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The Two Cultures Revisited: Environmental History and the Environmental Sciences

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SUMMARY

The gap between the sciences and the humanities persists in our intellectual life, with significant consequences. The new field of environmental history represents an opportunity to bridge that gap, since it requires historians to become more conversant with the environmental sciences and apply their insights to the study of the past. I give examples of where that conversation has been helpful in rewriting history. However, the scientists are in need of the historians and humanists more than they commonly acknowledge. Environmental problems have their source in human culture, and to solve those problems we need the insights of the humanities.

In 1959 the English physicist and novelist, C. P. Snow, described modern academic life as divided into ‘two cultures’, the literary intellectuals and the scientists. ‘Between the two’, he wrote, lies ‘a gulf of mutual incomprehension.... They have a curious distorted image of each other. Their attitudes are so different that, even on the level of emotion, they can’t find much common ground.’¹ The literary intellectuals appeared to him as pessimists about the human condition, turning their back on their times and seeking refuge in the individual self or in the distant past. The scientists, on the other hand, appeared to be shallow optimists, indifferent to books and tradition yet cosseted by those in power. We might not describe the two cultures in precisely those same terms today – there are, for example, a lot of pessimistic scientists around these days – but the cultural split that Snow perceived more than thirty years ago seems still to be a fact of intellectual life in many parts of the world. And standing on the humanities side of the gulf are not only the literary intellectuals but also historians like myself, warily eyeing the scientists and envying their money.

Snow believed that the two cultures needed to find a common ground, and he proposed one: understanding and developing the world’s poor nations, who

already in 1959 were falling farther and farther behind the rich nations. I believe that something like that solution has in fact become reality, as scientists, both theoretical and applied, natural and social, have discovered global poverty – have paid a lot more attention to the disparities of wealth, the stimulation of technical innovation, and the need for modern training and education among the poorer nations; and as historians and humanists have expanded their view to take in people of colour, have tried to address the ethical challenges of racism, classism, and sexism, and have come to see the value of cultural traditions that lie outside the northern hemisphere. Obviously, we have not eliminated the gap between the rich and poor, have not even succeeded in narrowing it in many parts of the world – a very discouraging result. But in a more positive light, we have made progress in understanding the world's social problems and have done so together, just as Snow hoped we would.

Now in this last decade of the century, which some have begun to call the environmental decade, we have an opportunity to discover new common ground between the two cultures. The opportunity comes from the world's environmental crisis, which stretches from the polluted waters of the industrial countries to the banks of the Amazon, the Nile, and the Mekong. The crisis consists of two parts, the first and more serious of which is the impending death of millions of species of plants and animals and of thousands of ecosystems, reversing the achievements of aeons of evolution. Part two is the growing threat to the security of human cultures, as virtually every society is now facing the question of how long it can sustain itself in a degraded and depleted environment. I rank their importance thus because it is easier to invent new technologies, new social organisations and institutions, or new values than new species or ecosystems; nonetheless, I acknowledge that the demise of old ways of life may be very hard on people who cannot adapt.

Scientists, historians, indeed scholars from all the academic disciplines, are beginning to come together in response to this crisis and open doorways through the walls of specialisation that divide us. We are doing this not merely for our intellectual enlightenment, or for the advancement of careers, but also for a moral reason – the good of the earth and all its inhabitants.

This concern, however, has a long, long way to go before it becomes general and before we have truly brought the two cultures together. Many of my fellow historians, for example, continue to throw up walls around their work and try to live undisturbed by world events. Despite thirty or forty years of public discussion of global environmental issues, only a few American history textbooks try to remind students of the environmental context of our national development: of the thick green pineries, for example, that once stretched from Maine to Minnesota, where Americans cut the lumber to build millions of balloon-frame houses in Boston, Detroit, Chicago, St. Louis, and Kansas City. Generally, the textbooks fail to convey even a hint of the lively, vital interaction with the land – with all its organisms and microorganisms, with such natural

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resources as soil and water – that has gone on through time. Thus, the account of American history that students usually encounter remains a lot like deodorised, fluorescent-lit, saran-wrapped supermarkets, where one can push a cart up and down the aisles every week and never be stimulated to think about the ultimate source of the milk or bread on which our politics, our heroes and villains, our social order, even (perhaps most particularly) our economic life, has fed. We commonly tell a story of the past that encourages irresponsibility in the present.

