ENVIRONMENTAL JUSTICE
DISCOURSES IN INTERNATIONAL POLITICAL ECONOMY

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Chapter 11

The Production of Unequal Nature

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Introduction

Nature is reacting to the activities of modern society in unique and largely unexpected ways. The spread of acidified rain to every continent, a worldwide decline of forested lands, and the ubiquitous presence of persistent organic pollutants due to industrial experiments in biochemistry suggest that the contemporary nature-society relation includes phenomena unlike any that were previously known in human, or geological, history. These reactions are surprising since human impacts on nature have traditionally been ascribed a minor role in determining the course of ecological change. While humanity has long discarded its wastes in nature, the "predominant view in the natural sciences was that life on Earth is primarily passive, responding to nonliving forces like volcanic eruptions, severe storms, droughts, and even drifting continents" (Schneider, 1990: 6).

This conception of passivity is under increasing challenge, but until recently, physical and biological debates about global change presumed its validity (Price, 1989). Accordingly, modernity can be characterized as the era guided by an ecological theory of nature's inexhaustibility at the broad scale, and certainly for those processes necessary to sustain overall human expectations. Such an understanding has fostered the belief that human reason is a superior instrument for the design of nature compared to the 'passive' forces of physical and biological change. In essence, modernity asserts that society can 'know' nature and apply that knowledge to shape a better future. Human progress, in this view, is identical with and dependent on the mastery of nature. Hence, in a landmark work of modernist environmental consciousness, the problem was framed thus (Ward and Dubos, 1972: 1):

> Man inhabits two worlds. One is the natural world of plants and animals, of soils and air and waters which precede him by billions of years and of which he is a part. The other is the world of social institutions and artifacts he builds for himself, using his tools and engines, his science and his dreams to fashion an environment obedient to human purpose and direction.

Breaking with this orthodoxy, a growing number of scientists have begun to doubt the adequacy of the modernist thesis. A prominent example is the reconceptualization of climate change now underway in which science bodies assert that the cumulative effects of human activity are overwhelming natural processes that until very recently were responsible for variation in climate (see e.g., IPCC 1990, 1996a, and 2000). But even in this instance, discussion of the social and political organization of nature is strangely absent. Thus, the case of global warming is commonly debated in terms of nature-society interactions expressed almost exclusively in units of carbon (or other chemicals), with the aim of establishing a natural limit on carbon releases that humanity should not exceed.

The nexus of society and nature cannot be captured by studying the chemical content of industrial emissions alone. Indeed, the social content—the political economy—of this nexus is likely to be key to unraveling the sources of, and responses to, global change. Perhaps the most difficult challenge is to consider whether nature is undergoing a process of social capture which eventually may make it in effect a social sub-system subject to political attitudes and ideologies, and a functioning part of the world political economy. It is readily admitted that modernist ideals of progress endanger indigenous cultures throughout the world. Mounting evidence suggests that the same argument now needs to be applied to ecosystems. Although the present society-nature regime is only about 300 years old (dating to the spread of a coal-based energy regime, steam technology, wage labor and capitalist political economy), it has reached a level of sophistication which may render its operations a threat to several million years of climate and biological, as well as social, evolution.

A clear implication of rejecting modernist premises of natural passivity and society-nature autonomy is that physical and biological phenomena must be reconceived as outcomes, to some degree of political-economic, as well as ecological, processes. One needed theoretical addition, in this vein, would be an explanation of nature as a medium of social advantage and disadvantage. In other words, while observations of environmental injustice are hardly new (consider, for example, Engel's accounts of the Irish working class in Manchester (Engels, 1993 [1845]), the slave trade of European nations, or conditions in colonial primary production), the concept of unequal nature as a contemporary invention of political economy needs systematic explanation. In effect, this would mean the pursuit of an explanation of modernization as a pattern of concomitant, 'co-produced' (O'Connor, 1994a) social and ecological change with a distinctive distribution of effects on and in the natural and social worlds. Together, these changes and effects can be understood as creating the levels of justice and injustice that are found in modernized ecology and society. Pursuing this theoretical strategy promises an explanation of the evolution of unequal nature that is ecologically, as well as sociologically, informed. Below we offer our initial efforts in this direction.

