1

Introduction to Environment and Society

Jules Pretty, Andrew Ball, Ted Benton,
Julia Guivant, David R. Lee, David Orr,
Max Pfeffer and Hugh Ward

PERSPECTIVES ON SUSTAINABILITY

It is only in recent decades that the concepts associated with sustainability have come into more common use. Environmental concerns began to develop in the 1960s, and were particularly driven by Rachel Carson's book *Silent Spring* and the publicity surrounding it (Carson, 1963). Like other popular and scientific studies at the time, it focused on the environmental harm caused by one economic sector, in this case agriculture. In the 1970s, the Club of Rome identified the problems that societies would face when environmental resources were overused, depleted or harmed, and pointed towards the need for different types of policies to maintain and generate economic growth. In the 1980s, the World Commission on Environment and Development, chaired by Gro Harlem Brundtland, published *Our Common Future*, the first serious attempt to link poverty to natural resource management and the state of the environment. Sustainable development was defined as 'meeting the needs of the present without compromising the ability of future generations to meet their own needs.' The concept implied both limits to growth, and the idea of different patterns of growth, as well as introducing questions of intergenerational justice (WCED, 1987).

In 1992, the UN Conference on Environment and Development was held in Rio de Janeiro, taking forward many themes prefigured at the UN Conference on the Human Environment held in Stockholm in 1972. The main agreement was Agenda 21, a forty-one chapter document setting out priorities and practices for all economic and social sectors, and how these should relate to the environment. The principles of sustainable forms of development that encouraged minimizing harm to the environment and human health were agreed. However, progress has not been good, as Agenda 21 was not a binding treaty on national governments, and all are free to choose whether they adopt or ignore such principles (Pretty and Koohafkan, 2002). The Rio Summit was followed by some international successes, including the signing of the Convention on Biodiversity in 1995, the Kyoto Protocol in 1998 and the Stockholm Convention on Persistent Organic Pollutants in 2001. The ten years after the Rio World Summit on Sustainable Development was then held in Johannesburg in 2002, again raising the profile of sustainability, but also failing to tie governments to clear actions and timetables.

Over time, the concept of sustainability has grown from an initial focus on environmental aspects to include first economic and then broader social and political dimensions.

- *Environmental or ecological* – the core concerns are to reduce negative environmental and health externalities, to enhance and use local ecosystem resources, and preserve biodiversity. More recent concerns include broader recognition of the potential for positive environmental externalities from some economic sectors (including carbon capture in soils and flood protection).

- *Economic* – economic perspectives recognize that many environmental services are not priced by markets and that, because of this, it may be economically rational to use the environment in unsustainable ways and to undersupply environmental public goods. In response to this, some seek to assign value to environmental goods and services, and also to include a longer time frame in economic analysis. They also highlight subsidies that promote the depletion of resources or unfair competition with other production systems.
- *Social and political* – there are many concerns about the equity of technological change. At the local level, sustainability is associated with participation, group action and promotion of local institutions and culture (Ostrom, 1990; Pretty and Ward, 2001; Grafton and Knowles, 2004). At the higher level, the concern is for enabling policies that target preservation of nature and its vital goods and services. Many believe that liberal democracies are more likely to give rise to such policies than are autocracies, as part of generally better governance (United Nations Development Programme, 2003), but the empirical evidence for this is ambiguous (Midlarsky, 1998; Barrett and Graddy, 2000; Fredriksson *et al.*, 2005). Partly because of this some argue that the liberal democratic state needs to be transcended by adding in representation of other species, other generations and other nations (Eckersley, 2004) and by enhancing the potential for open deliberation about the issues, to bring together the knowledge that different groups and communities have and to reduce the corrosive impact of narrow self-interest (cf. Saward, 1993; Dryzek, 1996).

SOCIAL PERSPECTIVE ON ENVIRONMENT AND SOCIETY

An important feature of this Handbook centres on how social organization constrains humans' relationships with nature, but also how social organizations are shaped by nature. Perhaps the most distinctive feature of such an approach is that it rejects the notion that any form of social organization or structured human action is ideal or given by nature. While much human action is constrained by social structures (e.g. market behaviour), it is assumed that those structures are socially constructed and subject to change. This stance implies that human behaviour in relation to nature can be redirected if social structures change. Furthermore, changes in nature may force changes in social structure which in turn lead to changes in human behaviour.

Social scientists have long striven to develop an understanding of the relationship between the natural environment and society, but until the 1970s treatment by sociologists of this relationship remained more implicit than explicit. At this time, sociologists began to consider the nature–society nexus, and contemporary environmental sociology became a reaction to growing social activism for environmental protection. This activism reflected discontent with the dominant pro-technology and pro-growth economic policies following World War II. During the Cold War era, these policies might have tended to be either more market- or state-centred, but regardless of ideological orientation economic growth driven by technological innovation was the overarching approach to economic development. This dominant worldview held that human domination of nature was unproblematic from a practical standpoint and was morally justified as well. But this point of view came to be challenged on both practical and moral grounds (Catton and Dunlap, 1978; Buttel, 1987; Beck, 1992a,b; Seippel, 2002).

From a practical standpoint, environmental deterioration became visible to the untrained eye. Air and water pollution became public issues of great concern (Buttel, 1997; Mertig *et al.*, 2002). Although the scientific community had been the foundation of technological development, critics of various technologies began to emerge from within it as well. Perhaps the most celebrated scientist to mount a sustained critique of the environmental impacts of technology was Rachel Carson. Many observers claim that the publication of her book, *Silent Spring* (Carson, 1963), marked the rise of contemporary environmentalism in the USA but there is clear evidence that concern about environmental destruction had already been stirring throughout the industrial world (Rootes, 1997; Mertig *et al.*, 2002). The rise of the environmental movement in the USA, for example, led to the enactment of a variety of unprecedented environmental legislation.

Sociologists were somewhat taken by surprise by the environmental movement, and struggled to understand it. Its substantive focus as well as the composition of its adherents appeared to be somewhat different from the other social movements of the day. The movement's adherents were initially thought to be more middle class and perhaps more mainstream than the anti-war and civil rights activists of the time. Substantively, the movement seemed to be charting a new course that was not rooted in the dominant socialist or capitalist ideologies. For this reason some sociologists began to suspect that environmentalists were advocating an entirely new paradigm – one that politically was neither left nor right, but entirely different. For this reason some initial thinking by sociologists was that an entirely new theoretical underpinning would need to be formulated

(Catton and Dunlap, 1978; Dunlap and Catton, 1994; Dunlap, 1997).

Initially, existing social theories were largely rejected on the assumption that they had been deficient in considering the active part played by the natural environment in societal development and had considered the impact of society on nature as inconsequential. Without a clear theory to guide the development of an alternative sociology of the environment, early efforts moved in a variety of directions that steered environmental sociology away from established theories of society.

Environmental sociologists initially criticized existing social theories for their hubris in assuming that humans through science and technology could dominate nature without significant impacts on the natural world or society. This paradigm was labelled 'human exemptionalism' (Catton and Dunlap, 1978; Dunlap and Catton, 1994). It was immediately clear that any sociology of the environment would need to focus on the relationship between that natural environment and society. A more careful treatment of this issue would challenge many assumptions in sociology. For example, sociology had assumed that all social structures could be explained by human agency. From this point of view, the physical and biological worlds were passive objects in the human construction of the social world (Murphy, 1994). But environmentalists' concerns about the destruction of nature and its consequences for society led to a reconsideration of how nature shapes society. Some claimed that what was distinctive about environmental sociology was its emphasis on the mutual constitution of nature and society (Freudenburg *et al.*, 1995; Norgaard, 1997). From this perspective, some sort of unidirectional and exclusively human construction of the life world is impossible.

So, what shapes the relationship between society and the environment? Some early attempts to apply sociological theory to the understanding of nature–society relationships drew on Marxist political economy. Political economists focused on the nature of the capitalist organization of production and how the functional demands of this system defined the use of nature. Some of the early thought in this area emphasized how capitalism's requirement for the continuous expansion of production into new areas would inevitably lead to the destruction of nature (Schnaiberg, 1980; Schnaiberg and Gould, 1994; Buttel, 1997). More recently, there has been greater emphasis on how capitalism is constrained by the biological and physical limits imposed by the natural world (Benton, 1989, 1998; Dickens, 1996, 1997).

The implications of the dominant system of market capitalism for nature–society relationships are a point of considerable contention in sociology. Some would argue that the capitalist economy is fundamentally destructive of the environment and for this reason is unsustainable in the long run. From this point of view, environmental destruction is the 'Achilles heel' of capitalism. This approach is deeply suspicious of claims that science and technology can always produce adequate substitutes for depleted natural resources (O'Connor, 1998). Recently, a decidedly more optimistic theory of ecological modernization has come into play. From this point of view, environmental destruction reflects a lack of investment in modern technologies and this deficit can be remedied with state policies that prohibit production practices wasteful or destructive of the environment. Ecological modernization is not just about technology, though. It is as much about bringing ecological considerations into market decision making through appropriate pricing of environmental services. In this theory the state plays a prominent role, with little real significance attached to abstractions like the 'free' market. The state constrains markets through policies that establish incentives to channel market behaviour in environmentally sound directions (Simonis, 1989; Mol, 1996, 2001; Mol and Spaargaren, 2000; Spaargaren *et al.*, 2000).

These opposing viewpoints on the environmental impacts of market economies point to the distinctiveness of this approach to understanding nature–society relations. Regardless of their theoretical orientation, sociologists consider organizational forms to be social constructs that are subject to change. This assumption implies that human behaviour is not inherent or given, but moulded by the social structures in place at any time in history. Thus, sociologists emphasize the distinctiveness of processes of societal rationalization, or the elaboration of a historically specific logic that structures the interaction between nature and society. Any particular rationalization is not 'natural' but has a distinctive form that constrains options for human interactions with nature (Murphy, 1994).

Since sociologists assume that social organization does not take some sort of 'ideal' form, the organization of human interactions with nature is a subject of particular interest to sociologists. Given an infinite number of possible forms of organization, why are similar forms of organization widely dispersed across a wide range of social and natural environments? This question has become especially salient with the emergence of the processes of globalization (Yearley, 1996). Economic, environmental and social organization displays some striking similarities in far-flung parts of the world. This organizational isomorphism is of growing interest to sociologists (Buttel, 1997; Frank, 2002; Frank *et al.*, 2000;

Schelhas and Pfeffer, 2005; Pfeffer *et al*., 2006). But just as interesting to sociologists are some of the distinctive ways that these organizations are refashioned by local interests and the local natural resource base (Pfeffer *et al*., 2001, 2005).

ENVIRONMENTAL ASSETS AND EXTERNALITIES

Many economic sectors directly affect many of the very assets on which they rely for success. Economic systems at all levels rely on the value of services flowing from the total stock of assets that they influence and control, and five types of asset, natural, social, human, physical and financial capital, are now recognized as being important. There are, though, some advantages and misgivings with the use of the term capital. On the one hand, capital implies an asset, and assets should be cared for, protected and accumulated over long and intergenerational periods. On the other, capital can imply easy measurability and transferability. Because the value of something can be assigned a monetary value, then it can appear not to matter if it is lost, as the required money could simply be allocated to purchase another asset, or to transfer it from elsewhere. But nature and its wider values is not so easily replaceable as a commodity (Coleman, 1988; Ostrom, 1990; Putnam, 1993; Flora and Flora, 1996; Benton, 1998; Uphoff, 1998, 2002; Costanza *et al*., 1997; Pretty and Ward, 2001; Pretty, 2003; MEA, 2005).

Nonetheless, as terms, natural, social and human capital have become widespread in helping to shape concepts around basic questions about the potential sustainability of natural and human systems. The five capitals have been defined in the following ways:

1   *Natural capital* produces environmental goods and services, and is the source of food (both farmed and harvested or caught from the wild), wood and fibre; water supply and regulation; treatment, assimilation and decomposition of wastes; nutrient cycling and fixation; soil formation; biological control of pests; climate regulation; wildlife habitats; storm protection and flood control; carbon sequestration; pollination; and recreation and leisure.
2   *Social capital* yields a flow of mutually beneficial collective action, contributing to the cohesiveness of people in their societies. The social assets comprising social capital include norms, values and attitudes that predispose people to cooperate; relations of trust, reciprocity and obligations; and common rules and sanctions mutually agreed or handed down. These are connected and structured in networks and groups.
3   *Human capital* is the total capability residing in individuals, based on their stock of knowledge skills, health and nutrition. It is enhanced by access to services that provide these, such as schools, medical services and adult training. People's productivity is increased by their capacity to interact with productive technologies and with other people. Leadership and organizational skills are particularly important in making other resources more valuable.
4   *Physical capital* is the store of human-made material resources, and comprises buildings, such as housing and factories, market infrastructure, irrigation works, roads and bridges, tools and tractors, communications, and energy and transportation systems, that make labour more productive.
5   *Financial capital* is more of an accounting concept, as it serves in a facilitating role rather than as a source of productivity in and of itself. It represents accumulated claims on goods and services, built up through financial systems that gather savings and issue credit, such as pensions, remittances, welfare payments, grants and subsidies.

As economic systems shape the very assets on which they rely for inputs, there are feedback loops from outcomes to inputs. For instance, some economists emphasize the way that markets respond to resource scarcity is by pushing up prices, encouraging substitution and searching for technical change (Beckerman, 1996). However, such market feedbacks cannot work properly if environmental assets come for free. Thus, while sustainable systems will have a positive effect on natural, social and human capital, unsustainable ones feed back to deplete these assets, leaving fewer for future generations. For example, an agricultural system that erodes soil whilst producing food externalizes costs that others must bear. But one that sequesters carbon in soils through organic matter accumulation helps to mediate climate change. Similarly, a diverse system that enhances on-farm wildlife for pest control contributes to wider stocks of biodiversity, whilst simplified modernized systems that eliminate wildlife do not. Agricultural systems that offer labour-absorption opportunities, through resource improvements or value-added activities, can boost local economies and help to reverse rural-to-urban migration patterns (Carney, 1998; Dasgupta and Serageldin, 1998; Ellis, 2000; Morison *et al*., 2005; Pretty *et al*., 2006).

Any activities that lead to improvements in these renewable capital assets thus make a contribution towards sustainability. However, the idea of sustainability does not suggest that all assets are improved at the same time. One system that contributes more to these capital assets than another

can be said to be more sustainable, but there may still be trade-offs with one asset increasing as another falls, though some environmental assets are essentially irreplaceable and vital, so they cannot be substituted – see the discussion of the idea of sustainability below. In practice, though, there are usually strong links between changes in natural, social and human capital, with systems having many potential effects on all three.

Many economic systems are, therefore, fundamentally multifunctional. They jointly produce many environmental goods and services. Clearly, a key policy challenge, for both industrialized and developing countries, is to find ways to maintain and enhance economic productivity. But a key question is: can this be done whilst seeking both to improve the positive side-effects and to eliminate the negative ones? It will not be easy, as modern patterns of development have tended to ignore the considerable external costs of harm to the environment.

VALUING THE ENVIRONMENT

The idea that the environment and the services it provides can be valued strikes some as antithetical to the intrinsic values of environmental resources and the role that these resources play in society, history and culture. How can we possibly assign an economic or monetary value, it might be asked, to unique biodiversity such as the bald eagle or the snow leopard, to views of the Alps or the Rocky Mountains, or to water resources that are essential to life and that many societies consider to be an inherent human right? If economic/monetary values of these and similar resources can be estimated, how can they possibly be accurate if underlying conditions of scarcity change, as they inevitably will, leading to changes in associated scarcity values? And, if economic/monetary values are assigned to resources, whatever those values may be, does this valuation in and of itself inevitably lead to political trade-offs that may degrade those resources in the interests of economic development or other goals?