This continuing indifference, this irresponsibility, can be blamed in part on the urbanisation of modern life, which has put so much distance between people and the land. But another important source, I believe, lies in the way we organise our academic life. Historians have not been *expected* to deal with nature or even with the imaginations of roving outdoor painters, the politics of environmentalism, or the changing models of natural science. Somewhere, it seems, a great lawgiver has inscribed on a tablet of stone that water cycles, deforestation, animal populations, soil nutrient gains and losses are reserved for Science, while History must confine itself to tariffs, diplomatic negotiation, union-management conflict, race and gender. Science is supposed to deal with Nature; the scientists even have a journal proclaiming that fact in its title. History, on the other hand, must deal with People, Society, and Culture.

Nobody is quite sure which great lawgiver decreed this division of the world, though one leading suspect is René Descartes, who in the mid-seventeenth century announced that the world is divided into two opposing forces, mind versus matter, the consequence of the announcement being that scientists took up the study of matter, leaving mind to the humanists. Others have pointed to the much older argument between Democritus and Lucretius, on the one hand, and Plato on the other, over the primacy of mind or matter in the order of things. And some would argue we must go back even before the rise of dualistic western civilisation to some deeper human tendency to divide the world into binary oppositions.² Whatever the origins of the split, we still suffer today from a rigid set of categories that set us apart from one another in the academy. Nature is set apart from culture. The material order is set apart from the spiritual. The realm of objective data is strictly demarcated from the realm of subjectivity, feeling, and value. This division has worked to balkanise our various university departments and academic professions, our intellectual loyalties, and even our scholarly languages. I cannot adequately express the enormous damage that this balkanisation has done not only to our intellectual and moral life but also to the natural world.

But we can open a small doorway through the wall, the doorway of environmental history, whose essential purpose is to put nature back into historical studies, or, defined more elaborately, to explore the ways in which the biophysical world has influenced the course of human history and the ways in which people have thought about their natural surroundings. Students of environmental history include both scientists and historians, all looking for some

common ground in this new field but probably all aware of how much will always divide us in our research.

In the United States environmental history has been, over the past two decades, essentially a study of the conservation of nature, both as idea and practice, or of the failure of conservation, and of the relationship of conservation to other ideas like development, laissez-faire economics, and private property. More recently, the field has broadened to include the reorganisation of nature that has been going on for a long time and is now accelerating everywhere. The first line of inquiry has not required environmental historians to create any new methodology; for the study of conservation historians have been able to use their traditional skills in interpreting documents, analysing the history of ideas, politics, and economics in the same old, familiar ways though with new questions in mind. But when we begin to move into that second area, the history of the reorganisation of nature, we find ourselves needing help from scientists. They become essential allies, an intellectual circle we must penetrate and understand. So environmental historians have begun reading books and papers written by scientists in ecology, physical geography, soil chemistry, climatology, plant genetics, parasitology, reproductive biology, and groundwater hydrology. In one recent work by a historian I found references to the following scientific journals: *Annual Review of Ecology and Systematics*, *Science*, *BioScience*, *Canadian Journal of Fisheries and Aquatic Science*, and the *Proceedings of the California Academy of Science*.³ Apparently, to do environmental history really well, one must have some familiarity with, if not advanced training in, more scientific fields than many scientists would venture to acquire. That requirement may be daunting to an historian who once thought he had a rather simple art to master, except for those foreign language exams, but now discovers he needs to know how to analyze, for instance, the record of atmospheric methane concentration based on measurements of air trapped in an ice core from Antarctica.⁴

A new door has begun to open, but where does it lead? It leads, I think, to a picture of the human past that is unlike anything you will find in the standard history books. It leads to a past wider in scope than any of our national territories, taking in whole continents, even the earth itself, to a past older than the American constitution, or the Magna Carta, or even the Pyramids, as old as the species itself, and yet as new as the automobile or aerosol sprays or the greenhouse effect.

Before sketching some of that new picture I want to acknowledge another, more basic kind of help that scientists have given the field of environmental history. In the most fundamental sense the field would not exist were it not for the moral leadership of many scientists, who have been in the forefront of discovering that we are in a state of crisis with the natural world, a discovery that began, at least in the United States, with the publication of Rachel Carson's *Silent Spring* in 1962, followed by the warnings of scientists like Paul Ehrlich, Barry Commoner, and others.

