ECO-THEOLOGY

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For my daughters
Sara Elisabeth and Mair Clare

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Acknowledgements

The preparation of this book has taken a number of years. My first contact with religious environmentalism came in the early 1990s through working with Martin Palmer at the International Consultancy on Religion, Education and Culture (ICOREC), then based in Manchester. The book I wrote then as part of my work with ICOREC, and sponsored by WWF, was intended to support Christian groups and enable them to link environmental issues with theology. It was published eventually in 1996 under the title of *A Handbook in Theology and Ecology*. Since then I took up a teaching post at the University of Chester and Martin launched the Alliance in Religion and Conservation (ARC), engaged with practical environmental projects worldwide. I realised from the continued popularity of the *Handbook* that there are still relatively few good accessible resources to help laity and others understand and appreciate eco-theology. The idea for the present work was first conceived through a conversation I had in early 2003 with Sarah Lloyd from Ashgate publishers, who subsequently moved to hardback-only publications. Bearing in mind the financial needs of the student community, I looked elsewhere. I am grateful, therefore, to Virginia Hearn of Darton, Longman and Todd for taking on this book, intended to appeal to a lay audience, students as well as established scholars of theology, religious studies, or indeed, the environmental sciences. The book was delayed by the arrival of my second daughter, Mair Clare, in December 2005, along with further delays due to the strictures of the British system of research assessment, which somewhat woodenly resists giving value to pedagogical texts, and so has an impact on the kind of work that it is possible to complete during periods of sabbatical leave. However, although this book has taken a number of years to compile, in view of the increasing intensity of popular and public interest in environmental concern, it seems timely to be publishing this book now.

I am especially grateful to other scholars who have either read and commented on sections of this book, or made their work available before publication. In this respect I would like to mention in particular Sigurd Bergmann, Ernst Conradie, Denis Edwards, Michael Northcott, Peter Scott and Christopher Southgate. I would particularly like to thank Ernst Conradie

for helpful conversations during his stay at Chester in February 2008, just as final corrections to this book were being addressed. I am also indebted, as is so often the case, to the resources and welcome of St Deiniol's Library, where I have had the opportunity for reading and reflection away from the demands of University and family. I am grateful for the feedback from my students at the University of Chester, who helped me refine some of my ideas for this book while taking the module *Ecotheology and Environmental Ethics*.

Some of the material that is presented here has also been delivered to various other audiences. Sections on eco-justice and environmental justice, for example, were delivered to the Catholic Women's League in Birmingham in March 2007. My article 'Environmental Justice and the Economy: A Christian Theologian's View', published in *Ecotheology* in 2005, was prepared for the 'Religion and Environment in Europe' workshop that met at the Theological Philosophical College of the Bendiktbeuern Monastery in southern Germany in June 2005. I have drawn on this article and aspects of my other published works in preparing this volume. I also spoke to a public audience at St Paul's Cathedral in Westminster in November 2006 as part of the *Costing the Earth? The Quest for Sustainability* programme, drawing on some of the material that forms the final chapter of this book.

In order to suit the pedagogical intent of this book, it is substantially different to any of my previous publications that I have drawn upon, and in as much as this book includes a critical review of other published work, it is completely new. I have also sought to develop my own ideas in a more focused way towards an eco-theological agenda, so in this sense, it seeks to provide the starting point for an original contribution to the field.

I would like to thank my family and my husband Henry, who has had to endure my confinement to my study over many evenings, periods of annual leave and weekends – no sabbatical could be granted to pen such a text, for reasons given above. Finally, this book is dedicated to my daughters, Sara (7) and Mair (2), who are innocently expectant of so much. Let us hope that the earth will be kept not just for them, and the generations that follow them, but for the myriad other creatures that co-exist with us on planet earth.

Preface

The turn to ecology

CONTEMPORARY CONCERN FOR THE ENVIRONMENT, broadly understood as a turn to ecology, takes its bearings from secular concerns about the environment that have developed and intensified over the last few decades. The rise of religious environmentalism in particular adds its own voice to the debate, for it seeks to trace the malaise of environmental decay as rooted in spiritual issues, along with its potential solution to environmental understanding, by a retrieval of religious symbols and traditions. In a recent survey entitled *A Greener Faith*, Roger Gottlieb traces the rise of religious environmentalism in different religious traditions, including Christianity.[1] His purpose is to survey the different possible religious responses to environmentalism, rather than analyse their validity from within a particular tradition. The intention of this book is rather different. Its aim, as the title suggests, is to offer a resource book that highlights and seeks to evaluate the merits or otherwise of different contemporary eco-theologies, drawing from different Christian theological traditions and contexts. It represents an attempt to map out a burgeoning field in a way that is accessible to university students or other readers with a serious interest in the topic.[2] It aims to introduce the reader to critical debates in eco-theology, and encourage further reflection and analysis. In bringing together something of the diversity of the field, my hope is that the student will be encouraged to listen to different emerging voices and form his or her own view on the merits or otherwise of particular positions. I have, accordingly, often left open-ended matters that arise as a result of the considerable diversity in opinion among those who engage in eco-theology, in order to encourage students to situate themselves within this debate. I have tried to invite students to ask questions of the literature in offering some of my own critique, but I also offer more general discussion questions for each chapter in order to allow students to begin such critical reflection.

I am fully conscious of the fact that there are areas of eco-theological discussion that I have been forced to omit, or have treated somewhat superficially. The field has also grown so large that every chapter could, in itself, be expanded into a monograph, or even a series of monographs. A work that was

fully comprehensive would be more like an encyclopaedia in its proportions and take several volumes. This would suit a more corporate international effort, and plans are underway to implement such an ambitious project.[3] I have also, necessarily, focused on the work of *contemporary* writers rather than historical figures, except where those writings become important in the work of contemporary authors.[4] I have also concentrated on *theology*, rather than what loosely might be termed eco-spirituality and Christian eco-ethics, even though, of course, any lines of demarcation are somewhat blurred.[5] Finally, I have confined my discussion to Christian theology, rather than attempt a broader, multi-religious perspective. I recognise the importance of other religious traditions in their engagement with ecological concerns. This is true of the other Abrahamic faiths as well as religions within Buddhist or Confucian traditions. However, there are existing resources that do attempt such a breadth,[6] and I am conscious of the primary need for Christian theologians to take on board the scale and extent of the development of eco-theology right across the globe from within their own traditions. This has often been recognised insufficiently, if at all. Perhaps only then a more articulate dialogue with other theological positions can begin. I find it astonishing that courses on eco-theology do not exist in many university departments of theology and religious studies in the United Kingdom. This book will, I hope, encourage tutors to take this issue far more seriously than to date, and place eco-theology firmly in the curriculum of contemporary theology. In addition, my intention is that this book will be suited to the wider context of educated laity for discussion and reflection, though I have presupposed a certain amount of theology.