For these and many other reasons, the valuation of environmental resources is often fraught with contention, both conceptually and certainly in practice, where many empirical estimation and measurement issues arise. Yet, as mentioned above, the treatment of environmental assets as natural capital and associated exercises in measurement, valuation and evaluation are increasingly common in both academic analysis and policymaking. This is for several reasons. First, without such valuations, society has done a remarkably poor job in managing its stewardship of environmental resources; surely, any mechanism that can help improve on society's past dubious record in environmental policy is an advance. Second, since at least the 1960s and 1970s, the environmental impacts of economic development and human interventions in the landscape have been central to policy debates as society has increasingly been concerned with both the direct effects and opportunity costs of those interventions – e.g. what is lost when development proceeds. Third, in the two decades since the publication of the Brundtland Report (WCED, 1987), issues of sustainability have achieved much higher prominence in public debate in many countries, highlighting the needs of future generations in decisions made today about resource use. This has increased interest in how to trade off current versus future demands on the environment and how to deal with associated intergenerational equity concerns, which, in turn, has increased interest in mechanisms, like economic valuation, that permit these intertemporal comparisons.

In addition to these general factors stimulating interest in environmental valuation, efforts at economic and monetary valuation of the environment have flourished over the past several decades because they address several additional specific needs that are increasingly evident in environmental policymaking. First, the importance of the divergence between social valuation of resources and their incomplete (or non-existent) valuation in the market is increasingly apparent. How can we begin to address the problem of global warming, for example, if the externalities of industrial pollution are so poorly measured and understood, and consequently devalued in the policy arena, compared with the measurable jobs and income that are created? Second, as the human population expands and many formerly abundant resources are increasingly scarce – clean water and clean air, wilderness, open space, even silence – accounting for, and valuing, the public good dimensions of these resources has become increasingly important in prioritizing their survival in policy debates. How else, outside of moral suasion, will the scarcity value of public goods be understood and taken into account? Third, as the demand for economic valuation has expanded since the 1960s and 1970s, specific valuation methods and estimation procedures have also improved significantly, permitting a more accurate – though still frequently problematic – estimation of economic and monetary values of environmental resources and associated services.

An additional factor has to do with the response to policymaking itself. The limitations of 'command and control' and 'fences and fines' approaches to environmental policymaking have become increasingly evident, both in industrialized countries, where the institutions are often in

place to deal effectively with at least some environmental problems, and certainly in developing countries, where such institutions are often non-existent, irrelevant or functionally powerless. Yet, 'command and control' policy and regulatory approaches often generate responses by private decision-makers that are, at best, socially inefficient and wasteful of resources, and, at worst, stimulate rent-seeking behaviour and strategic decision-making that yield perverse outcomes. Is it not preferable to develop policies and regulatory frameworks that are compatible with private incentives and that, in fact, employ these incentives and knowledge of human behaviour in innovative ways to lead to socially desired outcomes? Much of the recent interest in environmental valuation has been concerned with precisely these questions, specifically, the development of incentive-compatible policies and regulatory approaches that yield desired outcomes in ways that may be less costly and more socially efficient. Hence, the interest in tradable emissions permits, carbon-trading schemes, the pricing of heretofore free water resources, valuation, compensatory and payment transfer mechanisms for environmental services, and other such innovations.

Although alternative typologies exist, one common framework for organizing our thinking about resource valuation distinguishes four types of ecosystem values (Pearce and Turner, 1990): (1) *direct use values*, due to the direct utilization of resources and ecosystem services; (2) *indirect use values*, attributable to the externalities of ecosystem services; (3) *option value*, due to preserving the option for future use of the resource (also directly addressing sustainability criteria); and (4) *non-use values*, which are attributable to a variety of intrinsic ecosystem characteristics. This nomenclature aside, perhaps inevitably, much of the attention in environmental valuation has focused on specific methodologies and analytical approaches to assigning economic and monetary values to resources, especially those resources that have typically been outside the formal market (Hanley and Spash, 1993; Freeman, 2003).

Accordingly, as discussed further in several chapters in Section II, these approaches are commonly divided into 'expressed (or 'stated') preference' approaches and 'revealed preference' approaches. The former approaches ask consumers and other private agents to assign resource values and rankings directly; these approaches include 'contingent valuation' methodologies in which people are asked for their 'willingness-to-pay' to pay for environmental benefits, for example. The latter approaches indirectly elicit consumer valuations through methods such as the 'travel cost' approach and 'hedonic pricing', which estimate resource values through statistical analysis of factors underlying human behaviour and the preferences (e.g. values) that are thus revealed. All of these methods have acknowledged strengths and deficiencies (also discussed in Section II). Yet, they have achieved wide acceptance because they continue to be at least partially successful in giving policy analysts and policymakers useful mechanisms and standards for achieving a better understanding of the values of environmental resources, thus enabling them to make better decisions regarding resource management, including the conservation and preservation of environmental resources in the face of competing uses.

THE CONSUMPTION TREADMILL

Since the World Commission on Environment and Development began deliberating on the links between environment and economy, there have been at least a couple of hundred further definitions of sustainability, and the term has now entered our common language. But where are we now with this sustainability idea? Does it offer some new hope for the world, or has it just hidden a much greater problem? The biggest challenge to sustainable development is now the consumption treadmill. The figures are worrying. People in North America now consume 430 litres of water per day; in developing countries, 23% have no water. In North America, 308 kg of paper are consumed by each person annually; in Europe 125 kg, in China 34 kg, and in India and Africa just 4 kg. In North America, there are 75 motor vehicles per 100 people, in Japan 57, in Europe 24, and in China, India and Africa just six to nine (see Table 1.1). Worldwide, some 400,000 hectares of cropland are paved per year for roads and parking lots (the USA's 16 million hectares of land under asphalt will soon reach the total area under wheat). The world motor-vehicle fleet grows alarmingly, as the nearly wealthy look to other parts of our global community for guidance as to what to buy. By almost every measure of resource consumption or proxy for waste production, the USA and Europe lead the way. And what model is being held up as the one to aspire to? There are now few people in the world who do not now aspire to the same levels of consumption as North America, which is, after all, presented as the pinnacle of economic achievement.

This consumer boom is already happening (see Meadows *et al*., 1972; Bell, 2004; see also Frank, 1999; Kasser, 2002; Schwartz, 2004; Nettle, 2005). The new consumers (Myers and Kent, 2003, 2004) have already entered the global economy, and are aspiring to have lifestyles currently enjoyed by the richest. A number of formerly poor countries are seeing the growing influence of

Table 1.1   Indicators of consumption from different countries and regions of the world (data from 2004–05)

	USA	Europe	China	India	Asia	Africa	Latin Central America	World
Passenger cars per 100 people	75	24	7	6	17	9	6	9
Annual petrol and diesel consumption (litres per person)	1624	286	33	9	47	36	169	174
Annual energy consumption per person (kg oil equivalent)	8520	3546	896	515	892	580	1190	1640
Annnual carbon dioxide emissions (tonnes per person)	20.3	8–12	2.7	0.99	<1	<1	<1	3.85
Annual paper and board consumption (kg per person)	308	125	34	4	29	4	38	52
Annual meat consumption (kg per person)	125	74	52	5	28	13	58	40
Daily water consumption (cubic metres per person)	4.6	1.59	1.35	1.74	1.72	0.47	1.47	1.73
Population (million, 2005)	293	730	1306	1080	3667	887	518	6500
Children born per woman	2.08	1.56	1.72	2.78	3.1	4.82	2.75	2.55

Sources: Pretty (2007), using Brown (2004); Myers and Kent (2004); WRI (2006)

affluence, as the middle classes of China, India, Indonesia, Pakistan, Philippines, South Korea, Thailand, Argentina, Brazil, Colombia and Mexico engage in greater conspicuous consumption. The side-effects are already being felt – the average car in Bangkok spends 44 days a year stuck in traffic. But there is still a long way to go. The car fleet of the whole of India is still smaller than that of Chicago, and that of China is half the number of cars in greater Los Angeles. At the same time as a consumer boom is occurring among newly affluent urban elites, poor people in such countries as India and China lack access to the basics such as clean water and health care.

This is now the concern: the idea of sustainable economic development seems to imply that the world can be improved, or even saved, by bringing everyone up to the same levels of consumption as those in the industrialized countries. We can, it is said, grow out of many kinds of economic trouble. This cannot be done, as we would need six worlds at European and eight to nine at North American levels and patterns of consumption (Rees *et al.*, 1996; Rees, 2002, 2003). How much, we might wonder, would be enough (see Suzuki, 1997)?

The currently dominant idea about the inevitable benefits of progress would appear to be a modern invention. Indigenous peoples do not believe that their current community is any better than those in the past. To them, past and future are the same as current time. Their ancestors, and those of animals too, constantly remind them to be humble as they move about their landscapes. But the myth of progress permits the losses of both species and special places, as it is believed that

losses can be offset by doing something else that is better. The myth permits a belief in technological fixes, which are indeed effective in many ways, but rarely seem to make everyone happier, even if some of them contribute to human longevity and reduce suffering. Environmental problems are, after all, human problems. New technologies will make improvements, but possibly not fast enough to save us. They also bring some new risks, possibly rendering society more vulnerable. To come soon will be fabulous electronic memory, a genomics revolution, renewable energy, and human brains augmented by computers, though as Rees (2002) puts it, 'a super-intelligent machine could be the last invention humans ever make.' Rees recounts the 1937 efforts by the US National Academy of Sciences to predict breakthroughs for the rest of the last century. They made a good stab at agriculture, rubber and oil, but completely missed nuclear energy, antibiotics, jet aircraft, space travel and computers (see also Gray, 2002, 2004).

It is now clear from a variety of studies of people in the USA and Europe that people were happier in the 1950s compared with today. We can only guess more about earlier times, as the data do not exist in comparable form. But it does seem that our programmed happiness is about striving for, not actually increasing, happiness (Frank, 1999; Kasser, 2002; Schwartz, 2004; Nettle, 2005). One reason is that we compare our consumption with others around us, and we do not necessarily feel better off or happier if others' consumption is also increasing. There is always a nagging gap between present levels of

contentment and how it could be. We believe we will be happier in the future, but seldom are. We also are constantly worrying about how future life events affect our happiness. As Bell (2004) has pointed out, we could work four hours per day, or just for about half a year, if we consumed at 1940s levels, yet be equally happy. But would anyone choose this option if they could?

EMERGING PERSPECTIVES ON POPULATION AND THE ENVIRONMENT

Population will continue to grow in many countries at least until mid-century, posing considerable problems in relation to providing for basic needs and dealing with environmental damage in some. Yet population is already declining is some rich countries, and others' population can be expected to stabilize then to decline, as the age structure of the population shifts and social practices change. A psychological problem yet to be faced is the consequence of coming population decline. Thomas Malthus (1798) argued that human population growth would always outstrip resources. 'Population, when unchecked,' he said, 'increases in a geometrical ratio. Subsistence increases only in an arithmetic ratio. A slight acquaintance with numbers will shew the immensity of the first power in comparison with the second'. Since then, most policies and practice regarding natural resources and food have been shaped by concerns about our growing numbers. Humans are, after all, an extraordinarily successful species. When agriculture emerged, some 10,000 years ago, there were probably five million people worldwide. To the mid-19th century, world population then doubled eight times. Since then it has doubled four more times, and will continue to grow to probably eight and a half billion people by the middle of the 21st century. It will then stabilize for a while, and subsequently fall. Not because of wars, climate change or infectious diseases (though they may contribute to greater declines), but because of changing fertility patterns. More choices about contraception and decreasing poverty reduces the need to have so many children, and changing lifestyles among the rich delay child-bearing ages. When one generation produces fewer daughters, and fewer daughters are produced by them, then the replacement rate soon falls below the 2.1 needed to maintain population stability.

Today, the average woman in industrialized countries has fewer than 1.6 children, in the least developed countries 5 children, and in the other developing countries 2.6. The lowest fertility rates are now in southern Europe, at 1.1 children per woman. In the mid-1970s, the average Bangladeshi woman had six children; today she has about three; in Iran, fertility has fallen from more than five children in the late 1980s to just over two today. The worldwide annual gain is still 76 million people (down from 100 million in 1990), but this is expected to fall to zero by 2050 as the number of children falls from today's average of 2.55 to 2.0. Life expectancy at birth was 47 years in 1950–55, rose to 65 years by 2000–05, and will rise again to 75 years worldwide by 2045–50. By then, the number of people over 60 will have tripled to 1.9 billion, and the number over 80 will have risen from today's 86 million to 395 million. Of course, these changes will not be evenly spread. Some countries are predicted to triple their numbers by 2050: these include Afganistan, Burkina Faso, Burundi, Chad, Congo, DR Congo, DR Timor-Leste, Guinea-Bissau, Liberia, Mali, Niger and Uganda. But the populations of 51 countries will fall, including Germany, Italy, Japan and most of the former USSR (UN, 2004, 2005a).

What will happen after this peak, less than two generations away from us now? The United Nations (2005b) has made population predictions for the next 300 years, and uncertain though these must be, the medium fertility estimates suggest at least a levelling of world population for 250 more years at 8.5 to 9 billion. At low fertility (at the kind of levels we are already seeing today – after all, 93 out of 222 countries already have fewer than 2.1 children per women, and 37 have less than 1.5), world population declines to 5.5 billion by the end of this century, to 3.9 billion by 2150, and down to 2.3 billion by 2300. Which track we end up on depends entirely on early changes in fertility. Demographers cannot, of course, agree on the probability of stability or decline. But any kind of fall will bring huge changes. In 2000, people on average retired two weeks before mean life expectancy (at 65 years); by 2300, people will retire more than 30 years short of life expectancy (unless age of retirement changes), when on average women will live to 97 and men to 95 years. This does not take account of potentially revolutionary changes to human longevity that new medical technologies might bring.

Caldwell (2004) says that 'the low scenario is by no means implausible', and that the low projections 'would probably portend to many the fear of human extinction'. Governments would try to raise fertility levels, but it could be very difficult to achieve, as people do not always do the bidding of their governments. What, then, will happen to all those settlements we do not need? What of the fields and farms that become surplus to requirements? What of the wild animals – will we see their return to places where they had long since been eliminated (not the extinct species, of course,

as they are gone forever)? Or might the vision be quite different – of spreading urban wastelands, of forgotten linkages to nature, of the nightmare of decivilization (a term coined by Timothy Garton Ash, in Porritt, 2005)?

DUALISM, SEPARATION AND CONNECTIONS

In recent years, with growing concerns for sustainability, the environment and biodiversity, many different typologies have been developed to categorize shades of deep to shallow green thinking. Arne Naess sees shallow ecology, for example, as an approach centred on efficiency of resource use, whereas deep ecology transcends conservation in favour of biocentric values. Other typologies include Donald Worster's imperial and arcadian ecology (Worster, 1993) and the resource and holistic schools of conservation. For some, there is an even more fundamental schism – whether nature exists independently of us, or whether it is characterised as post-modern or as part of a post-modern condition. Nature to scientific ecologists exists. To some post-modernist perspectives, though, it is mostly a cultural construction. The truth is, surely, that nature does exist, but that we socially construct its meaning to us. Such meanings and values change over time, and between different groups of people.

There are many dangers in the persistent dualism that separates humans from nature. It appears to suggest that we can be objective and independent observers – rather than part of the system and inevitably bound up in it. Everything we know about the world we know because we interact with it, or it with us. Thus, if each of our views is unique, we should listen to the accounts of others and observe carefully their actions. Another problem is that nature is seen as having boundaries – the edges of parks or protected areas. At the landscape level, this creates difficulties, as the whole is always more important than each part, and diversity is an important outcome (Foreman, 1997; Klijn and Vos, 2000).

This can lead to the idea of enclaves – social enclaves such as reservations, barrios or Chinatowns, and natural enclaves like national parks, wildernesses, sites of special scientific interest, protected areas or zoos. Enclave thinking can lead us away from accepting the connectivity of nature and people, though it has the advantage of creating niches for specialization. One consequence is that biodiversity and conservation can be considered to be in one place, and productive agricultural activities in another (Cronon *et al.*, 1992; Deutsch, 1992; Brunkhorst *et al.*, 1997; Pretty, 2002). It is no longer acceptable

to cause damage in some natural landscapes, provided we leave some areas protected. Enclaves also act as a sop to those with a conscience – the wider destruction can be justified if we fashion a small space for natural history to persist.