Social Structure and Nature

Three hundred years of industrialization have rendered social and ecological relations[i] largely commodity-based. Human existence transpires within a reality of production and consumption of commodities which together release into the air and water and deposit on plants and the soil pollutants more numerous than we know and, certainly, more complex in their effects than we understand. This reality is structured and motivated by the logics of technology and capital; environmental consequences are, at best, a residual concern. We depend for our lives and our experience of life upon a collective capacity to produce goods and services and upon individual capacities to obtain and consume goods and services, as though nature was incidental to the human drama. As Mumford (1970) argued, society has become a 'megamachine' with its members existing as so many machine parts. In the technological milieu, natural experience has all but evaporated except as a reproduction or 'sign' (Barthes, 1972) that romanticizes the natural world as variously a pastoral retreat, a pristine, pre-human order of life, or a wild, primordial state (see, e.g., Merchant, 1980; and Borgmann, 1993).

In a world where adverse environmental and social consequences of industrial production and consumption are considered as unavoidable events along the way to modernity, dirty skies and the dirty lungs of society's members elicit little concern other than the need to fashion or strengthen regimes of management and treatment. Conceived in this context, much of social theory concerns itself with the travails and clean up ('remediation') of the mess of modern life. Few efforts are made to develop social analyses which can both characterize the commodification process and challenge its hegemony over social and ecological relations. Even several of the more comprehensive social frameworks conceive only the possibility of social activities which degrade the environment. Structural transformation of the environment is presumed to be beyond the reach of social influence. Theories of political economy by and large regard the 'laws of nature' as operating literally beyond the 'laws of social motion' (as Karl Marx termed them).

This is not to say that the analytic boundary between society and nature assumed in most social theory precludes significant impacts as a result of their interaction. But efforts to conceive the difference between nature-society relations and putatively social ones (especially, political and economic relations) typically embody an assumption of a duality of structures. For example, it is possible to develop a structural analysis of social activities producing pollution: social behaviors can be conceived as structurally organized to continuously disrupt or degrade environmental quality; and changes in social structure can be shown as necessary to remedy the pattern of polluting behavior. Mainstream analysis, though, leaves intact the distinction between society and nature as separate phenomenal structures.

Natural inquiry in its most general form likewise observes an analytic boundary between the two spheres. The influence of human beings on natural operations, and vice versa, is recognized in the paradigms of biology, chemistry, and physics. But again, the architectures of social and natural order are understood as maintained by relations and rules that are distinct to each sphere. In this respect, much of natural inquiry, like its social counterpart, operates on a premise of dual realities—one social and one natural.

Guided by the dual-realities premise, social theory presumes that virtually anything can be socially practiced and repeated with the principal environmental consequence being a natural disturbance or degradation of environmental quality. To speak about environmental 'spillover effects,' 'externalities,' and 'social costs,' it is essential to the very logic of the language in which these ideas are conceived that one can reliably believe in the natural reservoir as, in effect, bottomless; and that the problems of environmental disruption or degradation, eventually, can be internalized within the social structure. Accordingly, the natural world is bestowed with a resolute capacity for reproduction by individual species, life forms, and ecosystem processes. Their self-perpetuation then is counted upon in the social sphere to provide the range of resources that humanity can acquire and transform to meet its needs. Nature, we assume, takes care of itself in the manner that it takes care of human needs. This does not preclude social catastrophe—the starvation of large populations, the spread of epidemics, annihilation of societies, or even the human species—but, ultimately, such disasters are confined to the social sphere. The permanence of nature is not obviated or negated by human calamity.

The natural point of view is similarly predicated on nature's analytic permanence. Only with this characteristic can nature provide the grounds, literally, for validation/falsification of the supposed rules and laws of natural order, the epistemological centerpiece of this mode of inquiry. We cannot think about natural order within the reigning paradigms of science without, at the very least, assuming a distinct order for nature. It is the ability of science to uncover 'laws' that places it atop the hierarchy of human knowledge. Indeed, for most practitioners of natural inquiry, a hierarchy of orders is implied between the natural and the social, with the former setting, broadly, the conditions and constraints for actions in the latter, a so-called ecology of order.

However, a range of environmental issues, such as the depletion of stratospheric ozone, climate change, and other phenomena traceable to the changing chemical composition of the earth's atmosphere, point to the difficulties, to say the least, of maintaining the assumption of a dual reality—one natural and one social—at the structural level. For our purposes, the most important scenario for the breakdown of the dual reality thesis is that a 'commodification' process[ii] has functionally spread to the architecture of nature itself. In this possibility, the potential for social activity to affect its own context is thought to be great enough to redesign nature. This potential is in part an outgrowth or legacy of social behaviors under the structural guidance of industrial capital; and in part a result of the achievements of certain scientific and technological insights. Under this scenario, the forces of technology and capital are not limited to acts of natural disturbance or degradation. Rather, the very structure of nature is subjected to the design principles of these social forces. In the design of nature through science, technology and political economy, the fuller meaning of environmental and ecological injustice is also to be found.