The first premise that this book presumes is that it is possible to combine concern with the environment and an understanding of God. Eco-theology, as defined here, is that reflection on different facets of theology in as much as they take their bearings from cultural concerns about the environment and humanity's relationship with the natural world. It is, in other words, broadly speaking a particular expression of contextual theology that emerges in the particular contemporary context of environmental awareness that has characterised the late twentieth and early twenty-first centuries.[7] Given the widespread secular engagement with environmental issues at global, national and local levels, such expressions of theology are highly significant. This development is not simply the concern of a minority interest group, but reaches out to include all those who are aware of global and local environmental problems. Given that this affects human survival as well as the survival of all creatures on our living planet, such issues touch deeply our sense of meaning and purpose. In other words, it is hard to talk meaningfully about ecology in such a context, without also speaking about religion and theology as well. This is also true the other way round, so that for theology to be meaningful, it also, I suggest, needs to encompass an awareness that is beyond the human, inclusive of the natural world in which humanity is embedded. Ecology here means the

broader context of ecological concerns, as well as that described by ecological science as such.

The fashion in much contemporary academic theology has been to shift towards radical postmodern deconstruction, taking its cue from authors such as Derrida and Foucault. While such studies have their merits in raising unsubstantiated assumptions brought to bear in philosophical and theological reasoning, the spectre of relativism and nihilism looms, and unless carefully handled, leads to inactivity and disillusionment. Moreover, we should be fully conscious of the relativism of the turn to postmodernity in a way that is often insufficiently recognised. In other words, we need to view the swing to postmodern deconstruction as *itself* culture bound, often tied into particular Western traditions that form the basis of its criticism. What will be the next fashion *after* postmodernity? In such a climate, the tendency for theology might be either to resort to confessional positions that ignore such criticism, or bend to it through lack of confidence in any constructive proposal. In a loose sense, all eco-theology is postmodern in that it takes *context* as its starting point, and challenges the presuppositions of much theology emerging in the so-called modern period.[8] *EcoSpirit: Religions and Philosophies for the Earth* is published as this book goes to press.[9] *EcoSpirit* engages specifically with philosophy, and in particular, postmodern thought, but it assumes that grounding theological reflection in environmental and other practices is necessarily postmodern in its orientation – in other words, rejecting any notion of 'foundation', while affirming a sense of being 'grounded'. *EcoSpirit* is also wider in its brief compared with the present volume, gathering together a range of different religious and cultural traditions. It recognises that facts alone about environmental issues are not enough; what is needed is something more elemental, that probes the background assumptions pervading modern thought in a way that leads to denial – what the editors term 'apocalyptic insomnia'.[10] Such sensitivity to context echoes something of the concerns in other contextual theologies.[11] In the main, eco-theology turns against the tide of radical postmodern relativism or confessional counter-reaction in that it accepts that environmental problems have a substantial and reasonable basis in reality. At their best, postmodern critiques show up the limitations of scientific analysis and theological dogmas. Eco-theology can survive such criticism by also challenging the secular idea that the sciences are sufficient to solve environmental problems. Moreover, I suggest that even at a secular level the various forms of eco-theology need to be viewed as important contributions to myth making and symbol making, where 'myth' is not intended to imply the lack of truth, but rather shows its capacity to reach beyond the rational to include other dimensions of knowing. It is disentangling the roots of such myths and their impact, negative and positive, that forms the basis of much eco-theological reflection. In other words, religious thinking and practices are as much part of the root of the problem as they are part of the potential way forward.

Overall, eco-theology seeks to uncover the theological basis for a proper relationship between God, humanity and the cosmos. Humans are understood in Christian tradition to be created, but alienated from the natural world through their own tendencies towards domination. Many approaches to eco-theology are those that seek to recover our sense of place on the earth, a reminder that the earth is our common home, that the story of the earth and that of humans are one. This may also be broadened out to include the economy, the *oikos* or household of God. Such reflection naturally enough leads to a great deal of literature on ethics as that which needs to be practised to re-order the household. Yet, as Ernst Conradie has pointed out, moving too readily to a sense of humanity at home on earth misses out the concrete experiences of natural suffering, finitude and the pervasiveness of human sin.[12] Like Conradie, I believe that we need an ecologically informed anthropology, yet one that is more consciously aware of the limitations of simply trying to recover a sense of being at home on the earth. At the same time, other aspects of Christian theology need to be teased out through an ecological hermeneutic as well. Like Conradie, I believe that the agenda for eco-theology must be bold enough to encompass the main tenets of faith, without being reduced to environmental ethics.[13] He also acknowledges that while many publications have emerged from North American, British and German contexts, 'perhaps more important is the sometimes unarticulated ecological wisdom that has been gathered from impoverished local communities in Africa, Australia, Central America, India, Latin America, New Zealand, the Pacific Islands, the Philippines, South East Asia and also in North America itself.'[14] This 'rich mosaic' of different cultures, traditions and contexts informs ecological theology, and is one reason why I have sought to highlight the global nature of ecological reflection, while being acutely aware that the scope of such reflection is limited in a work of this length. I hope, at least, to give something of the flavour of such diversity in eco-theology. At the same time, eco-theology has as its horizon environmental praxis; it is theology worked out at the coal-face, as it were, of environmental concerns and problems.

The purpose of this book is threefold. The first task is pedagogical. The first two chapters in this book raise secular environmental and economic dimensions of the debate in order to set the scene for more rigorous theological discussion. Issues such as climate change, biodiversity, and secular ecological values are raised, alongside particular practices that affect the economy, such as globalisation, sustainability and genetically modified crops. Such coverage cannot be exhaustive, but it is intended to be sufficient to give a flavour of the issues and problems for those readers encountering eco-theology for the first time. It also raises some of the ethical issues that have been the subject of intense debate. Ethical controversy sets the scene for theological discourse and arguably far more has been written on religious environmental ethics compared with eco-theology, though the lines between the two are also very

blurred in many cases. The next four chapters (3 to 6) review something of the diversity of eco-theological thought, emerging from different global contexts. The designations 'North', 'South', 'East' and 'West' in the chapter headings are loosely intended to highlight the global variety of the discourse, rather than imply that this book can ever hope to encompass the full extent of theological reflection on the issue from different starting points. Moreover, all these chapters are illustrative, rather than exhaustive reviews, and aim to encourage further reading, rather than being fully comprehensive. For example, Chapter 3 deals with deep ecology, the mystical creation theology of Teilhard de Chardin and Matthew Fox, while Chapter 4 discusses ecology and liberation theology in comparison with indigenous theologies. Chapter 5 outlines the particular approach to the doctrine of creation from the perspective of Eastern Orthodox theology, alongside its commitment to grounding theology in liturgical practice. Chapter 6 is more concerned with sociological interpretations and the extent to which social and political insights might be incorporated into eco-theology. All these chapters to some extent are reviews of existing work as a basic primer in eco-theology.