By continuing to separate humans and nature, the dualism also appears to suggest that technologies can always intervene to reverse damage caused by this very dualism. The greater vision, and the more difficult to define, involves looking at the whole, and seeking ways to redesign it. Cartesian dualism that puts humans outside nature remains a strange concept to many human cultures. It is only modernist thinking that has separated humans from nature in the first place, putting us up as distant controllers. Most peoples do not externalize nature in this way. From the Ashéninha of Peru to the forest dwellers of former Zaire, people see themselves as just one part of a larger whole, as do many people who adhere to major modern religions – even Christians who are often accused of treating nature as something to be plundered. Their relationships with nature are holistic, based on 'both/with' rather than 'either/or' (Benton, 1998; Gray, 1999). Recent research on the biophilia hypothesis of E. O. Wilson is indicating that natural or green places are good for mental health, irrespective of social context (Kellett and Wilson, 1993; Pretty, 2004; Pretty *et al.*, 2005).

The idea of the wilderness struck a chord in the mid-19th century, with the influential writers Henry David Thoreau and John Muir setting out a new philosophy for our relations with nature. This grew out of a recognition of the value of wildlands for people's well-being. Without them, we are nothing; with them, we have life. Thoreau famously said in 1851, 'in wildness is the preservation of the world'. Muir in turn indicated that: 'wildness is a necessity; and mountain parks and reservations are useful not only as fountains of timber and irrigating rivers, but as fountains of life.' But as Roderick Nash, Max Oelschlaeger, Simon Schama and many other recent commentators have pointed out, these concerns for wilderness represented much more than a defence of unencroached lands. (For the Thoreau quote, see Nash, 1973, p. 84 – quoted in turn from a speech by Thoreau on April 23rd, 1851, to the Concord Lyceum. For the Muir quote, see Oelschlaeger, 1991. See also Nash, 1973; Schama, 1996; and Vandergeest and DuPuis, 1996.) It involved the construction of a deeper idea, which proved to be hugely successful in reawakening in North American and European consciences the fundamental value of nature.

Debates have since raged over whether 'discovered' landscapes were 'virgin' lands or 'widowed' ones, left behind after the death of

indigenous peoples. Did wildernesses exist, or did we create them? Donald Worster, environmental historian, points out for North America that 'neither adjective will quite do, for the continent was far too big and diverse to be so simply gendered and personalised' (Worster, 1993). In other words, just because they constructed this idea does not mean to say it was an error. Nonetheless, they were wrong to imply that the wildernesses in, say, Yosemite were untouched by human hand, as these landscapes and habitats had been deliberately constructed by Ahwahneechee and other native Americans and their management practices to enhance valued fauna and flora.

Henry David Thoreau developed his idea of people and their cultures as being intricately embedded in nature as a fundamental critique of mechanical ideas that had separated nature from its observers. His was an organic view of the connections between people and nature (For a good review of Thoreau, see Oelschlaeger, 1991, pp. 133–171). In his *Natural History*, Thoreau celebrates learning by 'direct intercourse and sympathy' and advocates a scientific wisdom that arises from local knowledge accumulated from experience combined with the science of induction and deduction. But he still invokes the core idea of wilderness untouched by humans – even though his Massachusetts had been colonized just two centuries earlier and had a long history of 'taming' both nature and local native Americans.

The question, 'is a landscape wild, or is it managed', are perhaps the wrong ones to ask, as it encourages unnecessary and lengthy argument. What is more important is the notion of human intervention in a nature of which we are part. Sometimes such intervention means doing nothing at all, so leaving a whole landscape in a 'wild' state, or perhaps it means just protecting the last remaining tree in an urban neighbourhood or hedgerow on a field boundary. Preferably, intervention should mean sensitive management, with a light touch on the landscape. Or it may mean heavy reshaping of the land, for the good or the bad.

So it does not matter whether untouched and pristine wildernesses actually exist. Nature exists without us; and with us is shaped and reshaped. Most of what exists today does so because it has been influenced explicitly or implicitly by the hands of humans, mainly because our reach has spread as our numbers have grown, and as the effects of our consumption patterns have compounded the effect. But there are still places that seem truly wild, and these exist at very different scales and touch us in different ways. Some are on a continental scale, such as the Antarctic. Others are entirely local, a woodland amidst farmed fields, a saltmarsh along an estuary, a mysterious urban garden, all touched with private and special meanings.

In all of these situations, we are a part, connected, and so affecting nature and land, and being affected by it. This is a fundamentally different position to one which suggests that wilderness is untouched, pristine, and so somehow better because it is separated from humans – who, irony of ironies, promptly want to go there in large numbers precisely because it appears separate. But an historical understanding of what has happened to produce the landscape or nature we see before us matters enormously when we use an idea to form a vision that clashes with the truth. An idea that this place is wild, and so these local people should be removed. Another idea that this place is ripe for development, and so a group of people should be dispossessed. The term wilderness has come to mean many things, usually implying an absence of people and presence of wild animals, but also containing something to do with the feelings and emotions provoked in people. Roderick Nash (1973) takes a particularly Eurocentric perspective in saying, 'any place in which a person feels stripped of guidance, lost and perplexed may be called a wilderness', though this definition may also be true of some harsh urban landscapes. The important thing is not defining what it really is, but what we think it is, and then telling stories about it.

SOCIOLOGY AND THE ENVIRONMENT

The classical approaches to understanding the structure of society shared two basic features. One was the ambition to provide ways of conceptualizing the large-scale structural features of whole societies, and to situate them in the context of long-term historical change and in relation to the alternative social forms and historical tendencies in the rest of the world. The other was the insistence that human social and historical life was a distinct order of reality in its own right, not to be explained away in terms of the biological sciences of the day: industrial development, social inequality, crime, suicide rates, gender divisions and the like were to be understood in terms of social and cultural causes, not racial inheritance, genetic endowment or physiological constitution. This second feature was the basis for a process of 'separate development', through which the life and social sciences proceeded in ignorance of one another: 'nature' and 'culture' were distinct and contrasting realms, knowing and needing to know nothing of one another (Benton, 1996, 2001).

A common feature of the classics was their insistence on human social and cultural life as an order of reality in its own right, irreducible to the

biological realm. Through most of the 20th century, this was taken to be an unquestioned assumption: social processes were to be explained in terms of social causes. This resistance to biological explanation was strongly reinforced by widespread revulsion at the consequences of Nazi doctrines of racial superiority, and the racist underpinning of much European imperial domination of non-Western peoples. With the rise of new social movements from the 1960s onwards, challenging established inequalities and social exclusions based on gender difference and sexual orientation, the terms 'nature' and 'natural' came to be viewed with suspicion. Sociologists sympathetic to the struggle for women's emancipation or gay rights critically exposed the way dominant ideologies justified oppression in the name of a distinction between what was 'natural' and what was 'unnatural', and therefore pathological. In this way, the strong links between sociology and progressive social movements reinforced the assumption already built into the main sociological traditions that biology, the 'natural', should be held at arms length and viewed with suspicion. It became a standard procedure for sociologists, and especially those who identified with a critical stance towards established society, to call into question all authoritative claims to knowledge of 'nature' or 'reality' (Soper, 1995; MacNaughten and Urry, 1998).

Then, from the late 1970s onwards, developments in linguistics and cultural theory became very influential, and approaches which (following Weber and Simmel, among the classics) focused on symbolic meaning and the role of language in shaping our experience of the world flourished. Questions about the material reality of nature and our relation to it now became excluded as a matter of methodological principle: all experience of the world is to be understood as mediated by language and culture. But there is no way anyone can stand outside the available language and culture to see reality in itself: we are left with the task of characterizing the role played in social life by various different and often conflicting linguistic and cultural 'constructions' of reality. It is important to remain neutral and agnostic about which, if any, of these 'constructions' is true. Critical sociology can aid emancipatory social struggles by exposing the 'constructed' character of the prevailing oppressive accounts of what is 'natural', thus 'deconstructing' them and challenging their authoritative hold over peoples' lives. These are the core insights of the approaches called 'constructionist'.

The sensitivity of sociology to the social and cultural movements and issues in the wider world outside the academy now presented it with a deep challenge: from the early 1960s the progressive social movements with which many sociologists had become identified also included a burgeoning radical environmental movement whose intellectual leaders (often dissident natural scientists) raised public alarm about the growing threat posed by our affluent, growth-oriented throwaway society to its own planetary life-support systems. Here was a new and powerful basis for a radical, critical politics, but one which celebrated nature, and claimed authoritative knowledge of the terrible destruction of it unleashed by contemporary society. This was a deep challenge in two ways. First, it was an intellectual challenge. Sociology had established its right to exist as a distinct discipline by a radical separation of the realms of nature and culture, but now faced pressing questions about the consequences of the mutual interconnection, the shared fate, of natural processes and social life. The second challenge was rooted in the normative commitment of critical sociologists and was particularly strongly felt by those who sympathized with such emancipatory movements as anti-racist, gay rights and women's liberation activism but were also drawn to the emergent green politics with its passionate defence of 'nature'.

There emerged two very broad, and to some extent conflicting, ways of addressing the new environmental agenda. One, typically 'constructionist', and deriving from the 'modest' tradition, tended to avoid large-scale theorizing. The great strength of this tradition has been its detailed case studies of particular environmental issues, social movements, campaigns and episodes of conflict. Rather than use the new environmental agenda as an occasion for questioning the basic inherited assumptions of the discipline, this sort of approach has concentrated on treating environmental issues as a new field in which to demonstrate the value of already-established sociological concepts and styles of argument. For instance, this approach has debunked many myths about the environmental movement. It was found that while parts of the movement retain a radical and progressive edge, many had evolved into highly professional lobby organizations seeking insider status in government decision making through moderating their demands (Dalton, 1994). At the same time, many members do little or nothing beyond giving an annual donation, having little or no direct involvement in local politics and living remarkably standard middle-class lives. The key standard concepts turn out to be institutionalization as a consequence of the problem of resource mobilization, which in turn derives from rational choice by individuals to do little, as captured in the Prisoner's Dilemma metaphor and other models of collective action failure (Jordan and Maloney, 1997).

For sociologists of science, the natural sciences are thoroughly social in character, their conceptual

organization, research priorities and methodological procedures all shaped by social interests and cultural values – generally subservient to the dominant group or elite interests. Similarly with technologies – these are designed to serve powerful interests and cannot be fully understood independently of the social practices and relationships which their use either maintains or transforms. This way of understanding scientific and technical innovation has much to offer in the environmental field. It opens up the possibility of analysis of the kinds of pressures, power relationships, forms of regulation, etc., which promote environmentally damaging technologies, and also suggests the sorts of social and economic change which might encourage more benign forms of technical change.

Contructionist approaches have also produced valuable research in the field of environmental social movement mobilization and organization. The key insight which informs their approach is recognition that there is no one-to-one correspondence between the existence of, say, air pollution, or biodiversity loss, on the one hand, and the emergence of a social movement which identifies it as an unacceptable condition and campaigns for change, on the other. A leading constructionist environmental sociologist, John Hannigan (1995), provides an illuminating set of concepts for analysing the social and cultural processes involved in 'constructing' an environmental problem. First, a problem-claim has to be 'assembled': evidence, including scientific evidence, has to be collected and put together in such a way as to show that the state of affairs is significant enough to justify public concern and action. Next, it has to be 'presented': the problem has to be characterized in ways which will attract attention, and provoke the desired public concern. Since the media are now so central to communication to wider publics, this will also involve ways of engaging with the media in such a way as to ensure not only their attention, but also that media representations coincide with the movement's own 'framing' of the issue. The case of Greenpeace's use of dramatic film footage of whaling is a good example. The visual images were irresistible material for the electronic media, and their vivid portrayal of the violent death of great and beautiful creatures had more impact on public conscience than a thousand books. Perhaps, too, the constructionists might argue that the ethical and aesthetic power of these images far outweighed the influence of detailed scientific studies of the population dynamics and risk of extinction of the different whale species.

Finally, Hannigan notes that success on the part of social movements in making their 'problem-claim' is not the end of the matter. In each case, interests will be threatened by the raising of an issue – in the case of whaling, for example, the industry itself, and spin-off processing and retail interests, as well as consumer cultures in certain countries and indigenous people for whom whaling is central to their whole way of life. So, the raising of an issue will generally be met with counter-arguments, and competition for media framing and public acceptance. Hannigan calls this the 'contestation' of movement claims. Social movement theory also has developed concepts for analysing the processes involved in establishing, maintaining and coordinating social movement activity, for studying the culture of such movements and how they shape the identities of individuals who participate in them (Eyerman and Jamison, 1991; Yearley, 1991, 1994; Munck, 1995).

It is increasingly common for constructionists to defend a more limited or 'contextual' constructionism, which does not deny either the reality or the importance of actual environmental change. So, there is a convergence between constructionist and the alternative 'realist' approaches in their underlying philosophy. Even so, the rhetoric of a more radical constructionism is often retained, and a lack of analysis of the crucial ambiguities of concepts such as 'construction' itself can give the impression that an account of the cultural *construction* of an environmental change as an 'issue' somehow also explains the socio-economic *causes* of the change itself. In other words, the constructionist approaches may be true to the 'nature-sceptical' critical traditions, but they do not, in the end, address the need to revise those traditions to reconnect our understanding of society with its material basis in nature.

The four basic types of approach are, first, the 'new environmental paradigm' advanced in the late 1970s, second, 'reflexive modernization', as advocated by Giddens, Beck and others, third, a more recent cluster of approaches referred to as 'ecological modernization', and, finally, a range of approaches deriving from the Marxist, or historical materialist, tradition in various combinations with green, feminist and anti-racist ideas. These latter approaches can be collectively referred to as 'radical political economy'. The pioneers of the first approach were the US sociologists, R. E. Dunlap and W. R. Catton. In a series of articles from the late 1970s onwards (see Catton and Dunlap, 1978, 1980; Dunlap and Catton, 1994) they criticized mainstream sociology for working with a 'human exemptionalist' paradigm: that is, sociologists had tried to understand human societies in abstraction from their interdependence with the rest of nature, as if we were 'exempt' from the laws of nature which apply to all other beings. Instead, they proposed a 'new environmental paradigm' which would locate human societies within the wider web of environmental interactions.

Clearly, their proposal was for an ecology-inspired radical revision of the whole sociological tradition. Very much in line with these original proposals is an influential approach which attempts to measure the scale of materials and energy taken up by and emitted by particular societies at different historical periods. Key concepts in materials and energy flow accounting are the 'metabolism' between societies and nature, and 'colonisation' of nature and natural resources by social processes (Fischer-Kowalski and Haberl, 1993; Foster, 1999; Schandl and Schulz, 2000). This approach offers a means of quantitative measure of the extent of 'ecological modernization' over time in the industrialized countries (Adrianne *et al.*, 1997; Matthews *et al.*, 2000).

Whereas the focus of the radical political economy analyses is modern capitalism, its expansionary tendencies and political implications, the key concept for these other approaches is 'modernity' and the key process 'modernization'. The shift from 'modern' as an adjective, to the idea of 'modernity' as a way of characterizing a whole society or historical period (Craib, 1992, 1997; Stones, 1998) is associated with a tradition known as 'functionalism'. This approach assumed an evolutionary development in the history of societies toward more complex and functionally differentiated societies. The Western societies represented the highest developmental stage, and models were devised to foster 'development' in the rest of the world, on the assumption that it would follow the model already achieved in the west. This process was 'modernization'. Its outcome would be capitalist and liberal-democratic. 'Modernity' was the state we in the West had already attained, and, by implication, one to which everyone else would, or should, aspire. In this early version the notion included three aspects: modernity was the destiny of the whole world, the West was leading the way, and this was a good thing. Initially influential as a cold-war ideology, this assumed more triumphalist forms with the fall of Soviet and East European state-centralist regimes at the end of the 1980s (Fukuyama, 1992). This period also marked a revival in the use of the terms 'modernity' and 'modernization' by sociologists, often as a way of avoiding the more politically contentious term 'capitalism'.