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In the new picture of history we are beginning to reconceive the past as a series of ecological interchanges that have gone on between human communities and their surroundings – the material, real world of objects that we have not invented but that constantly impinge on our cultural life. As Lewis Mumford once wrote, ‘all thinking worthy of the name must now be ecological, in the sense of appreciating and utilising organic complexity, and in adapting every kind of change to the requirements not of man alone, or of any single generation, but of all his organic partners and every part of his habitat’.⁵ I like to think that that is precisely the point of the new environmental history, ‘thinking that is worthy of the name’, thinking that places people in their full organic complexity and teaches responsibility toward all our partners on the earth.

Besides learning a broad ecological point of view, environment historians, with the aid of scientists, have begun to see the past as deeply influenced by the history of climate change. Only in the last few years have we assembled reasonably complete data on historic temperatures and rainfall for many parts of the world, so that we now know, for example, that, between 1550 and 1700, temperatures in western Europe were unusually cold and the climate was very unstable, bringing on a crisis of subsistence, the long-term social and economic effects of which we still do not fully understand.⁶ Historians have begun to look at new data on China also and to ask what may have been the relationship of rainfall and drought cycles to the rise and expansion of the Central Asian steppe peoples.⁷ Other recent evidence suggests the hand of climate in the declining fortunes of the Mayan civilisation of Central America. And going much farther back in time, we have new reason to think that agriculture, which involves turning wild annual grasses into domesticated cereals, may have begun in the southern Levant 12,000 years ago under the simultaneous pressure of drought, high temperatures, overpopulation, and overexploitation of natural resources.⁸ This study of past climates depends on scientific methods, but it is no longer exclusively a scientist’s concern.

Environmental historians have also learned the importance of the scarcity or abundance of natural resources, especially energy resources, in the making and unmaking of societies. It has been scientists and engineers who can take credit for reminding us of those resources and of the profound social consequences that may follow when they begin to run low. The first great energy crisis in history was not the one caused by the 1973 oil embargo but rather the much earlier one caused by the depletion of forests, and it occurred not once but many times and in many places. There was an energy crisis forming in England by the 16th century, forcing the English to turn to dirty, smelly coal to keep from freezing through the winter; any sensible Englishman would have preferred an oak log on the grate to a shovelful of coal, but most had little choice in a landscape severely overcut and turned into sheep pasture.⁹ The Chinese likewise depleted their forest reserves and went through an energy squeeze long before OPEC, lasting from 1400 to 1800 AD, during which time they were forced to burn straw and

build with bamboo.¹⁰ The consequences of the transition from wood to the fossil fuels have been more far-reaching than we once realised; they include changes in technology, the organisation of labour, political institutions, and, of course, the quality of the atmosphere and human health. On the positive side, the mining of coal helped realise an affluence that was unprecedented in human experience. By the early 19th century, writes R. P. Sieferle, ‘the whole area of England should have been planted with wood for energy purposes, had there been no coal’. Instead, after opening up their coal mines, the English could devote the rest of their lands to elegant country estates, important food crops, and row upon row of workingmen’s cottages.¹¹

Those cottages for the working class should remind us that with the new affluence came a new kind of environmental degradation, one especially borne by the rising numbers of poor people. Part of that degradation we now call pollution, but it has been around since the advent of modern fossil fuel energy use and mining processes. Nowhere has pollution’s impact been more deadly than in Europe of the last century; for example, in the German city of Freiberg industrial emissions became so bad by the 1840s that ‘not a blade of greening grass’ could be found in the area, and ‘the rooftops were covered with sediment from the poisonous smoke’. Even relatively non-industrial cities like York, England, suffered from the smokestack soot that came streaming in the open windows, ruining furniture and clothing, driving the wealthy to sell their houses at cut-rate prices and to move toward the cleaner air of the countryside.¹² The work of scientists – chemists and others – on contemporary air and water pollution is helping environmental historians understand the social and ecological effects of that past pollution, though it may require the full collaboration of the two cultures to tell us whether the air has gotten better or worse since the beginning of the industrial era.

