the Yellow River in China, are so reduced that they no longer reach the ocean. The intensifying use of phosphorous and nitrogen in artificial fertilisers, which in the latter case far outweighs natural releases, has caused widespread water pollution and eutrophication (where excess nutrients in agricultural runoff stimulate algal blooms that in turn reduce oxygen in the water, killing other forms of aquatic life). Rising sulphur emissions from smoke-stack industries and power generation have polluted the air and contributed

Table 1.1 Quartiles of human-induced environmental change from 10,000 BCE to 1985

Form of Transformation	*Dates of Quartiles*		
	25%	*50%*	*75%*
Deforestation	1700	1850	1915
Terrestrial vertebrate extinctions	1790	1880	1910
Water withdrawals	1925	1955	1975
Phosphorus releases	1955	1975	1980
Nitrogen releases	1970	1975	1980
Sulfur releases	1940	1960	1970
Carbon releases	1815	1920	1960

Source: adapted from Robert W. Kates, B. L. Turner and William C. Clark, 'The Great Transformation' in B. L. Turner, William C. Clark, Robert W. Kates, John F. Richards, Jessica T. Mathews and William B. Meyer (eds), *The Earth as Transformed by Human Action* (Cambridge: Cambridge University Press, 1990).

greatly to the emergence of an acid-rain problem in Europe and North America by the mid-1980s. Acid rain was a fast-growing problem in East Asia too by the mid-1990s (nowhere faster than in industrialising China).

The increase in the amount of carbon dioxide in the atmosphere, due primarily to burning fossil fuels, is potentially the most damaging environmental change. Global statistics reveal the exponential growth in fossil-fuel use since the advent of the Industrial Revolution. Coal production increased 500-fold between 1810 and 1990, from 10 million to 5 billion tonnes. Oil extraction rose around 300-fold in the century after 1890, from less than 10 million to more than 3 billion tonnes. Natural-gas production increased about 1,000-fold during the same period, from less than 2 billion to almost 2 trillion cubic metres. By living off the accumulated energy capital of the past instead of 'current income' (renewable energies), humankind released huge quantities of carbon dioxide that had been securely locked up underground, profoundly altering the global carbon cycle. Ice-core data from Greenland and Antarctica show conclusively that atmospheric concentrations of the 'greenhouse gas' carbon dioxide now far exceed pre-industrial values, up from around 280 to 379 parts per million in 2005 (an increase of over 35 per cent). Global warming, estimated at between 1.8 to 6.4 degrees Celsius by the end of the twenty-first century, will result in a whole range of 'natural disasters' that include desertification, droughts, species extinctions, sea-level rises and a destructive change in weather patterns.

As well as changing global elemental flows at a speed and on a scale that was impossible before industrialisation, humans have introduced numerous substances not previously found in nature: most notably oil-derived plastics, nuclear wastes and chlorofluorocarbons (the chemicals responsible for the Antarctic 'ozone hole'). In a relatively short space of time, humans have become a major influence on the biosphere and how it functions. Although emphases inevitably differ, recent studies have highlighted the following as the main human drivers of environmental change:

- **Population growth.** Between 1500 and 2000, the world's population grew from around 500 million to over 6 billion people (with most of this spectacular increase coming in the twentieth century). As numbers rose, so did demands for life's necessities – food, water, fuel, clothing and shelter – generally at the expense of supporting ecosystems. Population redistribution from the countryside to the city saw more and more people lose intimate contact with nature.
- **Technological advance.** After 1492, advances in transportation and communications played a crucial role in the transformation of the earth, facilitating the global movement of raw materials, trade goods, information, capital, people and other organisms. But it was the Industrial Revolution that decisively shifted the balance of power in the nature–human relationship. In the past two centuries, technological innovation

and cheap energy have allowed humans to shape their environments more than they have shaped us. Technology was, and still remains, the 'inexhaustible resource'; extracting wealth from the earth and circumventing energy and resource shortages. Modern industrial technologies help to support unprecedented numbers of people and unprecedented levels of material consumption – but the pressures they place on the planet's ecosystem 'services' are now becoming unsustainable.

- **Economic expansion.** Between 1500 and the early 1990s, the world's annual gross domestic product grew 120-fold, from around $240 billion to $28 trillion (with most growth coming after 1820). Europe's ability to exploit the natural resources of its colonies, reconfiguring ecologies and economies worldwide to meet the demands of industrial cities, lay behind much of this enormous increase in wealth and output. But the headlong pursuit of prosperity was undertaken with scant regard for the long-term conservation of natural resources (often finite), and disproportionately heavy environmental burdens (deforestation, soil erosion, loss of biodiversity) were borne by the poor countries that exported raw materials to the rich industrialised nations. Nor were the fruits of industrial capitalism shared equally. In 2001, just over 1 billion people in the developing world survived on less than $1 per day.
- **Cultural attitudes to nature.** From the sixteenth century, the world of nature was reconceptualised as machine-like to meet the needs of an emergent capitalism. In place of the notion that the earth was a single living organism – a cosmology shared by many of the world's peoples – capable of retribution against those who carried out destructive acts, this new scientific worldview saw nature as dead matter for human utilisation. Cartesian science and the rise of capitalism were highly compatible with Europe's leading religion, Christianity, which emphasised the theme of human domination of nature. While some writers have argued that Chinese, Indian, African and indigenous religions were more respecting of nature, non-Western cultures also recast and despoiled their environments in order to grow their economies and improve living standards, as did the modern socialist economies of the Soviet Union and Eastern Europe. Despite their differences, cultures everywhere refashioned nature to make it better serve humanity.

Over the past five centuries, the impacts of human activities on the 'faces and flows' of the global environment have escalated. Because of our extraordinary capacity to modify the natural world to meet our needs, the Nobel Laureate Paul Crutzen has suggested assigning the term 'Anthropocene' (the human epoch) to describe the present period of the earth's history. We will explore humankind's growing influence on the environment more fully in the chapters that follow.

Chapter 2 examines advancing hunting frontiers around the world, different cultural practices and attitudes to hunting, the economic advantages derived from hunting, efforts to conserve declining stocks and some of the environmental changes brought about by species loss. Chapter 3 considers the complex set of socio-cultural, technological and economic forces that have caused the world's forests to decline. It will also chart the growth and development of strategies to manage and conserve the earth's remaining temperate and tropical forests. Chapter 4 examines changing human relationships with the earth's soils, which are crucial for food production. Soil conservation has been – and still is – a major challenge for most societies, as it is a natural resource that is not renewable in the short term. Chapter 5 explores the impacts of urban-industrial growth on the global environment. As concentrated centres of population, production and consumption, cities have always placed heavy demands on natural resources. A focus on resource flows and waste emissions will reveal the long-term environmental effects of urban living, especially after the Industrial Revolution, tracking the 'ecological footprints' of major cities such as Manchester – the first industrial city – far beyond their own hinterlands. The concluding chapter highlights how local and regional environmental issues can connect to become genuinely global in scale.

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