Most relevant to our theme have been two theoretical approaches which have linked 'modernity' and 'modernization' with ecological change and environmental social movements: ecological modernization theory and the notion of 'reflexive modernization' associated with Ulrich Beck and Anthony Giddens. Both approaches see 'modernity' as a phase in historical development as well as a type of society, and both subdivide modernity itself into successive developmental phases.

In this respect, reflexive modernization theorists, especially, incorporate some of the themes of post-modernism as characterizing a significant transition within modernity. Beyond this, the two traditions diverge quite radically.

Ecological modernization theory had its origins in the 1970s. Its earliest advocates shared the optimistic evolutionary/developmental perspective of the American functionalist versions. They distinguished an early phase of modernity, a phase of industrial 'construction', in which increased production was won at the cost of increased environmental degradation, from a more recent phase of 'reconstruction'. In this latter phase, industrial production and consumption were increasingly governed by a new, 'ecological rationality'. Scientific and technical innovation was increasingly devoted to adapting the industrial society to environmental constraints (Murphy, 2000).

The idea of reflexive modernization, too, has a two-phase model of development within 'modernity'. Modernity itself is defined (in Giddens's version) as a combination of four distinct institutional dimensions: a liberal democratic state, concerned with surveillance, a military establishment which monopolizes the legitimate use of force, an economic system, characterized by private property and market, and industrial technologies as the mode of appropriation of nature. However, in recent decades, this model of 'simple' modernity is rendered increasingly inappropriate by three interrelated social processes. Globalization, which, for Giddens, is primarily a matter of increased international flows of communication and information, opens up all closed communities and stable traditions to the existence of alternatives. A new cosmopolitanism emerges in which it is impossible to maintain traditions 'in the traditional way'. So, along with globalization comes 'de-traditionalization.' Freed from the constraints of localism and traditionalism, both individuals and institutions become more 'reflexive': more self-conscious, and consequently more open to revising their practices and identities. Instead of a life whose main outlines are determined by the contingencies of birth – class, sex, locality – we are increasingly required to turn our lives into a 'reflexive' process of flexibly inventing and re-inventing our identities. Traditional forms of gender relation and family forms, established authority relations and norms of conduct and especially the traditional political divisions of left and right, rooted in traditional class identities, are expected to dissolve in the acid of reflexivity (Giddens, 1994; for commentary, see O'Brien *et al.*, 1999; Benton, 2000).

Beck and Giddens concur in their expectation that the mass politics of left and right, like the class identities which that expressed, will fade

away, to be replaced by a new politics 'beyond left and right'. Giddens speaks of this as a politics of life-style and voluntary activity, whilst Beck's hope is for a 'new modernity' in which non-institutionalized social activism will demand democratic accountability from technocrats and politicians in the way science and technology are developed and introduced.

In the face of such analyses from the reflexive modernizers, and from the developments of the radical political economy approach, the contemporary advocates of ecological modernization have significantly reworked their inherited theory. Writers such as A. Weale, G. Spaargaren, A. P. J. Mol, M. A. Hajer and others have acknowledged that the advance of their hoped-for 'ecological rationality' is more problematic than earlier writers such as Huber and Janicke had supposed (Weale, 1992; Hajer, 1995; Mol and Sonnenfeld, 2000). Recent work in this tradition differs from the earlier in three main respects. First, the earlier emphasis on technology is broadened to include the importance of accompanying changes in culture, consumer behaviour, organization and governmental intervention and regulation as fostering environmental adaptation. Along with this is a shift away from the functionalism of the earlier version in favour of recognition of the role of social agency in bringing about change, and, finally, the recognition that ecological modernization is a 'project', facing resistance, obstacles and reverses, not an inherent, smoothly operating tendency inherent in the historical development of 'modernity'.

The ecological modernizers remain, however, significantly more optimistic about the environmental prospects of 'modernity' than either the analysts of 'risk society' (Beck 1992) or the radical political economists (for more on these approaches, see Chapter 6). In favour of the ecological modernizers is the evidence that the 'advanced' industrial societies have made significant progress in environmental regulation and 'green' taxation, most have ministries devoted to environmental policy, significant gains have been made in combating important sources of air, water and soil pollution, recycling, materials substitution, and increasingly energy and resource-efficient technologies have been developed and employed. Evidence on materials and energy flow over a twenty-year period for some of the industrialized countries does indeed show the looked-for 'decoupling' of economic growth measured in financial terms from measurable environmental impact: industry in these countries does appear to be increasingly ecologically efficient per unit of economic value produced.

In the domain of environmental politics, the green movements in most advanced industrial societies have changed their role from a marginal, oppositional and 'outsider' status, to insiders, collaborators with business, government and technocrats in setting mainstream policy objectives. In the international sphere, the EU has gained democratic legitimacy for its vigorous espousal of environmental issues, both in relation to the wider global scene and in relation to the record of member states. At the global level, a series of conferences leading up to Rio in 1992 have provided an overarching concept of sustainable development embracing both social justice and long-term environmental protection, as well as international agreements on, among other important issues, trade in endangered species, climate change, ozone depletion and conservation of biological diversity.

There is a major debate about how effective these agreements are, and indeed about what effectiveness means (Underdal, 1992; Young and Levy, 1999; Sprinz and Helm, 2000). International agreements do not operate in isolation from each other and they frequently have negative side-effects on other environmental problems (Ward *et al.*, 2004). For instance, some substitutes for CFCs are powerful greenhouse gases, so the Montreal Convention on ozone-depleting substances has side-effects on the Kyoto Protocol, eventually leading to international action. Because of such interconnections and side-effects the real issue is whether the *system* of international environmental agreements promotes *sustainability* on balance (Ward *et al.*, 2004). There is evidence that it does do so, pushing countries beyond what they would otherwise have done to promote sustainability (Ward, 2006).

As the constructionists clearly demonstrate, the formation and transformation of environmental issues as an agenda for public attention and policy-making depends on complex interactions between social movement activists, researchers, media communicators, policy networks and communities, industrial lobbies, government departments, international organisations and many other sorts of actors. In the realist approaches favoured here, recognition of the roles played by these heterogeneous and often conflicting social actors has to be complemented by acknowledgement of the active causal role played by non-human beings, relations and forces: both those purposively mobilized in the course of technologically mediated human social interaction with nature, and those unintentionally and often unexpectedly 'striking back'. Scholars have an important place in the effort to understand the systemic connections between the social, economic, political and biophysical dimensions of our increasingly problematic 'metabolism' with non-human nature. The intellectual demands of such an enterprise, and the great divisions of interest and of value judgement at stake in it suggest that it will always be

a thoroughly contested enterprise. The less encouraging aspect of our situation, however, is that the socio-ecological processes of destruction and degradation escalate as we argue.

SECTION I: ENVIRONMENTAL THOUGHT – PAST AND PRESENT

In the first chapter of this Handbook (Chapter 2) on the enlightenment and its legacy, Ted Benton sketches some of the historical background to our contemporary debates about the relationship between human society and the rest of nature. This chapter begins with the influence of the 17th century scientific revolution on the thinkers of the Enlightenment. The views of Hobbes, Locke and Rousseau are compared, to illustrate the great diversity of thought within the Enlightenment. Rousseau, especially, is introduced as a precursor of the Romantic movement, which challenged the prevalent view of nature as merely a set of resources to be utilized for human purposes. Instead, the Romantics offered views of our relationship to nature as one in which aesthetic appreciation – even awe and wonder at nature's magnificence – were essential to full human flourishing.

Benton goes on to note the importance of the legacy of romanticism for Darwin's revolutionary understanding of the historical character of evolving nature, and for his sense of wonder at the immense diversity of life. Despite Darwin's own initial reluctance to elaborate on the implications of evolution for our understanding of human nature and prospects, he was soon drawn into the intense debates about these questions that followed the publication of his *Origin of Species*. Here, Benton attempts to show that the influence of Darwin's ideas on social thought were much more diverse than is often recognized.

Damian White and Gideon Kossoff then assess the history of anti-authoritarian thought in anarchism, libertarianism and environmentalism in the second chapter (Chapter 3). They trace the diverse connections between anarchism, the broader libertarian tradition, environmentalism and scientific ecology. Anarchists maintain that it is the very coercive ideologies, practices and institutions of modernity that are the source of the disorder and social chaos they are designed to prevent. The authors demonstrate that the resistance many contemporary forms of ecological politics holds for conventional leadership patterns, individualism and division of labour has a long pedigree. At the same time, social anarchist, left libertarian and ecological anarchist currents have all influenced thinking about social–nature relations. It is apparent that many politics going under the loose term ecology continue to find these traditions invaluable

sources of ideas and innovation. The se′arch for self-organizing societies continues, as does concern for the establishment of sustainable cities and other settlements.

In the third chapter (Chapter 4) of this section, Mary Mellor analyses the development of thinking around ecofeminism, gender and ecology (see also Mellor, 1992). Ecofeminism is based on the claim that there is a connection between exploitation and degradation of the natural world and the subordination and oppression of women. It also takes the view of the natural world as interconnected and interdependent, with humanity systematically gendered in ways that subordinates, exploits and oppresses women. Unlike some other writers, Mellor does not make a claim that women have a superior vision, or higher moral authority, but indicates that an ethics that does not take account of the gendered nature of society is doomed to failure, as it will not confront the structure of society and how that structure impacts on the material relationship between humanity and nature.

The problem, of course, is how political change can occur. Should it be driven from the top, or does political agency need to come from people and groups who are exploited, marginalized and excluded by the existing social and ecological structures? Mellor indicates that building coalitions and coordinated political action are essential. The basis for this position is that knowledge about the natural world will always be partial, and so awareness of pervasive uncertainty should be the starting point of all other knowledge. Humanity is part of a dynamic iterative ecological process where the whole is always more than the sum of the parts. Far from being a restriction on feminism, ecofeminism offers analyses that show how exploitative and ecologically unsustainable systems have emerged through the gendering of human society. Such an analysis demands radical change.

In the fourth chapter (Chapter 5) on deep ecology, Ted Benton suggests that the orientations to nature expressed in the art and literature of the Romantic movement (Chapter 2) find more systematic philosophical and political expression in the stream of modern environmentalism known as 'deep ecology'. Benton presents an outline of the thought of the Norwegian philosopher, Arne Naess, who is generally recognized as the 'founding figure' of the deep ecology movement. Naess made a sharp contrast between 'shallow ecology', which seeks mainly to manage resources for human purposes, and his own, 'deep ecological' perspective, which understands humans and nature as bound together in a single indivisible totality, every part of which is (in principle) equally valuable. Not surprisingly,

Naess's distinction itself, as well as the implications of his deep ecological alternative to 'mainstream' environmentalism have been very controversial. Benton goes on to present some of the main arguments of the critics of deep ecology, and the replies offered by the deep ecologists and other 'ecocentrics'. The debate is presented as open-ended, and as having much to offer to our current practice of environmental politics.

In the fifth chapter (Chapter 6) on greening the left, Ted Benton explores some of the historical background to the present tendency for social justice (a traditional concern of the political left) to be linked closely to the demand for environmental protection (a central concern of the green movement). He suggests that there has been a long history of the intertwining of these two sets of concerns in the thought and practice of some of the traditions of the left. Beginning with Marx and Engels's ways of analysing the different historical forms of human society and historical change in terms of their 'metabolism' with the rest of nature, he suggests that they have valuable insights to offer to today's environmental movements – this despite the dreadful environmental record of many of the regimes established in Marx's name (see also Benton, 1989, 1996; Foster, 1999).

With the re-emergence of radical environmental politics in the 1960s, some of the radical thinkers of the left responded by drawing on and developing the legacy of the earlier socialist traditions. Their aim was to address what they saw as the close connections between the social and ecological crises of our own times. The work of the late 19th century designer, artist, craftsman, environmentalist and socialist, William Morris, has been an important inspiration. Benton also discusses the more recent ideas of Andre Gorz and the American eco-Marxist, James O'Connor, going on to introduce an approach called 'World System Theory'. This is an attempt to understand the causes of continuing inequalities in the global economy and in the relations between different nation states. Benton suggests that this approach has much to offer in explaining global ecological degradation and the current lack of success in tackling its causes.

The sixth chapter (Chapter 7) of this section contains an exposition by Warwick Fox on the problems that need to be addressed by a theory of general ethics. Old ethics has generally occurred in a closed moral universe, whilst new ethics, that conducted in a whole earth, or Gaian, context seeks to work in an expansive moral universe. There are problems, though, with new ethics. If biodiversity is important to preserve, what do we make of introduced (or alien) species that are ecologically destructive? Should they be removed, even if they increase net biodiversity? What if they

are sentient themselves? The consideration of the holistic integrity of ecosystems is further considered, along with the difficulties of being both comprehensive and consistent. In this article, eighteen problems as they relate to interhuman ethics, animal welfare ethics, life-based ethics, ecosystem integrity ethics, and the ethics of human-constructed environments are discussed and analysed. This effectively sets out a map of the ethical terrain for those addressing environmental and society-related issues and the likely dilemmas they will encounter.

The final chapter of this section (Chapter 8) is by Damian White, Chris Wilbert and Alan Ruddy, and addresses the contemporary and growing problem of anti-environmentalism. The emergence of the Lomborg controversy was seen by some as a new phase of criticism of environmentalism, by some even a unique critique. Yet there were many antecedents, arising from left, right and technocratic sources to post-war environmentalism, then to the global environmentalism of the 1990s (after the Rio conference and as a result of the efforts to establish international treaties) and then the modern contrarians exemplified by Lomborg and others. There remains a fundamentalist form of contrarianism that is at the centre of greenwash attempts by anti-environmental industry. Yet framing of debates as primarily being between contrarians and radical ecologists misses many important developments in both thinking and action. There are, for example, distinct tendencies of green optimism in industrial ecology, sustainable architecture and sustainable agriculture. At the same time, there are others who frame arguments in technologically pessimistic terms.

SECTION II: VALUING THE ENVIRONMENT

In the first chapter of this section (Chapter 9), Thomas Crocker examines the basic economic questions underlying the social choice of environmental management instruments and institutions. The author argues that, at its root, this social choice is motivated by competing 'deontological' versus 'individualistic' visions and their associated management options. Neither vision, in its extreme, is seen as an accurate or realistic basis for environmental management. Rather, the author suggests that environmental management is based on discovering 'collective procedural rationality', not to be confused with the 'limited elemental rationality' of the individual. To the extent that exchange institutions – markets and other incentive-compatible environmental policies and instruments – accurately reflect available

information and options, they can help create collectively rational mechanisms which 'guide people to their own interests.' This process is based on market prices which provide incentives for collectively rational behaviour, but that are themselves subject to a variety of limitations which interfere with achieving efficient outcomes: incomplete information, non-zero transactions costs, misdirected incentives, and undefined, non-transparent or illegitimate initial distribution of rights over assets. The conclusion is that top–down decision-making of environmental authorities regarding the selection of control instruments and effort spent on monitoring and compliance to mandate 'what to do and how to do it' is obsolete, assumes scarce or incomplete information, and is expensive due to strategically interdependent decisions of the authority and users. But neither will the total privatization of environmental decision-making by individuals typically be collectively rational.

The best, then, that authorities can often do is help guide asset owners and resource users to make private decisions which lead to environmental outcomes that are compatible with collectively rational mechanisms. In the past 20 years, this principle has been extended to numerous examples, including effluent charges, tradable permits and liability standards. The chapter offers an extended example of the use of tradable permits to address biodiversity conservation, specifically the wildlife habitat requirements mandated by the US Endangered Species Act. Achieving a lower-cost, lower-risk incentive-compatible outcome is shown to be dependent on a clear definition of the habitat units to be traded, the baseline distribution of units, and a carefully defined institutional framework for exchange. In this and other similar examples, public goods constraints are a further obstacle to least-cost collectively rational outcomes and also must be considered. In general, collectively rational institutions for environmental management require three things: the credible commitments of economic agents, transparent market or shadow prices, and effective arbitrage opportunities. In the end, for these instruments to work and represent an effective alternative to command-and-control policies, careful initial attention must be given to institutional design based on a fully informed understanding of the use and users of the natural asset.