The impact of technology on the natural environment, we can now see, goes back much farther than Rachel Carson’s target of chlorinated hydrocarbons and other pesticides, even farther back than the industrial cities of Victorian England. Technology has been around as long as humans and has been reorganising nature during that entire span of social evolution. No matter how far back in time we go, it is difficult to determine just where technology began and where it left off in the landscape. For example, thanks to the work of a group of fire ecologists who have been studying the role of fire in ecosystems, we now understand that many of our so-called pristine landscapes, like the tallgrass prairie of North America, were in fact the product of fires burning across the land from time immemorial.

The unresolved, and probably unresolvable, question raised by that discovery is how many of those fires were really set by human beings, either deliberately to manipulate the environment or accidentally, and how many were the work of nature. This is a reorganisation of nature on which hard evidence is often lacking, and interpretations vary from those who see the fiery hand of aboriginal tribes in every landscape and those who are sure that lightning caused

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most fires. In any case, historians have joined scientists in asking questions such as, why is Australia the land of the eucalypts, a plant genus hardened to fire? What role, if any, did the Aborigines, who entered the continent from southeast Asia some 40,000 to 55,000 years ago, play in that ecological dominance? Did the English convicts arriving at Botany Bay in 1788 come into a land, ‘not as God made it’, but ‘as the Aborigines made it’?¹³

I could go on to review the work done by environmental historians on disease and the spread of microorganisms, on demography and human fertility, and on the overseas ecological impact of the European conquest; and I could review their work on the changing landscape of the Finnish forest, the Gangetic plain, the Mediterranean basin, and so on. But the point is simply this: the natural sciences, particularly environmentally-oriented sciences like ecology and climatology, have opened to historians a vast new agenda of research, with enormous relevance to our current global predicament. There are new methodologies to be understood if not always directly employed by historians. Most importantly, science can help historians see beyond the realm of culture and appreciate the significance of those autonomous material forces, processes, and beings that we call nature. Having learned to transcend the realm of human culture, we will see the past in a more complete, realistic light.

However, it would be a mistake to suppose that environmental historians want simply to become the pupils of environmental scientists, or their archival assistants digging up documents to supplement their scientific data. Instead, we historians want to see a convergence of long-divided modes of thought, one that brings about a genuine dialogue and a new openness in all the disciplines. Already, from our brief experience with the conversation that has occurred, historians have concluded that the scientists need to absorb a few lessons and methodological assumptions from us.

In the first place, scientists must acknowledge, as many have begun to do, that the nature they describe in their textbooks often seems unreal and contrived to the historian. Typically, it lacks any connection to human history and all its contingencies, accidents, cycles, ideas and social forces. Too often science seems oblivious to the fact that human beings have been interacting with nature over a very long period of time, at least over two million years – some would say four million years – and that what we mean by nature is, to some extent, a product of history.

That is by no means a new idea, even among scientists, who ever since the 18th century have been slowly becoming historians of a sort. For instance, Georges-Louis Leclerc, the Comte de Buffon, the leading naturalist of pre-Revolutionary France, was historical-minded enough to try to describe the seven great epochs of the earth, beginning with the moment of divine creation and coming down to the present.¹⁴ The geologist James Hutton of Edinburgh, who founded historical geology in the same century, realised that the landscape we see around us has not always looked as it does today but has gone through cycles

of decay and renewal. ‘The earth’, he wrote, ‘like the body of an animal, is wasted at the same time that it is repaired. It has a state of growth and augmentation; it has another state, which is that of diminution and decay. This world is thus destroyed in one part, but it is renewed in another.’¹⁵ Those were important anticipations of the modern historical consciousness, but science had to wait until the next century, when the biologist Charles Darwin came on the scene, to learn to be fundamentally historical in outlook. After *The Origin of Species* appeared in 1859, science became thoroughly historicised, not only in biology but in almost every scientific field, in the sense that natural phenomena came to be studied over time and the so-called laws of nature came to be seen more as historical observations – rather like the observations the social historian makes – than laws that must be obeyed, as Isaac Newton had it. Today, scientists regularly acknowledge that they deal with observations rooted in particular moments, with indeterminate events that may not be repeated, let alone predicted, in the future. Despite all the historicising that has gone on, however, science has tended to remain, until lately, intellectually isolated from the history that people have made on the planet.