The second task of this book, as exemplified in Chapters 7–12, seeks to go beyond merely critical literature review, and attempt more active theological construction. Chapter 7 begins the discussion by raising alternative interpretations of the Bible that draw on eco-justice principles. While such alternative readings could form the topic of a textbook in its own right, its purpose is primarily one that serves subsequent theological construction. The word 'construction' is not intended to mean an overarching or foundational position in the sense that it cannot be revised, but at the same time it seeks to go further than more timid renditions of theology that are becoming more popular in some quarters, where it is described as simple fragments to a discussion. It is, in other words, one way of reading systematic theology that arguably is helpful in the context of environmental concerns. All these chapters argue for the importance of the tradition of wisdom in theology and its potential for eco-theology. Different chapters focus on different systematic concerns in the light of ecology, ranging from Christology to Theodicy, Spirit, Eco-Feminist Theology and Eschatology. The doctrines of creation, Christian anthropology and the doctrine of the Trinity are also woven into the discussion of the book as a whole, rather than forming separate chapters. This is partly because I have written on these issues elsewhere,[15] and also because the other systematic themes are perhaps less obvious to students in terms of their potential ecological readings.

I am painfully and acutely aware that a book of this size could not cover all aspects worthy of consideration and some may be offended by my omissions or compressions of areas of work. There are also no specific chapters devoted to ecclesial perspectives, for example, but I have tried to give due consideration to these issues in other chapters, representing authors from Eastern and Western traditions. My hope is that this book will be a resource for reflection

in different churches, which is why I have deliberately not flagged up a particular denominational stance, such as a particular emphasis on the Roman Catholic tradition in which I now stand, or my roots in the Anglican tradition. The context in which I teach is one where students are welcomed from all faiths or none, and while I do not claim to be neutral with respect to my own faith position, I also believe that those who do not share a religious faith will find this book gives insights into the interweaving of faith, theology, and practices that form the basis for the development of eco-theology. In other words, a student does not have a requirement to be a believer in order to gain something from this book.

I am also aware that the layout of this work could have been very different, given the sheer size and scope of material relevant to eco-theology. For example, full chapters could have been devoted to gleaning the relevance of different aspects of the tradition from a historical perspective, such as Franciscan, Benedictine or Celtic traditions, for example. Such traditions do, I suggest, influence the authors that are represented in this book, so that those who are more influenced by Franciscan traditions will be inclined to a more sacramental approach, those by Celtic traditions towards a deeper affinity with the land, and those by Benedictine traditions will allow for some active change by human involvement, fostering notions such as stewardship, for example. Yet it also seems to me that sources relating to such traditions are relatively easy to access, so that the student or interested reader should not have difficulty finding such material. In fact, my hope is that those who read this book might feel inclined to delve more deeply into these traditions than has been possible in this very compressed survey. I could also, perhaps, have organised the material around what might be called loosely models of eco-theology, according to, for example, the sacramental and stewardship traditions already mentioned, but also according to eco-feminist and ecumenical approaches. By devoting a full chapter to eco-feminist thought, and by deliberately representing different theological traditions, my hope is that these issues will be clear to the reader. There is also a disadvantage in such modelling in as much as many authors draw from many different approaches and models, so fitting the work of one author to a given way of thinking is somewhat artificial, even if it lends some clarity. I hope that the reader will be alert to such different styles as they read this text.

As a pedagogic text this aims to highlight how it is possible to interpret more traditional doctrines in ecologically friendly ways. I have, of course, been limited by the scope of what is achievable in one relatively short volume, but I hope that I have been able to demonstrate the starting point for more reflection and more questions. I have woven in soteriological themes throughout, as well as considering such issues under the broader heading of Christology. My intention is to open up the field so that others will be encouraged to enter it, rather than even attempt a fully comprehensive survey. Given the diversity and contextual variety of much eco-theological literature to date,

even providing such a starting point proved extremely challenging. I hope that any readers who are disappointed with the selection that I have made will bear patiently with the intention of this book, namely one that seeks to encourage more interest and research in the topic. Moreover, I will argue that such an analysis implies not simply that ecology is an option for theology, but also that it is *necessary* if theology is to be correctly understood.

The third task of this book is to encourage readers to engage in active reflection and positive action. I suggest that the re-reading of theology sketched out in this book has important implications for eco-praxis. The closing postscript points towards such an interpretation, though I am fully aware that a full text on theological eco-praxis would be desirable from such an analysis. I am using praxis to mean the liturgical life of the church as well as the particular ethical boundaries for individual actions. I have also included discussion questions emerging from each chapter that can be used in order to stimulate either individuals or groups to think further about the issues raised. This book has also benefited from being used as a source on a taught module entitled *Eco-theology and environmental ethics* for students at the University of Chester. The feedback from these students was interesting and slightly surprising to me. Almost all said how, as a result of taking this module, they found it necessary not only to re-think their theological beliefs, but also to change their lifestyle and practice. I am delivering this book to the publisher on 11 July 2007, appropriately the Feast of St Benedict. For him, as many others, Christian belief could never be divorced from practices that were in tune with the land. If this book contributes in any small way to this task, then it will have succeeded in its intention.

Chapter 1

Trends in ecology and environment

THIS CHAPTER SEEKS TO HIGHLIGHT SOME OF THE MORE important environmental concerns raised by the rapidly expanding knowledge of environmental problems and ecology. It also forms the background in which eco-theological discussion is situated, and it is therefore appropriate to name these issues at the outset. It would be impossible to do full justice to the complete range of issues that need to be addressed; instead I will highlight areas that seem to me to be crucial in demonstrating the extent and complexity of the problems involved. I am also deliberately avoiding using the language of 'crisis' to discuss these changes, not because I see a lessening of the problems at the dawn of the twenty-first century, but because this language has been around since the early discussions of environmental issues in the 1970s, and it has often been used as a rhetorical, polemical device for particular political purposes. I am also not implying by this move that political issues are irrelevant for discussion, but I will return to more particular political questions in later chapters. This chapter sets the scene for subsequent political and economic debate. I will briefly review population, resource use/pollution, climate change and biodiversity. This list will give some indication of the state of the planet and likely trends in the future. The final section explores values emerging from ecology that also feed into later theological discussion.