A contrast exists between decisions guided by capital and technology to endanger the health of workers and whole communities by pollution practices at various industrial sites (which enhance profit, market position, etc.) and the collected practices of technological societies which *in toto* valorize a particular atmospheric chemistry (specifically, one richer in CO_2). The difference is fundamental. In the former case, a social structure—technological society—guides behaviors which adversely impact nature at the behavioral level: air, water, and human tissue are poisoned to some degree. But the natural order, which produces air, water, and living matter, is not itself altered; the effect of the pollution is too small to restructure nature; and the force of technolization and capitalization are too specific in their goals to alter natural order. In the latter, social structure threatens to cause a different natural order to evolve. This interpretation conceives commodification as having breached the nature-society duality and is now encroaching on the structural organization of nature itself. This prospect lies beyond the theoretically possible for social and physical analysis as presently organized. Apparently, however, it is not outside the reality of contemporary nature-society relations.

A similar contrast is identifiable with respect to issues of justice, environment, and society. In one instance, the environment is used as a weapon against those devalued by capital and the state—the shipment of toxic wastes generated in the U.S. to Africa is a poignant example of environmental injustice. But in another instance, ecological and social forms are threatened with elimination in the interest of a 'capitalized nature' (Escobar, 1996; and O'Connor, 1994b). The sacrifice of indigenous communities and ecologies for so-called ecological modernization comes to mind here. Explaining injustice in the latter sense and effectively challenging an era of capitalized nature will necessarily require theories that drop the pretense of nature-society duality. A reconceived theory of commodification offers one pathway to explain environmental justice/injustice without the dualism presumed by many current arguments.

Three Phases of Commodification

Three phases of the commodification process and its evolution to the capitalization of nature can be identified. As we conceive them, these phases represent a process of increased 'co-dependency' in nature-society relations (O'Connor, 1994a). The reach and range of commodification embedded in these relations successively expands and manifests an accretive quality in its evolution. But there are also transformative elements that alter the structures of nature-society relations themselves.

We do not intend in this analysis to suggest that one era 'rationally' supercedes the previous. Nor do we believe that one era dramatically ends a prior one. Instead, we argue that a common core of relations and transformations can be detected across the three periods of order and change. These occur *together* and constitute the whole of modernist nature-society relations and explain the realities of justice/injustice in those relations.

Normal Pollution

In his comprehensive examination of global urban industrial growth, Lewis Mumford argued that modern society had simultaneously lost all semblance of balance with the natural order while reducing the focus of human life to the mere production of things (Mumford, 1934, 1961). With the Industrial Revolution, an alliance of science, capitalism, and carbon power reorganized social order on the pervasive principle of *quantification* (Mumford, 1961: 570):

> Quantitative production has become, for our mass-minded contemporaries, the only imperative goal: they value quantification without qualification. In physical energy, in industrial productivity, in invention, in knowledge, in population the same vacuous expansions and explosions prevail.

The new social order produced goods at an unparalleled rate and magnitude, but also pollution of a type and scale hitherto unknown (Mumford, 1934: 168-169):

> In this [industrial] world the realities were money, prices, capital, shares: the environment itself, like most of human existence, was treated as an abstraction. Air and sunlight, because of their deplorable lack of value in exchange, had no reality at all . . . the reek of coal was the very incense of the new industrialism. A clear sky in an industrial district was the sign of a strike or a lock-out or an industrial depression.

The nature and content of what Mumford called the 'atmospheric sewage' of modern industry changed in the 20th century, but the chain of energy combustion-to-environmental degradation was not altered. The alliance of science and technology, the power complex, and the industrial economy ushered in a social order in which pollution was a functional element of human progress. In effect, pollution was "normalized."

Lasting into this century, the phase of *normal pollution* is distinguished by its rationalization of nature as alternately a resource mine and a bottomless sewer into which the afterthought of industrial production can be deposited. The industrial degradation of nature, of course, does not exempt human life from the damage. Indeed, industrial tolerance for pollution has presupposed that human suffering is a necessary part of the equation.

As the air was fouled with technological and economic advance, 20th century cities were afflicted with the worst pollution. Circulating through an industrially manufactured cloud of chemical waste, urban air worldwide exacted the price of modern existence—life threatened by the involuntary, heretofore life-giving, act of breathing. Chronic bronchial, lung, circulatory and heart problems were and are the special mark of industrial civilization.

When the industrial elites worried at all about pollution or social health, it was to assure that popular efforts to address these problems were kept strictly local and posed no threat to profit-making. In this objective they were assisted by the 'new thinking' of economics which abstracted environmental abuse from the workings of the production regime, assigning it the residual status of an 'externality' (Marshall, 1946 [1890]; and Pigou, 1924). In this treatment, those who profited from pollution or threatened human health were exempted from responsibility for cleaning up; society as a whole was to bear the burdens of progress. Policy and law followed the 'analytic' view of the economists, giving institutional permission for the waters, land, air, and the human body to be used as dumps.