Ecosystems, for instance, have been commonly described in the textbooks as self-contained assemblages of plants and animals, evolving over time but in the absence of any people, ignoring the fact that many of the world’s ecosystems have long been the home of people too. Some of those ecosystems have been profoundly, visibly altered by the human presence, while in other places that presence has been far more subtle and hard to discern. If wind has shaped the soil profile of my home landscape of the North American prairie, if bison have influenced its vegetation, if prairie dogs have dug holes all over the place, then humans have long been active there too. Historians want scientists to take more seriously the fact that a human impact on the rest of nature has always been a possibility and that the impact has been increasing exponentially in the modern era, for deep material and cultural reasons, until now it is as big and powerful as the atomic bomb.¹⁶

In the second place, historians expect scientists to acknowledge that their ideas of nature, even their most complex theoretical ideas, seemingly so immune to the pressures of daily life, are products to some extent of the cultures in which they appear. Ideas of nature have a history, one linked inextricably to the history of culture, whether economic, aesthetic, or political. We cannot isolate our perception of nature into one division called ‘science’ and into other divisions called literature, the arts, religion, or philosophy, for they all float along together in a single flow of ideas and perceptions. Moreover, I doubt that there are any truly profound methodological differences between the two cultures in apprehending nature; both profess to follow the same rules of reason, tolerance, critical thought, fairmindedness, and consensus, rules that are far more important than any special tools or methods of gathering data.

Historians, like scientists, are acutely aware that the professional papers they read in the scientific journals have dates on them, but may react to those dates differently. For scientists the dates seem to be an index to truth: the more recent the date, the more truthful the paper. For historians, on the other hand, the dates do not necessarily appear that way. We want to make the date itself a subject of analysis. What did an ecologist, writing in, say, 1920, see in nature, and how was his or her experience different from that of an ecologist writing in 1990? Did it matter that the former ecologist may have been an American writing in the aftermath of World War One, that he may have voted for Warren G. Harding for President, that he may have lived in Nebraska rather than southern France, that he looked at the landscape through the windshield of a Model T rather than from a covered wagon? Historians are trained to look for personal biography in every idea, no matter how scientifically objective it is supposed to be, and to look for the influence of contemporary opinion on the rise and fall of scientific theories. Granted that the present generation of scientists work hard to give us a more reliable account of nature than their predecessors, historians nonetheless find the ideas of other eras intrinsically interesting, often as interesting as those of our own day, and for all we know, they are as valid in their way.

Words like ecosystem, niche, competitive exclusion, biomass, energy flow, plate tectonics, chaos are all just that – words – and must be appreciated as such. We may hope they indicate facts, but we can only be absolutely sure that they are words, and as words they are only representations of facts. That in itself is a point worth pausing over in the dialogue of the two cultures. Every science that the environmental historian approaches presents him or her with a language, and that language is filled, like all of the world's languages, with metaphors, figures of speech, hidden structures of meaning, even world views – in short, it is filled with culture. The environmental historian wants to learn that language, no matter how strange it may seem at first, and use it to improve his understanding of the human past. But as a historian, trained in the modes of thought common to the humanities, where language itself is an important object of analysis, he must insist that the words of the scientist not go unexamined. They are themselves worthy of attention as expressions of culture, as expressions of ethical beliefs. We cannot take science out of its culture, out of the realm of meaning, value, and ethics.

In the third place, environmental historians would argue that scientists need them to answer a very big question that the latter have done much to raise to public consciousness but have no special methodology or expertise to answer: Why are we in a state of crisis with the global environment? Scientists have described that crisis with impressive precision, measuring, for instance, where the carbon is generated that is causing the greenhouse effect and learning how to track its flow from one hemisphere to the other and to make somewhat better predictions of its effects on temperatures and rainfall at the regional level. They

can pinpoint with amazing detail the sources of that carbon in the tailpipes and smokestacks of the industrialised, automobilised societies. But having done all that, the scientists still cannot tell us *why* we have those societies, or where they came from, or what the moral forces are that have made them. They cannot explain why cattle ranchers are cutting down and burning the Brazilian rain forest, or why the Brazilian government has been ineffective in stopping them. They cannot explain why we humans will push tens of millions of species toward extinction over the next twenty years, nor why that prospect of ecological holocaust still seems irrelevant to most of the world's leaders. They cannot explain why the Eastern European nations have such serious pollution problems, or why some western economists believe so fervently that market incentives alone will solve every problem. All those 'why' questions are rooted in culture. I emphasise the point not to denigrate the achievements of scientists, but only to remind us that natural science cannot by itself fathom the sources of the crisis it has identified, for the sources lie not in the nature that scientists study but in the *human nature* and, especially, in the *human culture* that historians and other humanists have made their study.