Population

Population growth is often one of the first issues that come to mind when reflecting on why the earth is suffering environmental strain. We are, in R. J. Berry's words, simply 'running out of world'.[1] The exponential rate of population growth alarmed many writers in the 1960s, Paul Ehrlich, for example, likening the population explosion to a 'bomb' that would soon wreak havoc on human survival on planet earth. Others are less pessimistic today, believing that indefinite population growth is not inevitable. Demographic studies calculate population growth from live births and immigrants minus the

number of deaths and emigrants.[2] The global population in 2000 was twice that in 1960, reflecting a staggering rate of exponential growth in the last half of the twentieth century. In 2005 global population grew by 74 million, so that the world's population topped 6.4 billion, more than twice the number in 1950. Although the population growth rate has dropped from 2 per cent in the 1970s to about 1 per cent in 2006, the overall trend is an increase in population.[3] Over time medical improvements in health care in some populations have increased the rates of population growth by reducing the death rate, even when birth rates are falling. On the other hand, complex social issues, including sex education, the availability of contraception and abortion, attitudes to women, homosexuality, and economic incentives, all affect birth rates. Often improvements in economic and social gains are correlated with declining birth rate, but the question here is which comes first, the improvement in economics, or the reduction in birth rate? If the former comes first, then improving social conditions and economics should lead to a decline in birth rate, but if the latter, then a targeted approach to birth control is favoured. The total fertility rate (TFR), or average number of children born to a woman in her lifetime, has fallen in many populations, including not just the USA and Europe, but also Japan and China. However, this shift does not mean that overall population size is declining, for reasons mentioned above. In addition, other poorer nations of the world that show a much higher TFR have a corresponding lower average population age; but medical disadvantages and other social conditions such as poor hygiene also lead to high infant mortality rate. The overall effects are global increases in population size, so that even if the exponential rate of growth is slowing slightly, overall global population size is still increasing.

Resource use and pollution

But is population growth itself the only variable worth considering? It is recognised that global resources such as energy, soil and water are insufficient to meet the needs of a growing population. Yet many environmentalists believe that over and above population growth, the distribution and extent of resource use by some privileged groups leads to gross differences in energy and pollution burden per head in different populations.

In spite of vast increases in the global productivity of grain, world hunger still prevails. The production of food through monocultures has reached its limits. The world grain harvest dropped slightly from 1869 million tons in 1999 to 1840 million tons in 2000, but by 2005 it had reached a steady level of 2015 million tons.[4] Yet the high grain production levels do not eliminate world hunger for economic reasons and because of difficulties of distribution. The modern system of producing food is dysfunctional. Not only are there mass migrations to cities in poorer communities, leading to a collapse in the

rural economy, but there is also a failure to meet the basic need for food for many of those in poorer nations. This contrasts with excessive over-consumption in other nations. Four billion people live on less than $2 per day, while 20 per cent of the world's population is responsible for 90 per cent of consumption of resources and energy. The richer, Western nations are primarily responsible for over-consumption, leading to considerable global environmental strain.[5] The largest cause of death in 2000 was due to cardiovascular diseases, which killed 16.7 million people. Infectious diseases and parasitic diseases, including AIDS, tuberculosis and respiratory diseases, malaria and diarrhoeal diseases, killed 14.4 million people, mostly in impoverished communities. Cancers also led to 6.9 million deaths. Cardiovascular diseases and cancers affected primarily those affluent populations who have sedentary lifestyles and consume unhealthy foods.[6]

In addition, 40 per cent of the world's population is short of fresh water, and this is projected to rise to over 50 per cent by 2032. In 2000 the World Heath Organisation estimated that 1.1 billion people could not meet their basic need for clean water, contributing to the deaths mentioned above. In Asia 693 million people lack access to clean water. An estimated 3.4 million people die each year as a result of water-related disease and many more suffer disabilities as a result of water-related pathogens. It is estimated that 64.4 million Disability Adjusted Life Years (DALTs) come from water-related pathogens, often linked to inadequate sanitation. The most recent report suggests that 2.6 billion people still lack adequate sanitation facilities.[7] Other data suggest that up to 1.1 billion people lack access to a clean water supply.[8] This effect is compounded by the growing use of artificial fertilisers in agriculture, leading to an increase in groundwater and leaching of minerals, reducing long-term productivity of the soil. Eutrophication is a process by which particular pollutants are washed into water supplies – be it a lake, river, wetland or shallow sea – and overload it with organic and mineral nutrients. Common sources are nitrate fertilisers washed from the soil and phosphates from fertilisers and detergents in municipal sewage. There has also been a massive increase in global livestock populations, increasing 60 per cent since 1961. Pig and goat populations have doubled, chickens quadrupled. Industrial forms of production are on the increase, 43 per cent through feedlots where animals are kept in a confined space in factory-like conditions. For 200 million people living in arid areas, livestock is the only option. Overall there has been a fivefold increase in the global consumption of meat since the 1950s. In developing countries meat consumption between the early 1970s to the mid 1990s increased threefold over that in industrial countries.[9] Farm animals consume 37 per cent of the world's grain harvest, cattle being the least efficient in this respect. Overgrazing has degraded 20 per cent of global rangeland; and half of rainforest destruction is the result of cattle ranging. Moderate, severe or extreme degradation affects 7–14 per cent of farmland, so that each year some

5–8 million hectares go out of production as a result of degradation.[10] The waste from livestock also contributes significantly to environmental damage, including consequences such as toxic algae blooms and global warming through methane production.

Global fossil fuel consumption has expanded by three and a half times since 1950. World oil use reached 3.8 billion tons (83.3 million barrels a day) in 2005, with the USA the largest consumer at 20.8 million barrels a day. Europe came a close second at 15.6 million barrels a day, China 6.6 million barrels and Japan 5.4 million barrels. Overall per capita, the USA uses two thirds more compared with Japan and 13 times more than China.[11] Natural gas use is rising, and replacing use of coal. There is debate about the projected trends in energy use. For example, World Energy Outlook 2000 was more pessimistic than some about projected energy use. In North America and Western Europe there are no firm plans to increase nuclear power, though, ironically perhaps, under the pressure from anxiety about climate change, political talks have resumed in the United Kingdom, and this may spread to other jurisdictions. China, Japan and South Korea continue to fund new projects. There has been a mixed response in other countries, some such as Cuba and Taiwan responding to public pressure not to continue, others such as India and Brazil still completing projects. Global wind power increased by 24 per cent in 2005, and in 2004, the latest year for available data, global hydroelectric power increased by 5 per cent. The latter is hampered by lack of appropriate sites for development. In 2005 the global production of photoelectric cells increased by 45 per cent from the previous year, representing a sixfold increase since 2000, making it the world's fastest-growing energy source.[12] These changes in energy use are, unfortunately, not yet sufficient to halt the overall trends in carbon emissions.

Climate change

The projected rate of climate change this century is far greater than anything experienced by the earth in the last 10,000 years, mostly caused by human activity through the burning of fossil fuels.[13] There have always been sceptics who challenge the detailed predictions anticipated through climate change models. The *extent* of change anticipated is debated, rather than whether there is any change taking place at all. The most recent analysis suggests that we are close to the tipping point on climate change. Action needs to be taken in the next 15 to 35 years in order to stabilise the climate. Accumulated scientific evidence points to increasing unpredictability. The intergovernmental panel on climate change (IPCC) accumulated detailed empirical evidence from a network of hundreds of distinguished scientists.[14] The overall consensus is that, in spite of the uncertainties, most of the observed global warming over the last 50 years is due to changes in greenhouse gas concentrations. Hence, it would

not make any sense to ignore such warnings, for even if the sceptics are right, change will inevitably take place, but it will just take slightly longer compared with more pessimistic estimates.