Environmental costs of production and wealth creation were considered, when considered at all, in the aggregate and not the particular. Accordingly, pollution became a 'social cost,' implying that the burden was collective, as were the benefits. Nothing could be more misleading; the costs and benefits of pollution were sharply and equivocally divided within society and between societies from the onset of industrialization to the present day. Arguably, the tendencies of early capitalism described by Mumford (and others), have become the habits of mature capitalism under the strategies of globalization.

Economics provided a *post hoc* rationale for the acceptance of unequal nature in parallel with unequal society. The distribution of the spoils of industry to the rich and the spoiled landscapes to the poor was justified by the circular assertion of productivity: those who accumulated the most wealth were able to do so because their services to society were highly valued; the poor deserved poverty because they had little to offer of value. That nature conspired in this rewards-for-productivity scheme seemed logical to economists: the wealthy could afford the princely rent of clean air, as though nature was organized to provide its 'services' to the highest bidder.

By leaving industry unfettered in its operations, overall economic gains would be optimized, economists averred, and through the realization of national economic growth, all would eventually benefit. Raw materials and resources for the industrialized world came increasingly to be drawn from the European colonies in the New World and poorer independent states during the era, while capitalism's productivity rationale was extended to these trading partners. Trading inevitably boosted the economic performance of some parties, although there was obviously great differentiation in those benefits within and between participant nations. Polluting capitalism was both an historical era and a development stage. As a result, many of the hallmarks of the era remain in the contemporary world and are spreading to societies on the eve of their being 'modernized.' Using trade to globalize the model, Western nations have been able to reduce their risks and discomfort from polluting capitalism through the displacement of many industrial practices to the developing world.

Essentially this has created a dualism within the industrial regime. Spurred on by the search for lowest cost, and most profitable, production, industrialization has predictably meant locating the most harmful activities in the poorest communities and nations. Lawrence Summers' infamous proposition (while employed by the World Bank) about poor nations being under-polluted (Foster, 1993), exemplifies exactly the economic rationale for shifting pollution away from the rich. Such social engineering through economic rationality formed the antecedent to globalization and its quest to organize a world wherein development choices are primarily dictated by global profitability.

The legitimation of pollution and disease, while defining facets of the first era of commodification, must be understood within the broader historical context. The target of capitalist development in the 19th and 20th centuries was the transformation of all social activities into commodities to be valorized in markets and exchanged for cash. Labor, leisure, sexuality, emotion and, above all, the human experience of time were stripped of their intimacy and personality, and reconstituted as anonymous units of market value. The reduction of nature to a supplier of resources and a repository of wastes was an instrumental component of the commodification process; but exploitation (of humanity and nature) was the driving force of the period.

The resulting class division of industrial society *and* nature set in motion forces of inequality that privileged certain lives and landscapes and denied or marginalized others. While many analyses of the period dwell on the social dimensions of injustice, a smaller number discuss the environmental implications, and only a few realize the intimate relation between the two, Mumford representing this last group. His depiction of worker-river injustice brilliantly captures his insight in this regard.

> Nothing seems more characteristic of [Manchester] . . . than the river Irwell, which runs through the place . . . The hapless river—a pretty enough stream a few miles up, with trees overhanging its bank and fringes of green sedge set thick along its edges—loses caste as it gets among the mills and print works. There are myriads of dirty things given it to wash, and whole wagonloads of poisons from dye houses and bleachyards thrown into it to carry away; steam boilers discharge into it their seething contents, and drains and sewers their fetid impurities; till at length it rolls on—here between tall dingy walls, there under precipices of red sandstone—considerably less a river than a flood of liquid manure (Mumford, 1934: 459-460).

From upstream communities of wealth, a healthy Irwell descended into industrial districts where low-cost production through low-wage labor re-defined the river, and the communities and factories housed alongside it, as 'working class.' The nexus of social and environmental injustice could not have been clearer. Capital's hegemony and labor's alienation were expressed not only in social relations, but ecological ones as well. A half-century after Mumford's landmark analysis, Crosby (1988) has documented the international scale of the class division of lives and landscapes (and species) that occurred with the imperial thrust of capitalism. The "demographic takeover" of the Americas and Oceania by Europeans recorded capitalism's social *and* environmental aims. Steward cultures that had sustained life for millennia were attacked and, in some cases, enslaved, in capital's pursuit of advantage. Equally important, biological warfare waged by European invaders, sometimes inadvertently and at other times by design, released pests and pathogens that Europeanized ecologies in the same degree that military and economic contests Europeanized human populations.