We are facing a global crisis today, not because of how ecosystems function in a state of nature but rather how our ethical systems function. Getting through the crisis requires understanding our reorganisation of nature as precisely as possible, but even more, it requires understanding those ethical systems that have directed the reorganisation and using that understanding to reform them. Historians, along with literary scholars, anthropologists, and philosophers, cannot do the reforming, of course, but they can help with understanding the causes.

In the view of this historian, the most important causes lie not in any particular technology of production or health care – the advent of medical inoculations, for example, or better ploughs and crops, or the steam engine, or the coal industry, all of which were outcomes more than causes – but rather in modern culture itself, in its worldview that has swept aside much that went before it in values and perceptions. We can call this modern culture by a simple name – the world view of *materialism* – but must try to think about it as a very complex phenomenon, one made up of many parts, economic and scientific, so intertwined and interdependent that even now historians have not fully probed their intellectual linkage. The shift in world view toward materialism was as important a cultural turn as the one that occurred in what Karl Jaspers has called the 'Axial Period' of human history, the 5th and 6th centuries BC, when so many of the world's great religious and philosophical systems first appeared – Confucianism, Buddhism, the pre-Socratics in Greece, the Old Testament prophets.¹⁷ I see this new world view – 'post-Axial' we might call it – taking over western Europe in the 17th and the 18th century AD, after a long spawning period, and manifesting itself in the many so-called 'revolutions' that comprise modernity, including the Scientific, the Industrial, the Capitalist, all of which were only surface manifestations of a more fundamental change in thinking .

Thus at the very centre of environmental history must stand the study of evolving world views, a study at least as important as investigating the reorganisation of the landscape that has occurred. For that study in the history of ideas we emphatically need the humanities and all their expertise, their methods, their traditions.

So we are opening a door in the wall that separates nature from culture, science from history, matter from mind. Where we are arriving is not at some point where all academic distinctions or boundaries disappear, where the categories of nature and culture have been completely abolished or subsumed, but one where those boundaries are more permeable than before. Nature has become less easy to isolate from culture than we once thought, and vice-versa. The two realms are linked together in an endless loop of exchanges, interactions, and meanings, so that they keep collapsing into one another. We try to make them distinct, and sometimes for good reason: we need to try to step outside of culture regularly and acknowledge, as Henry Thoreau once put it, ‘our own limits transgressed’. On the other hand, we have to realise that what we mean by nature is inescapably a mirror held up by culture to its environment, a mirror reflecting itself. This is a paradox we humans cannot get out of. The door we open between the two cultures is finally a passage to that unresolvable paradox.

We live in a material world, and nature is the largest, most complex, more wonderful part of that materiality. As an environmental historian, I want to bring that material world to the attention of my colleagues, whether they are studying the rise and fall of prices, the policies of kings and prime ministers, or the causes of war. That material world of nature, I want them to see, has a rational order, a structure that is at least partially intelligible, and a history of its own. We historians of every sort need to grant the significance of that autonomous nature and to respect its discordant harmonies, its intricate evolution.

But we cannot then fall back on a simple materialism as an explanation for why societies have behaved as they have. The human communities of the past have not been merely the products of climate, or soil, or disease, or ecosystems, or of an abundance or scarcity of natural resources. They have also been the products of ideas, dreams, and ethical systems. And it is those latter, distinctly cultural forces that explain how and why we humans have so often in the past, and almost everywhere today, gotten so badly out of sync with the rest of nature.

NOTES

¹ C.P. Snow, *The Two Cultures and the Scientific Revolution* (New York: Cambridge University Press, 1963; orig. given as Rede Lectures in 1959), pp. 4-5.