The ten warmest years have occurred since 1980. 2005 was among the warmest years on record since records began in 1880, and six of the warmest years on record have occurred since 1998.[15] NASA Goddard Institute for Space Studies (GISS) in New York City has reported that 2007 tied with 1998 for Earth's second warmest year in a century.[16] The average temperature of the earth's surface gives an even more sensitive measure of this trend. The increased concentrations of carbon dioxide and other greenhouse gases are likely to be responsible. Carbon dioxide levels have risen by 30 per cent from pre-industrial times, due to burning fossil fuels, land use changes, especially deforestation, and agriculture. If nothing is done, it could reach double the level in 2100. So far the concentration of carbon dioxide as predicted by emissions has not normally taken into account the effect of climate change itself on the carbon cycle,[17] so that at higher temperatures there is an increase in respiration from living organisms in soil, as well as dieback of forests. Hence the problem is likely to be even worse than that predicted on the basis of emissions originating purely from human activities. If this is taken into account, then a tipping point may be reached whereby the earth becomes a net emitter of carbon dioxide.[18] Oceans could turn from being carbon sinks, to carbon emitters; tropical rainforests would be depleted further by enhanced temperature rises, and more carbon released from decomposing peat and release of frozen methane. By mid 1995 the IPCC agreed that the anthropogenic effects (that is, effects as a result of human activity) could be positively detected, and stronger support for this view has emerged since then.[19] The simulation climate models, such as that from the Hadley Centre, take into account anthropogenic and natural factors, such as solar variation and volcanic activity. Increased temperature leads to increases in water vapour and decrease in ice cover, especially in the Polar Regions, leading to further positive feedback, that is, further temperature increases. A doubling of pre-industrial carbon dioxide would lead to an overall global 1.5–4.5 degree change in temperature. This might seem a small change, but the difference between having an ice age or not amounts to a mere 5 or 6 degrees. Hence 2.5 degrees over a century is massive in terms of climate change. It will also vary enormously over the earth's surface. Predictions of regional variation in temperature are very difficult because of uncertainty in profiles of greenhouse gases; extent and feedback from cloud formation; changes in ocean circulation and changes in composition of the biosphere.[20]

The impacts of climate change on the ecology of both human and non-human communities are through factors such as rising sea level and the increase in number and frequency of climate extremes, floods and droughts becoming more common due to a more intense hydrological cycle.[21] The

changes that have a 90–99 per cent probability, if trends continue, include higher maximum temperatures and more hot days as well as higher minimum temperatures, fewer cold days and frost days over nearly all land areas; reduced diurnal temperature range and increase in heat index over most land areas; and more intense precipitation events over many areas. Weather-related disasters affect millions of people; the overall cost in 2005 hit a record of $204 billion, way in excess of the previous record of $112 billion in 1998.[22] Three of the ten strongest hurricanes ever recorded occurred in 2005; high-profile cases include Hurricane Katrina that hit the United States coast at the end of August. In addition, at the very end of the previous calendar year, on Boxing Day 2004, the mega-tsunami that hit the Indonesian region left thousands of people dead, and thousands orphaned. Although this tsunami was related to geological changes, rather than climate change, it represented the extent to which poorer nations are unprepared for such catastrophes. Those nations that are the most subject to change are the poorer subtropical parts of the world. The projected impact of climate change for the end of the twenty-first century includes:

- *Increase in sea level rise* from 0.1 to 0.9 metres for delta regions like those in Bangladesh, Egypt and China. Low-lying islands in the Pacific and Indian Oceans will be particularly vulnerable. Geological data suggests that the eustatic sea level (that is, estimated global sea level) has changed at an average rate of 0.1–0.2 millimetres per year over the last 3000 years, one tenth of that occurring in the twentieth century alone. Significant sea-level rises could lead to swamping of entire communities. Millions of people are likely to be displaced. Such devastating loss will lead to a huge number of environmental refugees, estimated to be 150 million by 2050 if present rates of change continue.
- *Impact on water availability*. The hydrological cycle will be affected by climate change, leading to greater evaporation, more rainfall in some places and drought in others, with a tendency for greater extremes – that is, dry places become drier and wet places become wetter.
- *Change in the distribution of food production*. This is most likely to be felt in the subtropics, leading to further environmental refugees.
- *Negative effects on human health*. This comes from heat stress, increased disease, such as malaria, and damage to some ecosystems.
- *Economic loss*. Direct effects of climate change, such as flooding, are estimated to be about 1.0–1.5 per cent of GDP in the Western world, and 2–9 per cent in poorer countries. These estimates do not take into account indirect factors such as the immigration of environmental refugees.

The social problems resulting from these impacts inevitably raise the issue of environmental justice, namely the proportionally greater impact of climate change on the poorer communities of the world, which are, in relative terms,

contributing significantly less to the anthropogenic effects on climate change. Climate scientists have proposed a contraction and convergence approach in order to share out the impacts of climate change in a more equitable manner on a global scale. This approach adopts the following principles:

- *The precautionary principle*, in this context meaning that the existence of scientific uncertainty should not preclude action.
- *The polluter pays principle*, using measures such as carbon taxation.
- *The principle of equity*, both international and intergenerational, so that the burden is shared out evenly.

A drastic shift in global emissions of carbon dioxide from the burning of fossil fuels would be required to bring about stabilisation of $C0_2$ levels to 450 parts per million. This is called the contraction principle. But how are these reductions to be shared out? Using the above principles, the fairest way is to set the limit by allowing an equal share of $C0_2$ per capita, reaching this (convergence) by 2030. Having given allocations to each nation, based on population size, trading would be allowed, so that technical and economic resources would be given in exchange for greater pollution 'debt'.