Technological Authoritarianism

The first era of commodification left Western society transformed, non-Western society under economic siege, and many ecosystems polluted and infested with the species and landscape preferences of capitalist elites. But a second era emerged during the 20th century that advocates claimed would right the social and ecological wrongs of polluting capitalism. Scientific knowledge and technological organization would increasingly make it possible to divorce human activity from its past and travel along a new course. In the new era, society's needs could be designed in cooperation with nature and with a socially more equitable order. Old constraints on progress that had led to the failures of the first era of commodification were to vanish.

Why should anyone expect that the injustices of social and environmental commodification, which had permeated the first era of modernization, could be corrected by *deepening* the commitment to modernity? For modernization's believers, the answer was (and is) clear: the source of progress lay in the advance of scientific and technical knowledge. Modernity's first era had preempted civilizational success by yielding too much authority to the institutions of polluting capitalism and settling for a regime that simply exploited labor and nature with the tools of modern thinking (e.g., Bell, 1967; and Drucker, 1993). It was promised that the displacement of capital with science and technology as the guiding forces of society would realize a new era of cornucopian, yet egalitarian, modernity. Humanity's impact on nature would be considerably softened as societies replaced the first era's legacy of pollution with an intelligent ideology of nature conservation and management. At least for those confident that science and technology could be progressive rulers of modernity, the new era was anticipated to quiet social fears of inequality, end class antagonisms, and bring to a swift conclusion the unfortunate chapter of polluting capitalism.

Certainly, the Global North[iii] has experienced some of the triumphal effects promised for the new era. A string of intellectual revolutions has brought about an extended period of scientific and technological breakthroughs that have meant much longer lives and the eradication of major diseases for elite communities (and, in some cases, for non-elites as well). Suddenly, the length of human life—if you are wealthy—seems less dependent on fate than the advance of scientific knowledge. With the appearance of exceptionally productive crops and crop management strategies, and the invention of hybrid varieties that could grow food almost anywhere, minding nature has lost its compellingness. Human sustenance is no longer a matter of soil and water, but of chemistry and biology (and the wealth to afford their implementation). The spread of digital, wireless networks has enabled much greater and faster volumes of interaction, while computers have made calculation ubiquitous. Together these innovations have supplanted materiality with the limitlessness of post-material virtuality. A 'space of flows' has dissolved the traditional 'space of places' (Castells, 1984, 1996) and time is no longer rooted in experience but in the far more ‘precise’ atomic measure of its meaning. A radical transformation of the relation between idea and reality has resulted from these ‘revolutions’ as well as the fundamental progress made recently in the understanding of energy-matter and the genome. For many in the sciences and engineering, human intelligence has been elevated by the advance of knowledge to a determinant, rather than simply an inquirer, of phenomena. Indeed, the frequency and depth of change realized in the new era has led many in the Global North to believe that scientific and technological revolution is now the *privilege* of being modern.

But the dream-state of ‘knowledge society’ can mask only for a time the existence of another phenomenon that accompanies achievement of breakthrough science and technology—the catastrophic environmental risks that are ineluctably embedded in the world built on our genius.

For example, a state-of-the-art oil derrick erected in the 1960s off the coast of Santa Barbara, California was able to drill for its product to depths of 3,500 feet while balancing pressures of nearly 600 pounds per square inch—a feat that would have been unthinkable until extraordinary achievements in materials science (and other branches of knowledge) that had occurred by the mid-20th century. But in January 1969, when tolerances of the piping material were exceeded, the drilling column burst and an eruption of 1.3 million gallons of oil sent a ‘black tide’ ashore, sliming more than 800 square miles of coastline. The toll on wildlife was substantial: 6,000 to 15,000 birds died as a result of the blowout, as well as 74 elephant seals and five whales (Easton, 1972: 257-261). Seepage from seabed fissures caused by the blowout continues 30 years after the event. While politically important for the U.S., the Santa Barbara ‘spill’ no longer qualifies as a major event in the cavalcade of modern oil spill spectaculars (Oil Spill Intelligence Report, 2001). This is because the Santa Barbara catastrophe stimulated improvements in oil extraction technology that increased safety—and risk. Now, platforms balance much higher pressures and drill in far more ‘challenging’ areas (e.g., the North Sea). And when mistakes occur, the consequences are much greater.

A second environmental warning on March 23, 1989 suggests how greatly the scale of damage has escalated. On that date, the Exxon Valdez oil tanker hit a reef in the Alaskan Prince William Sound and spilled nearly 10 million gallons of crude. The oil spread to five National Wildlife Refuges and three National Parks, covering an area of 900 square miles.