² On this nature-vs-culture split I have profited from reading Neil L. Jamieson and George W. Lovelace, ‘Cultural Values and Human Ecology: Some Initial Considerations’, in *Cultural Values and Human Ecology in Southeast Asia*, ed. Karl L. Hutterer, A. Terry Rambo, and George Lovelace, Center for South and Southeast Asian Studies, University

of Michigan, No. 27 (Ann Arbor: University of Michigan Press, 1985), pp. 27-54; and Alice E. Ingerson, 'Some Practical Effects and Radical Uses of the Nature/Culture Dichotomy' (unpublished essay).

³ See Arthur F. McEvoy, *The Fisherman's Problem: Ecology and Law in the California Fisheries 1850-1980* (New York: Cambridge University Press, 1986).

⁴ See, for example, F.E. Graedel and P.J. Crutzen, 'Atmospheric Trace Constituents', in *The Earth As Transformed by Human Action*, ed. B.L. Turner II et al. (Cambridge: Cambridge University Press, 1990), pp. 300-301.

⁵ Lewis Mumford, *The Pentagon of Power* (New York: Harcourt, Brace, Jovanovich, 1970), p. 393.

⁶ Andrew B. Appleby, 'Epidemics and Famine in the Little Ice Age', *Climate and History: Studies in Interdisciplinary History*, ed. Robert I. Rotberg and Theodore K. Rabb (Princeton, N.J.: Princeton University Press, 1981), pp. 63-84; Jean M. Grove, *The Little Ice Age* (London: Methuen 1988). The pioneering studies in this area were H. H. Lamb, *Climate: Present Past and Future* (London: Methuen, 1972), and Emmanuel Le Roy Ladurie, *Times of Feast. Times of Famine: A History of Climate since the Year 1000*, trans. Barbara Bray (London: Allen and Unwin, 1972).

⁷ See L. N. Gumilev, *Searches for an Imaginary Kingdom: The Legend of the Kingdom of Prester John*, trans. R. E. Smith (Cambridge: Cambridge University Press, 1988).

⁸ Joy McCriston and Frank Hole, 'The Ecology of Seasonal Stress and the Origins of Agriculture in the Near East', *American Anthropology*, 93 (March 1991): 46-69.

⁹ John U. Nef, 'An Early Energy Crisis and Its Consequences', *Scientific American*, 237 (1977): 140-151; Richard Wilkinson, *Poverty and Progress: An Ecological Perspective on Economic Development* (New York: Praeger, 1973), Chap. 4; I. G. Simmons, *Changing the Face of the Earth: Culture, Environment, History* (Oxford: Basil Blackwell, 1989), 296-306.

¹⁰ Vaclav Smil, *The Bad Earth: Environmental Degradation in China* (New York: Sharpe, 1984), section 2.

¹¹ R. P. Sieferle, 'The Energy System – A Basic Concept of Environmental History', in *The Silent Countdown: Essays in European Environmental History*, ed. P. Brimblecombe and C. Pfister (Berlin and Heidelberg: Springer-Verlag, 1990), pp. 14-15.

¹² E. Schramm, 'Experts in the Smelter Smoke Debate', in Brimblecombe and Pfister, p. 197; P. Brimblecombe and C. Bowler, 'Air Pollution in York, 1850-1900', *ibid.*, p. 183.

¹³ See, for instance, Stephen J. Pyne, *Burning Bush: A Fire History of Australia* (New York: Henry Holt, 1991). The quotation is from page 82.

¹⁴ Buffon, 'Des Epoques de la Nature' (1779), in *Oeuvres completes de Buffon* (Paris: Pourrat Freres, 1838), Vol. I, pp. 479-569.

¹⁵ James Hutton, *Theory of the Earth* (Edinburgh: Cadell, Davie, Creech, 1795), Vol. II, p. 562.

¹⁶ An ecologist who has begun to study the landscape as influenced by human history is Norman Christensen of Duke University. See his essay, 'Landscape History and Ecological Change', *Journal of Forest History*, 33 (July 1989): 116-125.

¹⁷ Karl Jaspers, *The Origin and Goal of History* (New Haven, Conn.: Yale University Press, 1959), pp. 1-21. According to Jaspers, the Axial Period was a nearly simultaneous spiritual flowering occurring in three widely separated centres – China, India, and the West – in which rationality replaced primitive mythology, speculative philosophy appeared for the first time, and religion took on an ethical content.