The next chapter (Chapter 10) by Ian Bateman provides a comprehensive review of three central questions related to the valuation of environmental impacts. The first is comparison and contrast of the two principal approaches used in the evaluation of environmental impacts: cost–benefit analysis (CBA) and environmental impact analysis (EIA). The author states that CBA assumes an anthropocentric approach, growing out of economic analysis, and typically focuses on the precise measurement and evaluation of multiple impacts, discounted to the present. In execution, it is highly quantitative and attempts to incorporate multiple impacts into a single money value numeraire, with the attendant pro's and con's. It is not good, however, at addressing the distribution of costs and benefits among different groups nor in assessing sustainability dimensions. By contrast, EIA does not attempt to assess monetary impacts comprehensively but focuses on evaluating diverse physical environmental impacts, both quantitatively and qualitatively. Its wide variety of impact assessment measures is a positive feature of this approach, enabling long-term sustainability impacts to be more easily be incorporated than in CBA. However, by failing to incorporate the assessment of multiple impacts into a single measure, it becomes more difficult to compare projects and interpret their results using compatible criteria.

The author also discusses and summarizes a number of important conceptual and empirical distinctions that arise in valuing environmental impacts. To begin with, prices do not equate with values for either private or public goods (due to non-zero consumer surplus). The chapter outlines the basic distinction between private and public goods, with the key result that open-access resources may be highly valued even though private prices may be wholly absent. The broader concept of total economic value (TEV) (also discussed in Chapter 11) comprises both use values (option and bequest values, for example) and non-use values (existence and non-human values). These lead to complications in valuation which are reinforced by the existence of complex trade-offs and the multidimensional valuation criteria used by different individuals. In theory as well as practice, 'willingness to pay' measures (to obtain a gain or avoid a loss) very often differ from 'willingness to accept' measures (to forgo a gain or suffer a loss). Context specificity, loss aversion and 'part-whole' problems further complicate environmental valuation in practice.

Economists have developed a wide array of alternative approaches to conduct empirical monetary valuation of environmental public goods. These are often differentiated as 'pricing' approaches and 'valuation' approaches; each are briefly summarized in Chapter 11 (and discussed separately in chapter 12). The former includes approaches which employ estimates of: opportunity costs, costs of alternatives, mitigation costs, shadow project costs, government (subsidy) costs or dose–response value estimates. All of these approaches suffer from the flaw that the 'prices' that are estimated may differ from true economic valuation. The latter set of 'valuation' approaches

include two categories of methods. Expressed or stated preference methods such as contingent valuation, preference ranking and conjoint analysis all involve explicit, direct valuation (or ranking) of environmental goods by respondents. Revealed preference approaches – specifically, the travel cost method and hedonic pricing – assess environmental values by measuring respondent's actual market behaviour and statistically estimating the resultant 'revealed' environmental values. Overall, the author argues that while valuation methods are more cumbersome in their application, they have wider applicability and address the difference between prices and values. It should be noted that the Bateman chapter only reviews the relevant environmental economics research through the late 1990s; this is an active area of ongoing research in the field.

Chapter 11 by Randall Kramer reviews many of the basic economic valuation concepts covered in the previous chapter – use values, option values, non-use values – and applies them to the valuation of a particularly important environmental resource: water. The author summarizes some of the recent research regarding the non-market valuation of environmental services, and the advantages and limitations of alternative valuation methods. Several empirical examples employing standard non-market environmental valuation concepts and methods are introduced and discussed: impacts of lake pollution on water recreation (using the travel-cost method); impacts of water quality on residential land prices (contingent valuation); and estimation of the value of water quality protection (contingent valuation estimates subsequently used in a cost–benefit analysis). By focusing on the valuation of environmental services (specifically the value of water quality) the author emphasizes the fact that the 'true value of nature' termed by the Millennium Ecosystem Assessment (MEA) (2005) is best assessed by highlighting the scarcity value of the services provided by environmental resources.

Chapter 12 by David Lee treats the topic of environmental trade-offs addressed elsewhere in this section, but with an explicit focus on developing countries which are home to many of the most vexing environmental management and policy problems. Given the severe resource constraints facing many developing countries, achieving environmental management goals typically must occur in the context of simultaneously realizing food security, economic growth and improved livelihood objectives. But doing so is more often characterized by trade-offs among these goals than by synergistic relationships. The author argues that significant insights into understanding these relationships lie in the empirical evidence at both macro- and micro-levels. At the macro-level,

much of the discussion over the past decade has centred around the 'Environmental Kuznets Curve' (inverted 'U') hypothesis and empirical evidence supporting or contradicting it. Overall, the evidence is distinctly mixed for most indicators, suggesting that a country's ability to 'grow its way' out of environmental degradation problems is not a generalizable policy result.

At the micro or household level, the evidence is also limited, for different reasons. Comparing the results of household- and village-level studies is difficult due to the use of non-comparable analytical methodologies, the lack of results estimated over time (which would demonstrate the sustainability of production and livelihood systems), and the use of different empirical measures for key economic, production and environmental indicators. Several case study examples which surmount these obstacles and in which positive environmental outcomes are shown to be achieved alongside other social objectives are discussed. The factors which generally condition the achievement of sustainable environmental outcomes in the context of jointly realizing production, food security and economic livelihood objectives are identified and discussed.

In the final chapter of this section (Chapter 13), Joe Morris applies economic concepts and analytical tools to the analysis of the Water Framework Directive (WFD) of the European Union. The WFD seeks to prevent the deterioration of surface and groundwater sources and aquatic ecosystems in the EU and provide for good surface and ground water quality by 2015. It operates through a dual approach; first, of 'command and control' regulatory methods to establish environmental quality standards and control pollution discharges, and second, employs various economic measures and incentive pricing mechanisms to achieve targeted outcomes. As the author indicates, the setting of water quality standards by regulatory fiat means that cost-effectiveness, rather than economic efficiency, is the standard by which delivery mechanisms are evaluated. However, the WFD does treat water as an 'economic commodify' and employs economic analytical and policy tools widely.

The chapter describes in considerable detail the scope for using economic analytical tools in estimating water demand and the values of water's multiple uses, and in evaluating alternative measures to improve water quality. Specifically, these tools are used in estimating: a range of user benefits stemming from alternative water demands and uses; the external uncompensated costs of water supply; the cost-effectiveness of alternative delivery mechanisms; and the impacts of incentive pricing on consumers of water. While there are still considerable practical and methodological

challenges involved in implementing economic-based mechanisms in the WFD, the application of these analytical tools in identifying cost-effective measures for water quality management can be expected to be broadened to address issues of non-point source pollution and agricultural land management.

SECTION III: KNOWLEDGES AND KNOWING

What do we know about environment and society links, and what do we need to know to escape from the emerging environmental crises? Perhaps more importantly, we will need to ask how we can develop systems of knowing about the world that are transformative. Knowledge on its own is not a sufficient condition for change. What is needed is ways of knowing that change the way people see the world, interact with one another, and bring their views to bear over critical challenges for a complex and contested world.

In the first chapter in this section of the Handbook (Chapter 14), David Orr sets out the components and principles of ecological design and education. In spite of nearly a century of substantial economic growth, a large proportion of the world is either on the edge of starvation in absolute poverty, or is suffering the consequences of over-consumption in their worlds of traffic jams, bad diets, addictions, boredom and mental ill-health. These two worlds may appear to some to be diverging, but may actually be on a collision course. The inability to solve ecological and social problems points to deeper flaws in a faith in human capability to solve all the problems we bring on ourselves.

Ecological designers know one big thing – everything is hitched to everything else. This suggests a need for a blending of nature with human crafted space, a bringing together of arts, crafts, science and architecture. But this is easy to say, and hard to achieve. We will need to spend more time thinking about how we see the world, and how we learn from it. A number of key principles are set out for a new type of design that recalibrates education with ecology. Nature is not something to be mastered, but a potential tutor and mentor for human actions. But ecological design is deeper than mimicry. It should encourage us to ask what will nature permit us to do? Another key principle is that humans are not infinitely plastic. There are biological and evolutionary constraints that shape our interactions with the world. All design is, of course, inherently political, as it is about both provision of goods and services, but also the distribution of risks, costs and benefits. Ecological design implies robust economics, an honest assessment of human capabilities, a capacity to understand the lessons of history and past civilizations, and above all offers opportunities of healing. Designers are story-tellers that aim to speak to the human spirit, and this is where education must mimic, and tell better stories about the world.

Richard Bawden then develops the theme of knowing systems and the environment in the second chapter (Chapter 15). Once again, the problem lies in how we have come to risk the world on the back of such great achievements in economic and technological development. The chapter focuses on systems, both hard and soft, and on coming to know. Our quest, says Bawden, in seeking to come to terms with sustainability, must start with learning. What we think we mean when we use terms like development and sustainability. We have made the world as it is, and so it is up to us collectively to make meaning through our learning. In a state of denial, about how bad circumstances are, we are going to need to devise different ways to think, interact and act very quickly.

An important contrast centres on how we conceptualize systems' ideas, and thus bring some cognitive coherence to bear on a complex world. Earlier pioneers of systems' thinking focused on cybernetic regulative processes that maintained steady states, and many ideas about resilience and adaptation have since been developed. But strangely, systems ideas in the social sciences have seen declining support in recent decades. Another conceptualization, however, centres less on systems in the world, and more on systems of cognition, in which inquiry about the world is the soft system that can be both revealing and transformative. In this way, learning becomes less about the acquisition of knowledge and more about the transformation of experience, whereby knowledge is fluid, being created, recreated and used by individuals as they seek to make sense of the world. The quest for sustainability focuses on new types of engagement between people with their different worldviews and paradigms, and the world about us.

Max Pfeffer and Linda Wagenet show in Chapter 16 how such new ways of knowing are playing out in the environmental volunteering sector in the USA. Volunteer environmental monitoring offers the possibility of directly involving citizens in environmental decision-making. It may also reinforce public confidence in science-based decision-making, and offer the means to increase more direct interactions with the environment and its resources. Such volunteering is likely to be important where there are already extensive environmental regulations and clear compliance standards, and where concerned citizens have the time and resources to participate. Existing literature

contains no comprehensive review of volunteer environmental monitoring, and this chapter reviews its importance over more than a century in tracking weather data, bird ringing (or banding), game fish tagging, water quality monitoring, wastewater plant monitoring, and the Christmas bird survey. All of these represent important types of citizen science in action.

More than half of Americans are engaged in some kind of local volunteer activity, however minimal, and forms of civic environmentalism have become common and indeed effective. It is widely known that a lack of meaningful public involvement can lead to the emergence of barriers to environmental management, and since the 1990s there has been growing uptake by federal agencies, particularly for watershed management. Some authors are confident that this represents the potential for positive outcomes for both human and ecosystem well-being; others are cynical, characterizing the interactions as no more than the scientifically illiterate versus the politically clueless. Nonetheless, such community science does have transformative potential, not only for individuals but also for groups who coalesce to act together. The chapter addresses three key questions: do volunteers generate data that meet acceptable scientific standards? Are such data then used by agencies engaged in environmental management? And finally, does this activity reduce the gap between environmental science and the lay public?

In the fourth chapter in this section (Chapter 17) on environmental ethics, Val Plumwood goes on to draw some of these themes together by asking do only human lives and humans count, as we relentlessly drive other species from the planet? How we think about these kinds of questions determines partly how humans act in this world. Plumwood explores a series of perspectives on value, including instrumentalism, utility and intrinsic value, and teases apart common default settings that are often ignored in environmental narratives. Interspecies relationships may be the key task of environmental ethics, but such an ethic will also need to challenge conventional concepts of human identity too. The problem with instrumentalism is that it is seen to draw the life, meaning and wonder from the world, as we progressively commodity relationships with nature and its goods and services.

Instrumentalism also suggests a human apartness from nature, which echoes concerns about intrahuman dominance, especially on the grounds of gender and race. Non-humans are taken to be naturally inferior, and lacking qualities that are supposed to matter, such as mind, rationality and individuality. A human centred (or anthropocentric) worldview and its misunderstandings of human nature pose risks to both human and non-human survival. Commodities become taken for granted, and nature is starved of resource for its own maintenance. Sustainability is a project aimed at countering the exhaustion of the planet's resources for life, and Plumwood indicates why we should recognize human and non-human needs as part of this concept. The chapter concludes with a perspective on counter-hegemonic structures and communicative ethics, and includes how processes of knowing and coming to know can break down discontinuities between humans and nature, reconstruct human identity, dehomogenize nature and human categories, and acknowledge difference.

In the final chapter of this section (Chapter 18), Luisa Maffi analyses the concept of biocultural diversity and how it relates to current concerns about both ecological and cultural sustainability. Biocultural diversity draws on anthropological, ethnobiological and ethnoecological insights about the relationships between human language, knowledge and practices with the environment. Evidence now indicates that the idea of the existence of pristine environments unaffected by humans is erroneous. Humans have maintained, enhanced, and even created biodiversity through culturally diverse practices over many thousands of generations. There are some suggestions that biodiversity and cultural diversity in the form of linguistic differences are associated, though at the local level these relationships do not always stand scrutiny. But the role of language is nonetheless critical as a vehicle for communicating and transmitting cultural values, traditional knowledges and practices, and thus for mediating human–environment interactions.

Landscapes can be networks of knowledge and wisdom, conveyed by the language of local people. But the problem is that many languages are under threat. There are some 5000–7000 languages spoken today, of which 32% are in Asia, 30% in Africa, 19% in the Pacific, 15% in the Americas and 3% in Europe. Yet only half of these languages are each spoken by more than 10,000 speakers. Some 550 are spoken by fewer than 100 people, and 1100 by between 100 and 1000 people. A small group of less than 300 languages is spoken by communities of one-million speakers or more. Some 90% of all the world's languages may disappear in the course of this century – yet these very languages are tied to the creation, transmission and perpetuation of local knowledge and cultural behaviour. As language disappears, so does people's ability to understand and talk about their worlds. Natural and cultural continuity are thus connected. The phenomenon of loss has been called the extinction of experience – and the loss of traditional

languages and cultures may be hastened by environmental degradation.

Yet in many parts of the world, both in developing and industrialized countries, such traditional ecological knowledge (or ecological literacy) is declining and under threat of extinction. As humans coevolved with their local environments, and have now come to be disconnected, so knowledges that coded stories, binding people to place, have become less valued. New efforts to analyse biocultural diversity on a country-by-country basis are reviewed, and despite some important progress in the international sphere, such as in the Convention on Biodiversity, the most fundamental changes must come from ground-up actions. In this way, the field of biocultural diversity has embraced strong ethics and human rights components.

SECTION IV: POLITICAL ECONOMY OF ENVIRONMENTAL CHANGE

The fourth section of this Handbook explores questions of distribution, risks, winners and losers in the quest for representation and access to resources. Environmental change occurs at a different pace at different human scales, and affects different groups of people in different ways. As a result, incentives and inclinations to act differ greatly, even though all humans are part of the same world system. These differences raise contradictions, complexities and conflicts, and positive social outcomes for some may mean negative environmental outcomes for others.

In the first chapter (Chapter 19), Ron Johnson explores questions of representative democracy and the solution of environmental problems that require collective action at different scales. Many environmental problems have three common characteristics. They are produced by individual actions, but their intensity may be more than the sum of individual contributions. Most problems affect others, and these spatial overspills require that all those (or at least most) must reduce or end their contributions. And third, individual contributors can gain advantage over others by declining to participate in efforts designed to solve the problem. In small-scale situations, generally trust and enforcing agreements are possible, and indeed have been very effective in many parts of the world, but at higher scales, efforts have to centre on either privatizing the commons or on external regulation by bodies with the power to ensure compliance.