Again, hundreds of miles of shoreline were washed with a black tide. The estimate of bird kills was 100,000, including 150 bald eagles. Approximately 1,000 sea otters were also lost. Debris from the clean up of the oil spill was in excess of 50,000 tons. Importantly, the Exxon Valdez represented one of the most sophisticated ships in the world fleet at the time of the accident. Steered by a massive computer system and complex software, the enormous ship could not sail without scientific data. That 'pilot error' played a role in the accident misses the larger point: a vessel of that size would not have attempted to navigate off the section of the Alaskan coast where it crashed unless modern science had created the possibility.

Oil spills are only one category of environmental catastrophe experienced as part of the normal operations of the 'knowledge society.' For example, there is the ubiquitous destruction of forests and lakes as part of modernity's outdoor experiments in chemistry. Unlike the earlier era's penchant for dumping its wastes in streams, rivers, and lakes, and clear-cutting forests, the manufacture of 'acid rain' is a thoroughly modern technique for fouling these ecosystems.

The important elements of acid deposition—sulfur dioxide and, to a lesser degree, nitrogen oxides—are deposited in the atmosphere where they are transformed chemically and then fall to earth as acidic rain, snow, fog or dry particles. Damage to aquatic resources, estuaries and coastal waters, timber and recreational resources, buildings, monuments and statues, and public health are the result.

In many respects, this form of pollution repeats the practice of polluting capitalism in which environmental degradation is treated as a normal activity. The acid belt in China's heartland (Smil, 1993) is a testament to the triumph of industrial development and the ubiquity of modern technology in transforming what was the world's largest agricultural civilization into yet another concrete jungle. Socialist principles ushered forward this change with no less vigor than the capitalist ones that engineered European and North American industrialism. In this respect, even the contest of socialist and capitalist states over the aims, direction, and structure of society—which had dominated the first era—does not override the tendency to produce acid rain. Science and technology reach beyond the era of polluting capitalism to commodify nature and society in a distinctly new way.

In the U.S. and Europe, acid rain is produced not simply to bolster short-term business profits. Rather, it is the result of a practical strategy informed by scientific studies of wind mechanics, soil science and chemistry. When concerns about polluting capitalism began to take the form of national regulation of industrial activity (e.g., with the passage of so called 'clean air' and 'clean water' laws setting volumetric standards for the amount of pollution that could be released), science and technology were called upon to solve the problem. Industrial locations would now be assessed scientifically for environmental impact, and 'scrubbing' equipment, tall smokestacks, and other technologies would be added to factory 'tailpipes,' and chemicals would be injected in industrial processes in order to disperse and dilute pollution from traditionally 'dirty' industries.

But in the reform of polluting capitalism, acid rain *became* an outcome. While dispersing sulfur pollution, for example, tall smokestacks also allow transport of the pollutant higher into airsheds which, in turn, facilitates its mixing with water vapor for transport to wider geographical areas. Similarly, chemical treatment of industrial processes introduces new emittants that can interact with water vapor and promote acidification. In this way, chemical change of rain, fog, and snow can actually be traced to efforts to use science for the purpose of reducing old-fashioned pollution. The result is a new pollution regime with a scale of damage that is distinctive to our technological civilization. Large swaths of the Canada-U.S. border, the U.S. Midwest and East, Germany's Ruhr Valley, and eastern Russia are infected with this new disease created from the exercise of human intelligence. Only modernist political economies could manufacture continental and transcontinental acid pollution as a product of environmental management. While not a failure of a spectacular technological kind (like oil spills), acid rain in the Global North nevertheless derives from technological progress and is itself a stimulus for remediation by still more sophisticated technological means. In this respect, our social and natural futures are revealed in the case of acid rain as increasingly contingent upon the result of scientific and technological trial and error.

A prominent symbol of modern environmental pollution—Love Canal, a residential development in New York State close to Niagara Falls—offers a further lesson on our scientific and technological dependence. Between the early 1940s and early 1950s, some 21,800 tons of liquid and solid chemical waste were buried in an abandoned canal project, together with municipal waste from the city of Niagara Falls. Owned and operated by Hooker Chemical, the site was sold to the local board of education, which built a school there in 1954. Despite knowledge that the site was contaminated, between 1966 and 1972 the area also became the location for residential development.