While this might seem idealistic at first sight, it is well within the economic sights of richer nations to reach such a target. The estimated reduction in carbon dioxide emissions required to stabilise the climate exceeds that of the Kyoto Protocol.[23] In the UK a reduction in carbon dioxide emission by 60 per cent from current levels might seem overly optimistic. However, the actual cost of making such a change would amount to 0.02 per cent, or six months' economic growth over a half century to 2050.[24] The economic case for action has been robustly defended by the Stern report, published in 2007. Nicholas Stern has also responded strongly to critics who argue against the economic case for action.[25] The United States has still not yet signed the Kyoto agreement. The G8 summit in July 2005 did not come to satisfactory conclusions in this respect either. The latest figures from Defra show that the basket of greenhouse gas emissions in the United Kingdom have fallen significantly to within the Kyoto target.[26] However, the overall emission of carbon dioxide was only 0.1 per cent lower in 2005 compared with 2004. The greatest proportion of carbon dioxide emission (37 per cent) comes from energy industries, 22 per cent from road transport, 18 per cent from other industries and 15 per cent from residential use of fossil fuels. While there has been an overall 12 per cent reduction in emissions from the energy industry since 1990, this has risen again since 2004, suggesting that the overall trend downwards has stabilised. Overall the UK contributes about 2 per cent to total emissions from human sources. Taxing and fining those companies that are polluting provides a legal mechanism to manage the over-production of carbon dioxide, but it is certainly insufficient as a moral response, and some might argue, ultimately destructive.[27] As Michael Northcott aptly points out, 'the climate is not a

social construct; instead it represents a real biophysical limit on the freedoms of corporations and consumers to maximise their preferences and profits.'[28] Even more surprising, perhaps, is that those ecological systems that are necessary for human life, including climate regulation, food and fresh water production, are now becoming known collectively as 'ecosystem services'. Bulked together, 62.5 per cent of these 'services' are being degraded or used unsustainably, but the attitude of mind that considers ecological systems as 'services' for human life shows the extent to which a focus on human needs dominates even the secular environmental agenda.[29]

Environmental impacts and biodiversity loss

There are a staggering number of species in the world today, between 5 and 80 million, probably around 30 million. Only 100,000 species have been described in any detail out of the total 1.5 million identified so far. Yet 1–11 per cent of the world's species are becoming extinct every decade. The International Union for the Conservation of Nature has drawn up a comprehensive list of those species that are extinct, extinct in the wild, critically endangered, endangered or vulnerable. As well as an increase in extinction rate, there has been a huge increase in the number of species that are critically endangered. The colonisation of land by human populations has always led to some loss of biodiversity, even among prehistoric peoples. Since 1600 researchers have identified over a thousand recorded cases of extinctions of plant and animal species.[30] Ecological knowledge helps define biological diversity, though the species that have so far been identified represent only a small fraction of the actual diversity, especially in areas such as the tropical rainforest. Conservation is, at best, a safety measure for known species. There are others that are disappearing well before they can be identified.

Overall plant diversity is also threatened, so that from an estimate taken in 2004, 70 per cent of all species assessed and 3 per cent of all plant species are threatened with extinction, and 45 per cent are endangered or critically endangered.[31] In 2005, of the 9900 bird species, 12 per cent were threatened with extinction.[32] In addition, about a quarter of all mammals are threatened, with 73 mammal species already extinct, and 4 extinct in the wild. Within the next 50 years chimpanzees and other primates may be extinct in the wild. Black rhinos suffered a catastrophic loss in population numbers between 1970 and 1992 due to hunting.[33]

In general, species may be lost through (1) direct exploitation by humans, and in areas such as the tropical rainforest it is difficult to estimate original wildlife diversity because there are virtually no regions entirely free from human exploitation. Exploitative practices include bush meat, as well as fuel wood, which overall exceeds replacement planting. Direct exploitation also includes hunting, especially in parts of Indonesia, for luxury items or for the pet trade. About 50 per cent of traded birds end up in the USA.

As well as direct exploitation, (2) loss of habitat is a common reason for species extinction, correlated with population density and clearance of land as well as climate change mentioned above. Although habitat loss has been a feature of human history since the dawn of civilisation, its extent has increased rapidly with the march of technology. The main habitats under threat are the tropical rainforests, wetlands and coral reefs. The former is better known than the latter two examples.

Forest clearance, especially the tropical rainforest, has led to loss of a myriad of species, many not yet identified. Global forested area contracted by 36.6 million hectares, or just less than 1 per cent between 2000 and 2005, according to the 2005 Global Forest Assessment from the US Food and Agriculture Organisation (FAO). This is a net figure, so that actual losses were 65 million, with offset by expansion of plantations and natural re-growth.[34] While the destruction of tropical rainforest is well known, less appreciated is the destruction of mangrove forests on the coastlines, leaving coastline ecologies vulnerable to destruction.[35]

The planet has lost over half its wetlands in the last hundred years. These are highly fragile ecosystems. Most loss is through drainage for agricultural use. There are secondary effects as well: water tables can fall, leading to salinization; and the change in water flow in rivers can harm coastal ecosystems and ultimately lead to water shortages in some places and flood-related disasters in others. Many environmental problems are concentrated in coastal areas, including the mismanagement of fisheries and damage to coastal land by poorly planned land use through badly managed urbanisation, industrialisation, tourism and flood control. Wetland degradation also accounts for some of the decline. Wetlands cover up to 6 per cent of the earth's surface. The Mesopotamian marshlands of Iraq and Western Iran make up the largest remaining wetland system in the Middle East and Western Eurasia. This ecosystem had shrunk to 10 per cent of its original size, mostly due to draining projects in the 1990s by the Iraqi government.[36]

The rapid loss in coral reefs is one of the most dramatic changes seen since 1992. The latest World Watch Institute report is horrifying:

> As of late 2005, an estimated 20 percent of the world's coral reefs had been 'effectively destroyed', showing live coral losses of at least 90 percent and no immediate prospects for recovery, according to the Global Coral Reef Monitoring Network. Another 24 percent face imminent risk of collapse as a result of human pressures and 26 per cent face longer-term loss – bringing the share of world reefs now threatened or destroyed to 70 percent, up from 59 percent in 2000. The greatest destruction has occurred in the Caribbean Sea, Indian Ocean, Gulf regions, and Southeast Asia.[37]

Coral reefs are among the world's most complex and productive ecosystems.[38]

Loss in coral reefs is through human pressures, including fishing, coral mining, coastal development, waste dumping, inland deforestation and farming; nearly 60 per cent of all reefs are threatened in this way. Yet the greatest threat is global warming: just a one-degree rise in temperature makes the corals expel their living parts and turn white, a process known as bleaching.

Another major factor in species loss is through (3) introduced species. About 400,000 species have been introduced over time. While some may be intentional, others have come through transport routes between human populations. In about 10 per cent of cases, introduced species have effects on existing ecology, leading to negative impacts, including species extinction. Endemic species in lakes and islands are particularly vulnerable to predation and parasitism by introduced species. For example, the accidental introduction of the brown tree snake, *Bioga irregularis*, to the island of Guam in 1950 resulted in the loss either directly or indirectly of 12 species of an original fauna of 22 native birds, reduction in the remaining forest species to a mere remnant, and the loss of over a third of native reptiles.

The Convention on Biological Diversity represents international political recognition that sustaining biodiversity is within the scope of international interests. It attempts to arrive at an international consensus towards protecting biological diversity in different national regions. The convention has three aims: first, to conserve biological diversity; second, to use biological resources in a sustainable way; and third, to share any benefits arising from genetic resources fairly.