There is always a range of scientific and political challenges to be overcome. An issue has to be identified, recognized that there is an associated problem, a postulated cause accepted, and then acceptance that the problem can be tackled or remedied. But tackling a problem requires commitment of resources (and thus always in short supply), which have to be obtained from citizens. For a solution to be implemented, there must therefore be both political and public support. The challenges of environmental problems thus play out in different ways according to whether they are confined within individual states, are shared by two or more states, and confined within their boundaries, or involving interactions with large numbers of states. Most governments have short-time horizons, and this adds further complications to the need to address pressing current and future problems.

In the second chapter (Chapter 20), Ron Herring analyses how the genomics revolution in biology seems to be creating novel analytical and policy questions for political ecology. Such politics reinforce the centrality of science to all political ecology, which in turn presents new challenges to the way interests in nature are understood by citizens and political classes that control states. Much indeterminacy of interests in nature is knowledge based, and so radically different levels of ecological knowledge occur amongst mass publics, political actors and administrative managers over time. There are many contradictory positions. There are global conflicts over transgenic organisms that focus, at least in part, on ecological threats arising in agriculture (even though modern agriculture is itself quite destructive of nature), yet transgenic pharmaceuticals seem to be quite immune to protest. There are, of course, many political reasons for this selectivity – miracle drugs save lives and are ineffective targets for opposition.

At the same time, it is clear that public goods and bads are not objectively perceived, but rather are embedded in normative logic and cultural norms. A swamp was once seen to be unhealthy and thus gladly drained (except for the people living there); but wetlands now purify water and are for preserving. In the contested politics surrounding such normative spectrums, new and unpredictable relationships emerge. In the genomics revolution itself, new values are created in natural landscapes, as yesterday's obscure species becomes an object for bioprospecting and biopiracy. Whatever regulators may seek to do, there will be circumstances in which the practice of individuals forces further change. The seed sharing amongst farmers in India and Brazil is an example where states had to follow what farmers themselves preferred to do. In the end, though, the science of ecology frustrates policy, as unexpected interconnections amongst parts of systems keep being discovered. Honest science is always incomplete at the frontier, and yet such uncertainty is the most powerful weapon of opposition movements.

In the third chapter (Chapter 21), Steven Griggs and David Howarth explore protest movements, environmental activism and environmentalism in the UK, using examples of struggles against road building and airport expansion. There are not many people who are in favour of fewer pollution controls, more greenhouse gases and greater species extinction, and the public goods struggled for by many environmental movements and organizations are goods desired by large numbers of people. Yet, despite the appeal of many of these environmental demands, the translation of such popularity into a populist form of politics has not been straightforward or even successful. Populist discourses appeal to a collective subject, such as the people or a nation. They are grounded on the construction of an underdog versus establishment frontier, the latter being seen as the enemy or adversary of the people. And they are centred on an appeal to all the people in a space or a domain – there are, after all, universal concerns, it is commonly claimed.

The authors explore three phases in environmental politics – from early conservation environmentalism to mid-late 20th century ecological environmentalism, and the later emergence of radical environmentalism. Over time, membership of some environmental groups has grown remarkably, and their size and scope has caused them to become institutionalized, thus blunting the radical aspirations of some people or members. As some have become larger (and more effective in certain spheres), so others have moved away from such insider routes to set up alternative movements. Some of these have resulted in direct action against roads and airports, and indeed have led to the melding of unlikely social groups, such as radical protestors and middle-class residents. Tactics are often different, but new alliances have had some influence on how national politics frames environmental problems and solutions.

In Chapter 22, Tim O'Riordan explores the many faces of the sustainability transition by suggesting that the phrase sustainable development has become so universal that it now means everything and so is in danger of meaning nothing. Sustainable development binds a range of movements – peace, democracy, development and environment, and yet current economic development patterns are widening the gap from wealthy to poor and destroying the natural resources and life-support systems daily, and so are rapidly moving away from sustainable development by the day. Despite concerns, though, about reaching global tipping points arising from the huge collective human influence on the world, the chapter suggests that localism offers real opportunities to create sustainable communities. People can form communities where safety, security and sustainability can flourish and form livelihoods that offer hope for all involved.

We do not, however, know enough about the changing state of planetary support systems. Forecasts remain uncertain, and so there is great difficulty in making predictions about how political systems and their leaders will respond. At the same time, of course, we are not good at delivering well-being for both people and nature. The UK has a very good sustainable development strategy, but as yet there is little or no capacity in the UK government for a change of direction. We will need to build from below, and seek to find ways to leap to sustainability in one generation. Several zones of sustainability engagement show promise, including some change in businesses, consumer behaviour and use of purchasing power, in that tipping points are beginning to be noticed, and in that well-being is appearing on the political agenda.

The final chapter (Chapter 23) of this section takes forward one of these themes, as Christina Page and Amory Lovins explore whether businesses can be greened, and whether the very idea represents an opportunity or contradiction. Businesses have recently begun to move beyond command and control environmentalism towards the mindset where pursuit of sustainability is seen as a competitive advantage. Private businesses and companies can be a source of innovation and invention, and so can create novel solutions to some social and environmental challenges. Assets in socially responsible investing have grown faster than all other professionally managed assets, and this too is causing a rethink. The authors set the scene for a natural capitalism framework. Industrialized capitalism liquidates rather than values important forms of natural, social and human capital, yet sustainability calls for ways to protect and invest in these assets over the long term.

What can businesses themselves do? They can seek to increase radically the productivity of resources – do more, better, with far less and for longer. This is easy to say, but there are indeed compelling examples of where this is working. They can practice biomimicry, by designing individual systems with closed loops, no waste and no toxicity. They can shift from a product-based economy to a solutions-based one, and finally, they can reinvest in natural capital. Progress, however, may bring unintended consequences, as successful enterprises that use less per unit of product may see demand so increase that at the aggregate level an increase in negative impact on the environment may occur. The path forward suggests the need to think in whole systems and to adopt full cost accounting to capture the problem of externalities. But there will still be a need for civil

society, shareholders and government to apply more than a little pressure to help in the transition.

SECTION V: ENVIRONMENTAL TECHNOLOGIES

The fifth section of this Handbook explores key questions around environmental technologies, the history of pollution, the scales at which environmental problems are manifested, and some potential options for intervention that could solve hitherto intractable problems. In the first chapter (Chapter 24), Thomas Wilbanks and Patricia Romero-Lankao analyse the human dimensions of global environmental change, a term that covers a wide range of processes and phenomena. There are three major categories: human driving forces that lead to environmental change, human impacts of environmental change and human responses to environmental change. To these has recently been added human decision support, which links information about driving forces and impacts with decisions that can moderate driving forces or reduce impacts. The range of key drivers include industrialization, world population demographics, technological change that encourages greater consumption, and institutional change. Vulnerability to environmental change is related to exposure and sensitivity to changes, and the capacity to cope. Human responses then centre on mitigation or adaptation, and when impacts are negative, there are many types of adaptive responses.

The chapter details three specific cases to explore these issues: human settlements and carbon footprints, economic growth and development, and governance and society. The human dimensions of global environmental change have the potential to be profoundly important for the fundamental challenges of sustainability, equity and peace. Human societies, economies and responses to these impacts, and concerns about the risks of them, in turn shape further changes. We will need to improve our understanding of these dynamics if sustainable futures for both nature and society are to be discovered.

Howard Frumkin then discusses the concept of environmental health in the second chapter (Chapter 25). The human impact of environmental exposures, it is suggested, should be considered broadly. The environment affects people along many dimensions, including medical status, psychological well-being and spirituality. While the focus of much scientific attention has been on environmental exposures that are toxic, it is clear that other exposures can also be health promoting. These differences have shaped the evolving definitions of environmental health over time. The chapter explores the ancient origins of environmental health, the industrial awakenings, combined with the emergence of new analytical methods, and the modern era.

A range of themes have developed in the modern era, beginning with the recognition of chemical hazards, and the linkages to ill-health, supported by advances in toxicology and epidemiology. A new development was in environmental psychology, founded on E. O. Wilson's theory of biophilia (Wilson, 1984). Further developments included the continued integration of ecology with human health, and the expansion of clinical services related to environmental exposure. Environmental health policy has continued to emerge, at both national and international levels. A new theme, though, has been a growing focus on environmental justice, born of a fusion of environmentalism, public health and civil rights. Environmental justice is one example of a broader trend, a focus on susceptible groups rather than whole populations.

In the third chapter (Chapter 26), Ian Colbeck explores the history of actions and effectiveness of change in influencing air pollution and its impacts. Despite some technological and policy advances, air pollution continues to impose a heavy burden on the health of populations in many parts of the world, particularly now in urban areas of developing countries. In the European Union, though, particulate matter claims an average of 8.6 months from the life of every person. Other key problems arise from ozone, sulphur dioxide and oxides of nitrogen. Air pollution also has other key effects on the environment, including on forests, lakes, agriculture, wildlife and buildings.

There has been a long history of the recognition of the problems of air pollution, dating back at least to ancient Rome. But it was the industrial revolution that substantially increased the burden of pollutants in the air, leading to many combined efforts by civil society and policy makers, which in turn did affect attitudes amongst the public. Single large events had a significant effect on change, such as from the anticyclone that covered London in December 1952. The smoke-laden fog caused the deaths of at least 4000 people (possibly nearer 12,000 according to recent assessments), the asphyxiation of cattle, the suspension of public transport, and even the suspension of an opera performance when smog in the auditorium made conditions intolerable for the audience and performers. The Clean Air Act of 1956 was considered a success, and has been followed by a number of examples of helpful policy interventions. In general, though, there has been a change from permissive to mandatory legislation with the setting of specific air quality standards.

The fourth chapter (Chapter 27) by Andrew Ball addresses terrestrial environments and the

potential arising from bioremediation to solve difficult environmental problems. In soils, decomposition of organic compounds returns them to their inorganic form, thus making them available to plants for uptake. But what if compounds in the soil are not naturally present? Will they be broken down, or persist? If they are toxic, what effect will they have on the biotic community? There exists in the natural soil community the potential for the breakdown and recycling of a wide range of compounds by microbes. If this potential can be identified, new technological options may follow.

Boiremediation is the use of microorganisms to return an object or area to a condition which is not harmful to plant or animal life. One of the advantages of bioremediation centres on the possibility of treating a polluted soil without having to remove it elsewhere, thus reducing the cost of treatment. A range of options are available, including biodegradation, biostimulation, bioaugmentation and biorestoration. The increasing sophistication of chemical industries, combined with a growth in complexity of waste materials, means that the opportunities for bioremediation are large. However, efforts have to be paid to questions of social acceptability of these methods, as a failure to anticipate public concerns can derail potentially beneficial technologies. Key dimensions centre on types of dialogue, attention to constituents affected and interested, and the details of the physical, social and institutional context. There are many areas of land heavily contaminated, and bioremediation is a growing and relatively cheap and effective set of technologies.

The fifth chapter (Chapter 28) by Stuart Bunting contains an analysis of the environmental problems brought about by aquaculture systems, and offers guidance for their reconfiguration to make them productive, environmentally sensitive and equitable. Aquaculture has emerged in recent decades as an important food production sector, now worth some $60 billion annually. However, aquaculture appropriates a wide range of environmental goods and services, and where demand exceeds carrying capacity, then adverse impacts can occur. The consequences of such negative environmental impacts include self-pollution, restricted amenity, reduced functionality, and impacts on option and non-use values. In some locations, social tensions and conflicts have arisen, especially where traditional access rights and resource-use patterns are disrupted.

There are, however, a range of regeneration strategies and policies that can be employed. These include using resources more efficiently, especially for neighbouring production systems, horizontally integrated production, again to better use of wastes, and efforts to increase the sustainability of both feed and seed supplies.

Community-based management is a crucial option in many locations, yet many past efforts have ignored the involvement of local people and their institutions. There are relatively few helpful policies, yet these could help to reduce negative impacts and improve access to benefits. A wide range of institutions need to be involved, including national and local government authorities, extension agents, development practitioners, education establishments and communities themselves.

The final chapter in this section (Chapter 29), by Peter Oosterveer, Julia S. Guivant and Gert Spaargaren, addresses the emergent issue of sustainable food consumption, one of the key features in the green consumption trends. Starting in the 1990s, this trend has been consolidated through the role of a new global actor: the supermarkets. Recent data show how countries where most organic products are sold via supermarket chains tend to be the countries where the organic market shares are the highest as well. But what is the role of supermarkets in possible transitions to more sustainable food systems? This is a topic still not significantly recognized in social sciences in its relevance for the transformation of the horizon of the provision of green food-products and also the changing profile of the consumer. The authors take this challenge and elaborate an original theoretical framework in dialogue with the current perspectives on the sociology of consumption and the ecological modernization theory.

The retail outlet is considered as a special example of the meeting point of different rationalities (production, distribution and consumption) and as the 'locale' constitutive for their interaction. The transitions are characterized in a non-essentialistic way, opening the analysis to identify new developments within the global network society. The authors also identify plural and complex profiles of sustainable consumers, suggesting four dimensions that are not mutually exclusive: naturalness, food safety, animal welfare and environmental related. Examples are presented from different countries and special incidences discussed, such as food scares, and this global approach allows the authors to translate their theoretical proposal into an outlook of variables that could be part of a future research agenda.

SECTION VI: REDESIGNING NATURES

If things have become bad in many environments across the world, what are the prospects for making improvements? Are there options for redesign of sectors and relationships? The fact that some environments can be rehabilitated does not justify their damage in the first place, nor does it suggest

that complacency is acceptable when environments are further threatened. However, given our current knowledge about harm to all types of environments across the world, combined with the losses of key environmental goods and services, then redesign is a crucial challenge.

This section begins with a chapter by David Rapport (Chapter 30) on the evolving paradigm of healthy ecosystems. The chapter reviews the evolution of the concept of ecosystem health and its potential to motivate and guide the politics of the environment. The timetable is, of course, pressing, as harm to the world's environment may soon be a challenge to humanity's future. The concepts of health and illness offer new perspectives, and these lead to the development of diagnostic indicators to aid assessment of the state of the environment. The term health is, however, somewhat enigmatic, and many argue it is too subjective a term to provide real utility. On the other hand, it does aid the identification of stressors on systems and their capacities to self-regulate and function.

For ecosystem health, there are three key measures: vitality (or productivity), organization and resilience. All of these involve analyses of the connections between social and biological aspects, and therefore must transcend the boundaries of single disciplines. This further suggests the need to understand the interfaces between human health and ecosystem health, between cultural health and ecosystem health, and between governance and ecosystem health. Design for regional eco-cultural health will have to be proactive, if there is to be a lighter human footprint on the planet.

The second chapter (Chapter 31) is by Laura Little and Chris Cocklin, and addresses the question of environment and human security. While consensus over definitions remains elusive, many discourses on sustainable development have shared a greater recognition and understanding of the interdependence of human societies and the natural environment. This chapter asks specifically what can the viewing of environmental issues through the lens of security contribute, both to the understanding of the current relationship between human societies and the environment, and to recognizing what must be done to shape future transformations. Definitions of security vary, depending on what activities are trying to be made secure, and what are defined as threats to security.

The authors indicate that the security discourse is a powerful political tool to channel energy and resources in particular new directions. Environmental degradation can clearly be seen as a threat to human security, either in terms of welfare or development, or to survival itself. A number of perspectives are relevant, including the military and security, national economic interest and security (played out on both domestic and international arenas), and the links between security and sustainable development. A human security perspective focuses specifically on the interconnections between environmental and social, political and cultural issues. Thus, environmental concerns are human social and political problems as much as scientific and economic ones.

The third chapter (Chapter 32) by Jules Pretty addresses key questions of redesign in agricultural and food systems. Concerns about sustainability in agricultural systems centre on the need to develop technologies and practices that do not have adverse effects on environmental goods and services, that are accessible to and effective for farmers, and that lead to improvements in food productivity. Despite great progress in agricultural productivity in the past half-century, with crop and livestock productivity strongly driven by increased use of fertilizers, irrigation water, agricultural machinery, pesticides and land, it would be over-optimistic to assume that these relationships will remain linear in the future. New approaches are needed that will integrate biological and ecological processes into food production; minimize the use of those non-renewable inputs that cause harm to the environment or to the health of farmers and consumers; make productive use of the knowledge and skills of farmers, so substituting human capital for costly external inputs; and make productive use of people's collective capacities to work together to solve common agricultural and natural resource problems, such as for pest, watershed, irrigation, forest and credit management.