After a few years of occupation, residents began to complain of odors and other problems. Subsequent chemical analysis revealed that highly toxic chemicals from the waste had contaminated groundwater sources and migrated to the surface of the area's soils. However, there was considerable resistance by officials to take action and accept responsibility for the problem. Instrumental in bringing the issue to local and national prominence was the activity of a local group of concerned residents (Gibbs, 1982). Their efforts to have the extent of the health impacts researched were frustrated by officials, but investigations eventually revealed exceptional rates of miscarriage, birth defects, and epilepsy in the community living atop the chemical (and municipal) refuse dump. Finally, a federal emergency was declared and owners of over 1,000 houses were ordered to abandon them. The canal was capped and subsequently some $250 million was spent on relocation and remediation efforts.

The saga of Love Canal commanded special attention precisely because it was so ordinary that it could be repeated everywhere—and it was. By the 1980s, it was learned that modern development transpires within a reality of ever-present invention and use of chemicals, and their disposal, in ways which threaten lives and ecologies as a normal part of its operations. The least powerful in society had been and would continue to be the 'lab mice' for the societal experiment in modern development (Lee, 1987). Repair of this situation could not include a cessation in the use of these substances—such action would be tantamount to trying to repeal progress, since toxic chemicals are in everything and found almost everywhere in modern life. Instead, social confidence in expert management of chemicals was favored as national legislation enlisted scientists and engineers to assume permanent responsibility for 'societal risk assessment and mitigation.' In fact, Love Canal reveals just how dependent modern society had become on science and technology, not only for products, but also for the investigatory powers necessary to discover and affect its impacts. The irony of technological risk and the 'normal accident' could not have been more transparent, thanks to Love Canal: to diagnose the problem of risk and accidents, activists turned to science and technology; to reduce risks and restore society and the environment in the wake of accidents, government and industry turned to science and technology; yet, the greater use of science and technology will bring new risks and accidents … that only science and technology can understand and act upon.

Initially, the risks and damage evident in the Santa Barbara and Valdez catastrophes, the acid rain debacle, and the Love Canal disaster (and its imitated conditions throughout modern societies) might have been seen as episodes of excessive confidence in the progressive capacities of the new era. But as the essential features of these environmentally and socially calamitous events have proliferated, it has become increasingly difficult to treat them as isolated cases. For those who doubted the globality of the phenomenon, the evidence of pervasive risk was undeniable after yet another display of advanced knowledge gone awry.

The manufacture of methyl isocyanate is a distinctly modern enterprise. Its use to manage pests as part of a high-yield cropping regime has assisted the globalization of scientific agriculture. Production of this chemical compound depends upon a sophisticated industrial scheme that required the invention of advanced technology and breakthroughs in agro-chemistry. Only an organization with the most modern research and development infrastructure could have commercialized pest management of the kind offered with methyl isocyanate; and only a large, multinational company could afford its manufacturing requirements and organize its production regardless of geographic location.

A plant built by Union Carbide experienced a leak on December 3, 1984 in a large storage tank. The interaction of methyl isocyanate with the night air produced a toxic gas that drifted over shantytowns in Bhopal, India. By morning, there were more than 3,500 deaths and in the coming months, over 150,000 injuries caused by the 'leak' would be recorded, many permanently disabling. The awful sacrifice of human life at Bhopal to profit an 'advanced' industry is inexcusable. Yet, modernity necessarily excuses it. Such an 'accident' can now occur on any continent on any day because the technology linked with the Bhopal factory is so widespread. However, it would not have been possible in India before the 1970s and could not have happened without scientific and engineering progress earlier in the 20th century. And the prevention of a 'Bhopal-like' disaster also rests with scientific and engineering progress.

One further insult, in 1986, left only true believers to champion the new era as necessarily progressive. The origins of this catastrophe lay in the use of one of the iconic achievements of the era—the discovery of the atomic structure of matter. From the outset, even some in the scientific and engineering communities worried about the implications of our new knowledge and of the institutional machinery evolving to assure its permanent expansion. With the knowledge of nuclear fission, the human race was seen to have acquired the permanent capacity to destroy the basis of life on earth (Schell, 1982). This capacity renders obsolete 'nature' as we have traditionally known it. No society can escape the threat of nuclear annihilation, but must depend upon the mutual decisions of the community of nations to forego use of certain applications of atomic knowledge. A parallel condition of dependency upon social decisions/actions exists for the natural order as well, all of which became evident in 1986.