The relationship between biodiversity and ecosystem function is a major research area within ecology.[39] In some cases a species may be lost without any effect, known as ‘redundancy’. In other cases there are crucial species whose loss disrupts the ecosystem, an effect known as ‘rivet popping’. In a third ‘idiosyncratic’ scenario it is not possible to predict accurately the impact of the loss of a particular species, because each species has complex and varied roles. An ecosystem with a large number of species is more likely to show species ‘redundancy’. Yet the value of conserving biodiversity is not simply related to ecosystem function. The benefits of biodiversity relate to (a) direct uses – that is, instrumental uses for human benefit; and (b) indirect use, achieved through biogeochemical cycling (cycling of basic nutrients including carbon, nitrogen and sulphur, released as appropriate gases into the atmosphere). Such cycling is necessary both for the maintenance of global ecology and climate stability. So-called ‘redundant’ species may also be indirectly useful as food sources for other species that are of instrumental use. Other indirect uses could include tourism and recreation. There are also (c) four values that do not relate to present usefulness. Future generations may have (i) instrumental or other uses for biodiversity, known as (ii) bequest value. There is also (iii) existence value, which is the value of species as such for human beings. Finally, the value of species in and of themselves apart from human valuation leads to the notion of (iv) intrinsic value.

There are other disturbances to ecology related to human activities in addition to degeneration in biodiversity. Algal-carrying biological toxins are on the increase, along with the appearance of novel toxic species.[40] The increase is related to wash-off nutrients, especially nitrogen, from the land. Three hundred out of the 4,1000 species of phytoplankton produce red tides; about 70 per cent of these are toxic tides that then poison marine species and sometimes people as well. The overall phytoplankton population has declined by up to 30 per cent in Northern oceans since 1980 as a direct result of climate change, or more indirectly through changes in carbon dioxide levels. Changes in ocean temperatures also increase algal blooms. Paralytic shellfish poisoning, linked directly to harmful algal blooms through the food chain, is also on the increase. Rehabilitation of coastal habitat areas, which act like natural filters, is the best preventative strategy.

A thousand major agricultural pests, including 550 insects/mites, 230 plant diseases and 220 weeds, are resistant to pesticides. These changes threaten to lead to a loss in food security. Repeated pesticide over-use encourages the evolution of resistant species. Multiple resistances to pesticides are also soaring, so even a cocktail will not eliminate all pests. Herbicides, antibiotics and fungicides used to control plant disease are also diminishing in their effectiveness. The overall crop loss due to pests has not changed in spite of a tenfold increase in pesticides. Genetically modified crops engineered to produce pesticides throughout the growing season are likely to exacerbate the problem. Data on extent of genetically modified crops showed a 23-fold increase between 1996 and 2000. The bulk of transgenic crops are grown in the USA, Canada and Argentina.[41] Integrated pest management, which uses less pesticides and non-chemical methods such as crop rotations, intercropping and release of beneficial insects, may help to slow down the trend.

Values in ecological science

How might humanity respond to this somewhat gloomy account of escalating environmental problems? One of the core values in ecological science is the challenge to anthropocentrism – that is, the view that humanity is the centre of the universe. Authors such as Anne Primavesi and Mary Midgley have argued that James Lovelock's Gaia hypothesis presents an even deeper challenge to the place of humanity on the earth.[42] Lovelock's hypothesis addresses the interaction between the sum of living organisms on the planet, known as the biota, and global geochemistry. In its strongest version, Lovelock's hypothesis argues for the homeostatic regulation of the earth's atmosphere by the biota in order to keep environmental conditions constant.[43] The values implicit in this hypothesis are more commonly interpreted in terms of cooperation and symbiosis. Yet, it is equally possible to interpret Gaia's theory along more Darwinian lines, which includes the idea that those species that are the most influential in setting the environmental state become the most dominant. In

this respect Lovelock's Gaia hypothesis is rather more ambiguous as a guide for ethics than some of its proponents allow. In so far as it raises the importance of cooperation and symbiosis, it can serve the function of reminding humanity of the varied ways in which species relate to each other – competition, in other words, is not the only or last word that might be said from an ecological perspective.

Alongside a paradigm of interrelatedness and cooperation, there is an equally strong notion of 'balance' that has served ecology for many years. Of course, it is a disputed point as to what extent the idea of the 'balance of nature' arose from ecological science; more likely it was already embedded in cultural assumptions about the natural world, and ecology just reinforced this notion.[44] This idea of balance continues to dominate the discourse among many contemporary Christian theologians, who find it congenial in relation to the concept of connectivity and community expressed in idealised terms, and serving as a pointer towards ethical conduct.[45] Yet ecologists themselves in their current practice are less attuned to this notion now compared with the past. Instead, the notion of flux, unstable equilibrium, openness to external influences, disturbance from internal and external forces, including humanity, is much more to the foreground of the way ecologists perceive their tasks.[46] This shift illustrates the difficulties of using ecological science as a basis for values, for as further research is conducted, other values appear that undermine the original notions. Ideas related to balance include integrity, which fits in well with the notion of balance, and serves to inform some ethical positions.

The concept of balance cannot be dispensed with altogether, since just as Newtonian mechanics proved accurate at the broadest level, but was eventually supplemented by Einstein's ideas, so too the concept of ecological balance can persist at the crudest level, even if flux is a more accurate description of what actually happens. Balance is also crucial in consideration of broad global processes such as climate change, but here too, research shows that such balances are subject to disturbance, often anthropogenic in origin. The concept of ecosystems being in fragile balance, subject to disturbance, is important to *inform* the way humanity thinks about ethical conduct in relation to the environment – that is, we need to be aware that this is the case, but it should not become paradigmatic as a *value term* for ethical behaviour. Why not? I am reluctant to adopt a strong philosophy of naturalism – that is, deriving how we *ought* to behave from the way things are. This is not the same as saying we can ignore ecological science; rather, such aspects of the way ecology *is* serve to help us interpret how to treat the environment even if, to some extent, this knowledge is always provisional. If flux became a value, this would lead to chaos, and shows how inappropriate it is to derive or read off values from the natural world. There need, in other words, to be other reasons why humanity has decided that balance serves the common good, and reflects the goodness of creation understood as God's gift, rather than being derived as such from ecological science.

A case might be made for ecological wisdom, arising out of a perceived sense of the interrelationships and integrity of biological nature. In one sense natural wisdom exists, arising from the way creatures are so marvellously attuned to their environment and converge into particular patterns during the course of evolution.[47] The meaning of wisdom is itself elusive. Wisdom as a particularly human capacity is, according to Jeffrey Schloss, that ability to critique culture in the light of human evolutionary history. He suggests that 'Wisdom is living in a way that corresponds to how things are.'[48] The way things are could helpfully include ecological insights and knowledge. Wisdom, then, would be living in accordance with our knowledge of such sciences, but in such a way that gave meaning to existence.