These principles help to build important capital assets for agricultural systems: natural, social, human, physical and financial capital. Improving natural capital is a central aim, and dividends can come from making the best use of the genotypes of crops and animals and the ecological conditions under which they are grown or raised. Agricultural sustainability suggests a focus on both genotype improvements through the full range of modern biological approaches, as well as improved understanding of the benefits of ecological and agronomic management, manipulation and redesign. The ecological management of agroecosystems that addresses energy flows, nutrient cycling, population regulating mechanisms and system resilience can lead to the redesign of agriculture at a landscape scale. Sustainable agriculture outcomes can be positive for food productivity, for reduced pesticide use and for carbon balances. Significant challenges, however, remain to develop national and international policies to support the wider emergence of more sustainable

forms of agricultural production across both industrialized and developing countries.

In the fourth chapter (Chapter 33), Henry Buller and Carol Morris explore questions relating to animals and society. Animals and humans are rarely wholly apart, even thought the spaces they occupy are increasingly differentiated. They share common origins, common biologies, and a long history of interaction and interdependence, yet in modern industrialized settings are increasingly disconnected, continuing the lengthy process of anthropocentric disassociation from nature and the wild. Animals and humans are usually studied separately, yet an ethnoethology would bring together contemporary approaches to help understand relations between human and non-human animal society. The article explores a variety of issues. Humans are animals, and much of human social organization and behaviour to non-human animals can be explained by this human animality. Although the otherness of animals is still commonly evoked, there is a need to develop less anthropocentric conceptualizations of the non-human world.

The modernist legacy has been separation, yet this chapter analyses recent and less dualistic approaches to human–animal relations by assessing humans as animals, animals as others, and human–animal hybrids. The common theme is that interactions, such as use, enjoyment, observation, killing and eating of animals, are so unavoidable and so universal that they have been central constituents of human society from it origins. These relationships do not break down clearly into binary categories, and so it is better to think of them as part of a network, permitting perhaps the intermixing of humans and non-humans in practice and thought, and perhaps too ways to link social, natural, constructed and realist conceptions of the living world.

Madhav Gadgil explores questions of social change and conservation in the fourth chapter (Chapter 34). Human society has been both prudent and harmful to the natural environment over thousands of generations, and Gadgil uses the concepts of ecosystem people and biosphere people to explore the continuum between those who rely mostly on local resources and those that have exploitative access to additional sources of energy and resources from outside. Ecosystems people in many parts of the world continue to exhibit a variety of cultural traditions of conservation practices, in spite of widespread loss of control over the resource base. However, there are now very few examples of entirely autonomous people, fully in control of their local ecosystems with very light human demands.

But when control is lost, local communities can easily lose their motivation for sustainable use, together with their local institutions that arrange rules, sanctions and behavioural norms. Political and economic subjugation, combined with market forces, have made it progressively more difficult for local communities to continue practices that may have been sustainable over many generations. As a result, the costs of conservation can increase, even to the point where the state intervenes, feeling it can do better. Ultimately, options for ecodevelopment will have to arise from below, but will need new forms of external support if they are to succeed in providing both livelihood options and protection for the natural environment.

The final part of this section (chapter 35) moves from the terrestrial domain to the highly biodiverse and now threatened environments of coral reefs, in which David Smith, Sarah Pilgrim and Leanne Cullen address a range of issues relating to human pressures, valuation and management. Coral reefs represent one of the largest natural structures on the planet, and are home to more species than any other marine system. They are also important for the welfare of millions of people, providing a range of vital environmental goods and services. However, the majority of coral reefs worldwide are now overexploited, and 60% show severe signs of decline. During the course of the next century, pressures are likely to increase, with some estimates suggesting that 70% of coral reefs could be completely lost by 2050.

Despite the value of coral reefs to local communities, and their long-term dependence on them, it has become clear that efforts to govern and sustain reef fisheries have frequently failed. Yet many self-management systems have been very successful at maintaining resource levels over long periods. Local knowledge of species and ecological interactions, combined with institutions to set norms and rules, have been successful in many parts of the world. But centralized conservation, where ownership changes hands, or responsibility towards local resources is lost or abandoned, does not always work. Government-imposed authority frequently backfires, even if it is originally driven by a desire to protect resources sustainably. The dynamics of reefs systems can never be fully understood by those external to it, and thus co-management options need to be developed and implemented.

SECTION VII: INSTITUTIONS AND POLICIES FOR INFLUENCING THE ENVIRONMENT

The final section of the Handbook explores how institutions from local to national level shape and influence environmental outcomes. What are the

best options for those with different types of knowledge? How do social–ecological systems develop over time, and what are the best approaches for community-based natural resource management? At the national level, how do questions of precaution affect policy development, and finally, in what form do environmental risks manifest themselves in the configuration of society?

In the first chapter (Chapter 36), Jon Hastie assesses the role of science and scientists in environmental policy, and shows how there is no straightforward relationship between science and politics. There are four institutional norms characteristic of science: organized scepticism (judgement is suspended until evidence if convincing), universalism (knowledge claims are tested with universal criteria), disinterestedness (scientists support ideas on the basis of merit, not self-interest) and communism (findings are shared in order for knowledge to progress). Scientists, of course, have differing opinions and hypotheses, yet where scientists disagree, so policy makers and interest groups may take advantage, using only those findings that support their pre-existing preferences. Sometimes, political interests use the products of science after their generation, on other occasions they seek to intervene during the assessment or funding process. In a variety of ways, therefore, science does not linearly produce evidence that policymakers simply then adopt. Scientific knowledge can be exploited, influenced or even ignored.

Scientists themselves may, too, become actively involved in political struggles, seeking to promote certain policies, either as individuals or groups. Today, appointed scientific advisors themselves have great power. Epistemic communities theory accepts the notion that scientists are far from disinterested, and examines how they build consensus to gain authority. In a similar way, discourse coalitions can focus around sets of shared ideas and principles. In this way, a constructivist (compared with a positivist) model of science in society sees scientific knowledge as constructed within a social process. In observing environmental policy, it is important therefore to study science, policy and the shifting boundary between the two with equally intensity.

The second chapter (Chapter 37) by Carl Folke and colleagues analyses the characteristics of social–ecological systems. They seek to provide a rich understanding of not just human–environment interactions but of how the world we live in actually works and the implications it has for current policies and governance. The chapter emphasizes that the social landscape should be approached as carefully as the ecological in order to clarify features that contribute to the resilience of social–ecological systems. In this context, Pretty and Ward (2001) find that relations of trust,

reciprocity, common rules, norms and sanctions, and connectedness in institutions are critical. Folke *et al*. have similar findings that include vision, leadership and trust; enabling legislation that creates social space for ecosystem management; funds for responding to environmental change and for remedial action; capacity for monitoring and responding to environmental feedback; information flow through social networks; the combination of various sources of information and knowledge; and sense-making and arenas of collaborative learning for ecosystem management. Their work illustrates that the interplay between individuals (e.g. leadership, teams, actor groups), the emergence of nested organizational structures, institutional dynamics and power relations tied together in dynamic social networks are examples of features that seem critical in adaptive governance which allows for ecosystem management and for responding to environmental feedback across scales.

An important lesson from the research is that it is not enough to create arenas for dialogue and collaboration, nor is it enough to develop networks to deal with issues at a landscape level. Further investigation of the interplay between key individuals, actor groups, social networks, organizations and institutions in multilevel social–ecological systems in relation to adaptive capacity, cross-scale interactions and enhancement of resilience is needed. We have to understand, support and perhaps even learn how actively to navigate the underlying social structures and processes in the face of change. There will be inevitable and possibly large-scale environmental changes, and preparedness has to be built to enhance the social–ecological capacity to respond, adapt to and shape our common future and make use of creative capacity to find ways to transform into pathways of improved development. They conclude that the existence of transformative capacity is essential in order to create social–ecological systems with the capability to manage ecosystems sustainably for human well-being. Adaptive capacity will be needed to strengthen and sustain such systems in the face of external drivers and events.

In the third chapter (Chapter 38), Stephen Brechin, Grant Murray and Charles Benjamin analyse the current challenges and opportunities in community-based natural resource management. The article links four bodies of work. The first concentrates on the social and political issues related to demarcated land-based conservation initiatives, particularly focusing on management issues involving local people. The second addresses similar issues in marine protected areas. The third addresses questions of state-centred devolution of responsibilities that are redefining

community-based efforts, and the last reviews the social promises and pitfalls of ecotourism. The evidence clearly now shows that the future of biodiversity conservation rests on finding more effective and connected ways of integrating local people and communities into the conservation process, and not in their greater separation.

There are many questions, though, on how to ensure greater social justice, how to address the specific needs of indigenous people (who some commentators have called the 'danger within'), the rise of private parks, the growth of big international NGOs (BINGOs), and the challenges of developing processes that are effective across whole landscapes. Community-based conservation is increasing in relevance and importance, partly through decentralization, and partly because of the emergence of strong evidence to show its effectiveness when the social, ecological and political conditions are right. The future of biodiversity conservation must rest largely on working together with people and communities, both in developing and industrialized countries.

Harini Nagendra and Elinor Ostrom explore a range of institutional and collective action questions in the fourth chapter (Chapter 39) of this section of the Handbook. Until recently, the dominant theory predicted that individual users of common pool resources would always overuse and/or underinvest in the resources unless these were owned privately or by government. In this chapter, the theoretical perspectives are first reviewed, and the central principles of alternative positions summarized: with the right institutions, rules and boundary conditions, it is possible for communities to manage common pool resources over very long periods. There is, however, a need for flexible rather than blueprint thinking, a recognition of the importance of differing contextual variables, an understanding of how financial benefits can serve as incentives for effective management, and an acknowledgement that heterogeneity can be positively associated with successful collective action.

The case of Nepal is analysed in detail, and the particular problem of blueprint thinking identified. A consequence of the growing appreciation of the value of community-based efforts for forest conservation has resulted in their increased promotion by government, with over 8500 forest user groups now formed in the hills and plains. But where models are applied from above rather than developed iteratively from below, then successful management may be threatened. At the same time, financial benefits are rarely evenly shared between communities, especially those in buffer zones of parks bringing in substantial ecotourism revenue. In conclusion, scholars interested in environmental policies will need to pay more attention to the need for adaptive development of institutions to fit the ecological system of interest.

The fifth chapter (Chapter 40) is by Albert Weale, and contains a clear analysis of the precautionary principle in environmental politics. There is an interesting conflict in environmental policy – on the one hand, there is widespread agreement on the need to act to protect biodiversity and encourage sustainable development. On the other, there remains controversy as to what to do to attain these apparently consensual goals. Uncertainty is a central element of contemporary environmental policy, with many key questions on the frontier of scientific knowledge and understanding. Sometimes uncertainty seems to suggest taking no action, and on other occasions it appears to commend immediate action. The precautionary principle has received widespread attention in many policy instruments, and again has been invoked in many different ways. Thus, governments dispute its formulation and contest its applications, and policy commentators and activists are divided on whether it is useful or not.

Discussions of the precautionary principle centre on three interrelated questions. How is the principle defined and what claims are being asserted? How should policymakers deal with inevitable uncertainties about cause and effect? How do the values protected by the application of the principle of precaution stand relative to other values? The varying conceptions of precaution suggest that there is not one precautionary principle, rather a precautionary attitude, characterized by a willingness to act on threats, even when the risk is unclear or unlikely, and to the differing degrees to which threats and costs are evaluated. Proponents of a strong conception will act with less evidence than those who hold to a weaker conception of the principle. The bigger question, however, centres on whether it is possible to democratize decision on precaution.

The final chapter of this section and of the Handbook (Chapter 41) is by Ulrich Beck and Cordula Kropp, and explores issues relating to environmental risks and public perceptions. The backdrop is Beck's concept of the world risk society. Global approaches to problems can work, but face three problems: relevant (both lay and expert) knowledge is rarely clear about global hazards, global definition of environmental problems can be seen itself as a kind of ecological imperialism, and the very idea of nature conservation can be perverted into a new kind of world management. Underpinning these questions are issues of uncertainty – existing ones and self-generated manufactured ones. Can risks be brought under control, or will they always escape, leading perhaps to ecological flashpoints? In the world risk society, therefore, industrial projects become

political ventures. Thus, what is required is global action from above, such as through international treaties and institutions, and globalization from below, such as through new transnational actors operating beyond the system of parliamentary politics and challenging established political organizations and interest groups.

In the crisis of global interdependence are global financial risks, the threats from terrorist networks and ecological risks. All three have the potential to cause cross-border conflicts, though environmental ones have particular features, such as having long periods of latency, the need to pass scientific, media and public attention to come into existence, and the difficulty of individualizing risks which generally spread over and under national borders. Global environmental risks are potentially transformative, especially where the desire for sustainability has eclipsed or displaced the long-held notions of economic and technical progress.

REFERENCES

Adrianne, A. (1997) *Resource Flows: The Material Basis of Industrial Economies*. Washington: W.R.I.

Barrett, S. and Graddy K. (2000) Freedom, growth and the environment. *Environment and Development Economics* 5(4):433–456.

Beck, U. (1992a) From industrial society to risk society: questions of survival, social structure and ecological enlightenment. *Theory, Culture and Society* 9:97–123.

Beck, U. (1992b) *Risk Society: Towards a New Modernity*. London, Newbury Park and New Delhi: Sage.

Beckerman, W. (1996) *Through Green Coloured Glasses: Environmentalism Reconsidered*. Washington DC: Cato Institute.

Bell, M. M. (2004) *An Invitation to Environmental Sociology*, 2nd edn. Thousand Oaks: Pine Forge Press.

Benton, T. (1989) Marxism and natural limits: an ecological critique of reconstruction. *New Left Review* 178:51–86.

Benton, T. (ed.) (1996) *The Greening of Marxism*. New York: Guilford Press.

Benton, T. (1998) Sustainable development and the accumulation of capital: reconciling the irreconcilable? In Dobson A. (ed.) *Fairness and Futurity*. Oxford: Oxford University Press.

Benton, T. (2000) Reflexive modernization. In Browning G., Halcli A. and Webster F. (eds) *Understanding Contemporary Society*. London: Sage.

Benton, T. (2001) Environmental sociology: controversy and continuity. *Sosiologisk tidsskrift (Journal of Sociology)*. 9:4–48.

Brown, L. (2004) *Outgrowing the Earth*. New York: W. W. Norton.

Brunkhorst, D., Bridgewater, P. and Parker, P. (1997) The UNESCO biosphere reserve program comes of age: learning by doing; landscape models for sustainable conservation and resource use. In Hale P. and Lamb D. (eds) *Conservation*

Outside Nature Areas. University of Queensland, pp. 176–182.

Buttel, F. H. (1987) New directions in environmental sociology. *Annual Review of Sociology* 13:465–488.

Buttel, F. H. (1997) Social institutions and environmental change. In Redclift M. and Woodgate G. (eds.) *The International Handbook of Environmental Sociology*. Cheltenham, UK: Edward Elgar Publishing, pp. 40–54.

Carney, D. (1998) *Sustainable Rural Livelihoods*. London: Department For International Development.

Carson, R. (1963) *Silent Spring*. Boston: Houghton Miflin.

Catton, W. R. and Dunlap, R E. (1978) Environmental sociology: a new paradigm. *The American Sociologist* 13:41–9.

Catton, W. R. and Dunlap, R E. (1980) A new ecological for post-exuberant sociology. *American Behavioural Scientist* 24:15–47.

Coleman, J. (1988) Social capital and the creation of human capital. *American Journal of Sociology* 94, suppl. S95–S120.

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neil, R. V., Paruelo, J., Raskin, R. G., Sutton, P. and van den Belt, M. (1997) The value of the world's ecosystem services and natural capital. *Nature* 387:253–260.

Craib, I. (1992) *Modern Social Theory*. Hemel Hempstead: Harvester Wheatsheaf.

Craib, I. (1997) *Classical Social Theory*. Oxford: Oxford University.

Cronon, W., Miles, G. and Gitlin, J. (eds) (1992) *Under an Open Sky. Rethinking America's Western Past*. New York: W. W. Norton.

Dalton, R.J., (1994) *The Green Rainbow: Environmental Groups in Western European Politics*. New Haven: Yale University Press.

Dasgupta, P. and Serageldin, I. (eds) (1998) *Social Capital: A Multiperspective Approach*. Washington, DC: World Bank.

Deutsch, S. (1992) Landscape of enclaves. In Cronon, W., Miles G. and Gitlin, J. (eds) (1992) *Under an Open Sky. Rethinking America's Western Past*. New York: W. W. Norton.

Dickens, P. (1996) *Reconstructing Nature: Alienation, Emancipation and the Division of Labour*. London and New York: Routledge.

Dickens, P. (1997) Beyond sociology: Marxism and the environment. In Redclift M. and Woodgate G. (eds.) *The International Handbook of Environmental Sociology*. Northampton: Edward Elgar Publishing, pp. 179–194.

Dryzek, J. S. (1996) Strategies of ecological democratization. In Lafferty W. M. and Meadowcroft J. (eds) *Democracy and the Environment*. Cheltenham: Edward Elgar Publishing.

Dunlap, R. E. (1997) The evolution of environmental sociology: a brief history and assessment of the American experience. In Redclift M. and Woodgate G. (eds.) *The International Handbook of Environmental Sociology*. Northampton: Edward Elgar Publishing, pp. 21–39.

Dunlap, R. E. and Catton W. R. (1994) Struggling with human exemptionalism: the rise, decline and revitalization of environmental sociology. *The American Sociologist* 25(1):5–30.

Eckersley R. (2004) *The Green State: Rethinking Democracy and Sovereignty*. Cambridge, MA: MIT Press.

Ellis, F. (2000) *Rural Livelihoods and Diversity in Developing Countries*. Oxford: Oxford University Press.

Eyerman, R. and Jamison A. (1991) *Social Movements: A Cognitive Approach*. Cambridge: Polity.

Fischer-Kowalski M. and Haberl H. (1993) Metabolism and colonisation: modes of production and the physical exchange between societies and nature. *Innovation in Social Science Research* 6(4):415–442.

Flora, C. B. and Flora J. L. (1996) Creating social capital. In Vitek W. and Jackson W. (eds) *Rooted in the Land: Essays on Community and Place*. New Haven and London: Yale University Press, pp. 217–225.

Foreman, R. T. (1997) *Land Mosaics. The Ecology of Landscapes and Regions*. Cambridge: Cambridge University Press.

Foster, J. B. (1999) Marx's theory of metabolic rift: classical foundations for environmental sociology. *American Journal of Sociology* 105(2):406–454.

Frank, D. J. (2002) The origins question: building global institutions to protect nature. *Organizations, Policy, and the Natural Environment*. Stanford: Stanford University Press, pp. 41–56.

Frank, D.J., Hironaka A. and Schofer E. (2000) The nation-state and the environment over the twentieth century. *American Sociological Review* 65(1):96–116.

Frank, R.H. (1999) *Luxury Fever*. Princeton: Princeton University Press.

Fredriksson, P.G., Neumayer, E., Damania, R. and Gates, S. (2005) Environmentalism, democracy, and pollution control. *Journal of Environmental Economics and Management* 49(4):343–365.

Freeman, A.M. (2003) *The Measurement of Environmental and Resource Value: Theory and Methods*, 2nd edn. Washington, DC: Resources for the Future.

Freudenburg, W.R., Frickel, S. and Gramling, R. (1995) Beyond the nature/society divide: learning to think about a mountain. *Sociological Forum* 10(3):361–392.

Fukuyama, F. (1992) *The End of History and the Last Man*. London: Hamish Hamilton.

Giddens, A. (1994) *Beyond Left and Right*. Cambridge: Polity.

Grafton, R. Q. and Knowles, S. (2004) Social capital and national environmental performance: a cross sectional analysis. *Journal of Environment and Development* 13(4):336–370.

Gray, A. (1999) Indigenous peoples, their environments and territories. In Posey D. (ed.) *Cultural and Spiritual Values of Biodiversity*. London: IT Publications and UNEP.

Gray, J. (2002) Granta Books, London: *Straw Dogs*.

Gray, J. (2004) *Heresies. Against Progress and Other Illusions*. London: Granta.

Hajer, M. A. (1995) *The Politics of Environmental Discourse: Ecological Modernisation and the Policy Process*. Oxford: Clarendon.

Hanley, H.D. and C. Spash, (1993) *Cost–Benefit Analysis and the Environment*. Aldershot: Edward Elgar Publishing.

Hannigan, J.A. (1995) *Environmental Sociology: A Social Constructionist Approach*. London and New York: Routledge.

Jordan, G. and Maloney, W.A. (1997) *The Protest Business: Mobilizing Campaign Groups*. Manchester: Manchester University Press.

Kasser, T. (2002) *The High Price of Materialism*. Cambridge, MA: MIT Press.

Kellert, S.R. and Wilson, E.O. (1993) (eds) *The Biophilia Hypothesis*. Washington, DC: Island Press.

Klijn, J. and Vos, W. (eds) (2000) *From Landscape Ecology to Landscape Science*. Dordrecht: Kluwer Academic.

MacNaughten, P. and Urry, J. (1998) *Contested Natures*. London: Sage.

Malthus, T. (1798) *An Essay on the Principles of Population*.

Matthews, E., Amann, C., Bringezu, S. and Fischer-Kawalski, M. (2000) *The Weight of Nations*. Washington DC: WRI.

Meadows, D.H., Meadows, D.L. and Behrens, W. III (1972) *The Limits to Growth*. New York: Universe.

Mellor, M. (1992) *Breaking the Boundaries*. London: Virago.

Mertig, A. Dunlap, R.E. and Morrison, D.E. (2002) The environmental movement in the United States. In Dunlap, R.E. and Michelson W. (eds) *Handbook of Environmental Sociology*. London: Greenwood Press, pp. 448–481.

Midlarsky, M. (1998) Democracy and the environment: an empirical assessment. *Journal of Peace Research* 35(3): 341–361.

Millennium Ecosystem Assessment (MEA) (2005) *Ecosystems and Human Well-Being*. Washington, DC: Island Press.

Mol, A.P.J. (1996) Ecological modernisation and institutional reflexivity: environmental reform in the Late Modern Age. *Environmental Politics* 5(2):302–23.

Mol, A.P.J. (2001) *Globalization and Environmental Reform: The Ecological Modernization of the Global Economy*. Boston: MIT Press.

Mol, A.P.J. and Sonnenfeld D.A. (eds) (2000) *Ecological Modernisation Around the World: Perspectives and Critical Debates*. [special issue of *Environmental Politics* 9(1)].

Mol, A.P.J. and Spaargaren G. (2000) Ecological modernization theory in debate: a review. *Environmental Politics* 9(1):17–49.

Morison, J., Hine, R. and Pretty J. (2005) Survey and analysis of labour on organic farms in the UK and Republic of Ireland. *Int. J Agric Sustainability* 3(1):24–43.

Munck, G.L. (1995) Actor formation, social co-ordination, and political strategy: some conceptual problems in the study of social movements. *Sociology* 29(4):667–685.

Murphy, J. (2000) Ecological modernization. *Geoforum* 31:1–8.

Murphy, R. (1994) *Rationality and Nature: A Sociological Inquiry into a Changing Relationship*. Boulder: Westview.

Myers, N. and Kent J. (2003) New consumers: the influence of affluence on the environment. *Proc Natl Acad Sci* 100, 4963–4968.

Myers, N. and Kent, J. (2004) *The New Consumers*. Washington, DC: Island Press.

Naess, A. (1990) *Ecology, Community and Lifestyle: Outline of an Ecosophy* (transl. D. Rothenberg). Cambridge: Cambridge University Press.

Nash, R (1973) *Wilderness and the American Mind*. New Haven: Yale University Press.

Nettle, D (2005) *Happiness*. Oxford: Oxford University Press.

Norgaard, R.B. (1997) A coevolutionary environmental sociology. In Redclift M and Woodgate G (eds) *The International Handbook of Environmental Sociology*. Northampton: Edward Elgar Publishing, pp. 158–168.

O'Brien, M., Penna, S. and Hay, C. (eds) (1999) *Theorising Modernity*. London and New York: Longman.

O'Connor, J. (1998) *Natural Causes: Essays in Ecological Modernization*. New York: Guilford Press.

Oelschlaeger, M. (1991) *The Idea of Wilderness*. New Haven: Yale University Press.

Ostrom, E. (1990) *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.

Pearce, D.W. and Turner, R.K. (1990) *The Economics of Natural Resources and the Environment*. Hemel Hempstead: Harvester Wheatsheaf.

Pfeffer, M.J., Schelhas J. and Day L.A. (2001) Forest conservation, value conflict, and interest formation in a Honduran National Park. *Rural Sociology* 66(3):382–402.

Pfeffer, M.J., Schelhas J.W., DeGloria S. and Gomez J. (2005) Population, conservation, and land use change in Honduras. *Agriculture, Ecosystems and the Environment* 110:14–28.

Pfeffer, M.J., Schelhas J.W. and Meola C. (2006) Environmental globalization, organizational form and expected benefits from protected areas in Central America. *Rural Sociology* 71(3):429–450.

Porritt, J. (2005) *Capitalism as if the World Matters*. London: Earthscan.

Pretty, J. (2002) *Agri-Culture. Reconnecting People, Land and Nature*. London: Earthscan.

Pretty, J. (2003) Social capital and the collective management of resources. *Science* 302:1912–1915.

Pretty, J. (2004) How nature contributes to mental and physical health. *Spirituality & Health International* 5(2):68–78.

Pretty, J. (2007) Agricultural sustainability: concepts, principles and evidence. *Phil Trans R Soc Lond B* (in press).

Pretty, J.N. and Koohafkan, P. (2002) *Land and Agriculture: From UNCED Rio to WSSD Johannesburg*. Rome: FAO.

Pretty, J. and Ward, H. (2001) Social capital and the environment. *World Development* 29(2):209–227.

Pretty, J., Peacock, J., Sellens, M. and Griffin, M. (2005) The mental and physical health outcomes of green exercise. *International Journal of Environmental Health Research* 15:319–337.

Pretty J., Noble, A.D., Bossio, D., Dixon, J., Hine, R.E., Penning de Vries, F.W.T. and Morison, J.I.L. (2006) Resource-conserving agriculture increases yields in developing countries. *Environmental Science & Technology* 40(4):1114–1119.

Putnam, R.D., with Leonardi, R. and Nanetti, R.Y. (1993) *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton, NJ: Princeton University Press.

Rees, M. (2003) *Our Final Century*. London: Arrow Books.

Rees, W. (2002) Ecological footprints. *Nature* 421:898.

Rees, W., Wackernagel, M. and Testemae, P. (1996) *Our Ecological Footprint. Reducing Human Impact on the Earth*. Gabriola, Canada: New Society Publ.

Rootes, C.A. (1997) Environmental movements and green parties in Western and Eastern Europe. In Redclift M. and Woodgate G. (eds) *The International Handbook of Environmental Sociology*. Northampton: Edward Elgar Publishing, pp: 319–348.

Saward, M. (1993) Green democracy? In Dobson A. and Lucardie P. (eds) *The Politics of Nature: Explorations in Green Political Theory*. London: Routledge, pp. 63–80.

Schama, S. (1996) *Landscape and Memory*. London: Fontana Press.

Schandl, H. and Schulz, N. (2000) *Using Material Flow Accounting to Operationalize the Concept of Society's Metabolism*. Colchester: University of Essex.

Schelhas, J. and Pfeffer, M.J. (2005) Forest values of national park neighbours in Costa Rica. *Human Organization* 64(4):385–397.

Schnaiberg, A. (1980) *The Environment, From Surplus Scarcity*. New York: Oxford University Press.

Schnaiberg, A. and Gould K.A. (1994) *Environment and Society: The Enduring Conflict*. New York: St. Martin's Press.

Schwartz B. (2004) *The Paradox of Choice*. New York: Harper.

Seippel, Scand, Crossed, 'ø'. (2002) Modernity, politics, and the environment: a theoretical perspective. In Dunlap R. E., Buttel F. H., Dickens P., and Gijswijt A. (eds) *Sociological Theory and the Environment: Classical Foundations, Contemporary Insights*. New York: Rowman and Litttlefield.

Simonis, U.E. (1989) Ecological modernization of industrial society: three strategic elements. *International Social Science Journal* 121:347–361.

Soper, K. (1995) *What is Nature?* Oxford: Blackwell.

Spaargaren, G., Mol, A.P.J. and Buttell, F.H. (eds) (2000) *Environment and Global Modernity*. London: Sage.

Sprinz, D.F. and Helm, C., (2000) Measuring the effectiveness of international environmental regimes *Journal of Conflict Resolution* 45(5):630–652.

Stones, R. (1998) *Key Sociological Thinkers*. Basingstoke and London: Macmillan.

Suzuki, D. (1997) *Sacred Balance*. London: Bantam Books.

UN. (2004) *World Population to 2300*. New York

UN. (2005a) *Long-range World Population Projections: Based on the 1998 Revision*. New York: UN Population Division.

UN. (2005b) *World Population Prospects. The 2004 Revision*. UN Population Division. UN. 2004. *World Population to 2300*. UN Population Division.

Underdal, A, (1992) The concept of regime 'effectiveness'. *Cooperation and Conflict* 27(3):227–240.

Uphoff, N. (1998) Understanding social capital: learning from the analysis and experience of participation. In Dasgupta P. and Serageldin I. (eds) *Social Capital: A Multiperspective Approach*. Washington, DC: World Bank.

Uphoff, N. (ed.) (2002) *Agroecological Innovations*. London: Earthscan.

Vandergeest, P. and DuPuis, E.M. (1996) Introduction. In DuPuis E. M. and Vandergeest P. (eds) *Creating Countryside. The Politics of Rural and Environmental Discourse*. Philadelphia: Temple University Press.

Ward, H. (2006) International linkages and environmental sustainability: the effectiveness of the regime and IGO networks. *Journal of Peace Research* 43:149–166.

Ward, H., Grundig, F. and Zorick, E. (2004) Formal theory and regime effectiveness: rational players, irrational regimes. In Underdal A. and Young O. (eds) *Regime Consequences: Methodological Challenges and Research Strategies*. Dordrecht: Kluwer Academic.

WCED, (1987) Our Common Future. World Commission on Environment and Devleopment. Oxford: Oxford University Press.

Weale, A. (1992) *The New Politics of Pollution.* Manchester: Manchester University Press.

Wilson, E.O. (1984) *Biophilia-The Human Bond with other Species.* Cambridge, MA: Harvard University Press.

Worster, D. (1993) *The Wealth of Nature: Environmental History and the Ecological Imagination.* New York: Oxford University Press.

WRI (2006) World Resources Institute Statistics. At www.wri.org

Yearley, S. (1991) *The Green Case: A Sociology of Environmental Issues, Arguments and Politics.* London: HarperCollins.

Yearley, S. (1994) Social movements and environmental change. In Redclift M. and Benton T. (eds) *Social Theory and the Global Environment.* London: Routledge, pp. 150–168.

Yearley, S. (1996) *Sociology, Environmentalism, Globalization: Reinventing the Globe.* Thousand Oaks: Sage.

Young, O.R. and Levy M.A. (1999) The effectiveness of international environmental regimes. In Young O. R. (ed.) *The Effectiveness of International Environmental Regimes: Causal Connections and Behavioural Mechanisms.* Cambridge, MA: MIT Press, pp. 1–32.