Wonder, like wisdom, is also a virtue, or a particular habit of mind, that is common to many of the sciences, including ecology. Wonder among ecologists largely springs from the marvellous fecundity and diversity of life on this planet, in spite of multiple extinctions that threaten this diversity. Edward O. Wilson contends that humans possess an innate tendency to focus on life and life-like processes – a tendency he calls *biophilia*.[49] He argues that modern biology is a genuinely new way of looking at the world that happens to be in tune with this tendency. It is through such a search that he believes we can discover the core of wonder, due to the rich abundance of life.[50] Wilson wonders at biological facts, such as the fact that a handful of soil is home to hundreds of insects, nematode worms and other larger creatures, alongside a million fungi and ten billion bacteria. Other amazing facts include the genetic information required for one particular insect – if printed as standard-size letters, would stretch over a thousand miles. He is aware, as are many other biologists, that 90 per cent of species are not even named, and species are disappearing faster than they can be identified. Amidst a tropical rainforest, the sheer diversity of life is such that there are literally thousands of undiscovered species, with the number of discoveries per investigator greater than anywhere else in the world.

Wilson tries to argue for uniting the natural sciences and the humanities.[51] He intends the humanities to be absorbed by the sciences and reconfigured through the latter's knowledge. He does the cause of biology a disservice in using rhetorical devices such as the language of conquest and imperialism, which imply an underlying arrogance on his part in favour of biological knowledge. This imperialising tendency is opposed to the very wonder that he is trying to foster among fledgling ecologists. One of the reasons why he may have thought that this strategy would work is that it appeals to both group instincts and inter-group hostility, as according to him territorial expansion is 'an epigenetic rule'.[52] The fact that his strategy failed shows that there are values in human nature that do not conform to his model of human values. Instead, the project of uniting natural sciences and the humanities becomes more relevant when each is allowed to contribute to the overall discussion. Environmental problems are too complex to be the prerogative of one field of

study, even if the scientific study of ecology is highly relevant to such discussions.

Rachel Carson, a biologist writing in the era before E. O. Wilson developed his sociobiology, argued passionately for the wondrous appreciation of the natural world.[53] However, this appreciation did not lead her to announce the tyranny of biology over other forms of knowledge in the manner of Wilson's rhetoric; rather, it came from a more fundamental anxiety about what might happen to the world if humans continued to despoil the environment. Although Wilson used the language of wonder to express his forays in natural history, he appealed to baser aspects of human nature as a basis for environmental protection. The natural world was valuable for its instrumental use to humans, so that it could be viewed as an untapped source of new pharmaceuticals, crops, fibres, and so on. Carson believed that the despoliation of nature was not in humanity's best interest.[54] She believed that wonder is a prelude for care for the earth, and in this her views are directly contradictory to those of Wilson. For example, she claimed that 'The more clearly we focus our attention on the wonders and realities of the world about us, the less taste we shall have for destruction', and 'A child's world is fresh and new and beautiful, full of wonder and excitement. It is to our misfortune that for most of us that clear eyed vision, that true instinct for what is beautiful and awe inspiring is dimmed and even lost when we reach adulthood.'[55] It is unlikely that she was advocating a return to childhood in a way that is detached from science, for where such romanticism means a total rejection of science it fails to convince. Carson was hinting at something profound about wondering, for it allows us to pay attention to what is, and in this sense comes closer to the religious instinct in wonder that Wilson only partially expressed. Wonder includes a sense of the aesthetic, an acknowledgement of what might loosely be termed 'beauty', but it also allows for recognition of what, to us, would be an awareness of horror, the dark side of creaturely being.[56] The capacity for wonder does, I suggest, go a step further than a simple awareness of creatureliness – humans understood as contingently embedded in a network of relationships, that Michael Northcott has correctly identified as being essential in order to counter more destructive attitudes to the environment.[57] For Christian believers both a sense of creatureliness and wonder are related to an understanding of God as Creator, but this is to anticipate theological discussion that will follow in later chapters.

Conclusions

The story of environmental damage outlined in this chapter shows the complexity of the issues involved, even using a few illustrative examples. While population issues do need to be addressed, it is more important to address the lifestyles of the existing populations in order to begin to contain some of the more negative effects of human activity on the environment.

Inequality in distribution of resources, alongside over-consumption by richer nations of the world, contribute to depletion of energy reserves, water shortages, pollutant damage, health impacts and biodiversity loss. International cooperation is called for in order to address what might be called the tragedy of the commons, shared resources that are then abused, as no nation feels directly responsible. Human activities contribute to climate change that then adds to problems created by direct effects of pollution and energy shortages. In particular, those countries of the world that contribute relatively little to greenhouse gases suffer the worst impact, with the prospect of environmental refugees looming in low-lying areas and islands likely to be subject to flooding due to rising sea levels, or other areas exposed to climate extremes and soil erosion. While climate scientists have called for a greater degree of equity in calculating allowable pollution rates per person, there is little sign of a real desire by nations to make the necessary changes. Ecological science has contributed significantly to our knowledge of biodiversity and its loss due to anthropogenic activities, both due to direct exploitation and indirect loss of habitat and introduced species. Ecological science offers a reminder that ecological systems are fragile and subject to disturbance, including disturbance by humans. Humanity, in other words, is an integral aspect of the ecology of an area, though the global impact of humans is far greater than other species.

Are there values implicit in ecology that might be helpful in addressing some of the environmental problems that have become more pressing with each generation? Viewing the earth as a whole system through the Gaia hypothesis has been inspirational for some authors. Others point to the feeling of wonder possible through the study of the natural world in all its diversity and complexity. Such wondrous appreciation can be a prelude to more responsible behaviour. In addition, the cooperative integrity of living things points to a kind of ecological wisdom, though of course in making this suggestion we need to bear in mind other features of evolutionary history, 'red in tooth and claw', that appear less attractive. Human wisdom, in particular, can mean living in tune with the way things are in the sense of not undermining the very basis for biodiversity, understood in ecological and well as evolutionary terms. Such a discussion lends itself to theological analysis, for it points to the issue that environmental problems are not simply about scientific discoveries of what those problems might be, but also the underlying crisis of values in the human community.

Yet before we trace some of the different religious responses to such crisis, it is important to spell out more clearly than we have so far some of the global trends in economics which seem to have paralysed human political will to change in line with the suggestions presented above. In addition, one of the main reasons for the growth in biotechnology has been economic gain, and it illustrates how such direct human intervention in genetics can further the ecological impacts that are already in place through the widespread use of industrialised agriculture. The arguments in favour of such technology are

often couched in terms of the requirement for food, but more often than not, the economics might suggest alternative motivations. The following chapter deals with economic issues and environmental justice in order to set the scene for the alternative theological positions that follow.

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