In early April of that year, *The Economist* (1986), citing the latest probability studies and in-depth engineering analyses, declared to its worldwide readership that a nuclear power plant is "as safe as a chocolate factory." A few days later, the lid blew off the No. 4 Reactor at the Chernobyl nuclear power complex. A cloud of radioactive debris swept across Europe and eventually circled the Northern Hemisphere. An estimated 300 million people in 15 nations experienced elevated radiation levels as a result of the explosion. Locally, 130,000 then-Soviet citizens were evacuated within a 30-mile radius of the site. An area within a 10-mile radius of the reactors became a 'dead zone' where nothing grows; nor can anything be allowed to grow because the radioactive soil could transfer its toxicity up the food chain (e.g., via bird transit to and from the site). The World Health Organization monitored at-risk populations for a decade and found that: 600,000 persons had suffered significantly increased levels of radiation exposure in the months after the 'accident;' 238 Ukrainian residents and emergency workers had contracted acute radiation syndrome (which is often fatal) and 31 individuals had lost their lives because of the explosion; and childhood thyroid cancers were eight-fold higher in the region after the Chernobyl blast (Medvedev, 1991; WHO, 1995; and Yamashita and Shibata, 1996).

Of course, the startling dilemma is that a nuclear power plant that suffers *no accidents* and is successfully retired after 40 years of operation has absorbed enough radioactivity in all of its equipment and building structure to require the entire site's designation as a highly toxic waste dump. The plant, with the spent fuel accumulated during the plant's operation, poses a far worse biological and human risk than the Chernobyl disaster unless contact with all living things is prevented for 10,000 to 100,000 years. Obviously, nuclear risk is like nothing that previously existed in human history (Byrne and Hoffman, 1996). Curiously, only our most sophisticated science—the physics of energy-matter, could produce the knowledge that informed the engineering that designed the Chernobyl reactor (and 212 similar and different reactors operating around the world).

Santa Barbara, Prince William Sound, transnational acid rain, Love Canal, Bhopal, and Chernobyl exemplify an environmental geography of accidents that are tragic but normal. They represent what is necessary to maintain the whir of modernity. Catastrophes such as these may be exceptional in the scale of their potential ecological and societal consequences, but in all other regards they represent what is routinely risked while in the embrace of science- and technology-driven progress. Only the vigilance of experts can be expected to protect society from technological risk and the omnipresent catastrophic accident. When management by expertise fails, the illusion of an autonomous social order is revealed. Unfortunately, in the face of such revelations we have all too often redoubled our efforts to create even more compelling illusions with pronouncements of new fail-proof management and technology innovations.

Thus, in the second era we arrive at a curious point where only advanced knowledge is regarded as capable of protecting the natural and social order from destruction. Yet, the source of destructive threats is traceable to the exercise of the very same expertise. The continued spread of modern technology will necessarily increase the frequency of accidents, and the stockpile of long-lived, toxic wastes, bringing into sharp focus the hegemony of commodity values over life-affirming ones. Notwithstanding the escalation of catastrophic risk and destructive potential, the momentum of modernity hinges upon continuation of a Faustian gamble that our firm conviction in scientific objectivity is more right than believing the contrary but supposedly 'temporary' evidence of the arrogance of that conviction. Of course, society could go without oil retrieved from beneath the sea; it could reduce electricity consumption; it could close all nuclear facilities and adopt a sustainable development path; it could preclude use of toxic chemicals.

But such choices would mean repudiating the very quantification ideology which undergirds modern ideals of progress. Leaders of our 'knowledge society' know instinctively of the dangers of such Luddite thinking. The only acceptable alternative in such a society for meeting its needs is to resort to risky advances. In this respect, modern society increasingly struggles with itself: it is a captive of the environmental problems that it is uniquely capable in all of social history of creating; and likewise a captive of the technological solutions which, once employed, invariably breed new, more difficult social and environmental problems.

Beck (1992, 1995, and 1997) has impressively described the contradiction. He contends that one of the major functions of the state in modernity is to respond to the hazards and dangers generated and perceived by society, by insuring the ongoing production of the risk information and assessment expertise necessary to promise the public that solutions on its benefit will be discovered.

Technological requirements are paramount in the modern order. Human existence has been broken into endless acts of commodity production and consumption which in turn depend for their accomplishment upon networks of technology. In an explicit sense, society is governed by technological institutions that create and manage the conditions of human experience. Nature is reduced in this phase to a technical problem. An authoritarianism of technique prevails in the social and, increasingly, natural spheres. To realize progress in this era, decisions about technology-society-nature relations are removed from spheres of democratic activity and considered instead in the domains of science and economics.

In the new era, nature and its evolution is no longer phenomenally independent of the evolution of human knowledge. Nature is now imbued with knowledge—and the escalating risks that only advancing knowledge can create. Thus, to Lyotard's observation that knowledge is a "force of production" (Lyotard, 1984), there must now be added the recognition that it is likewise a 'force of nature.' In essence, nature has a "social structure" that is expanding with the advance of the knowledge society (Byrne et al, 1991). Justice or its violation, in the new era, is a property of nature, as well as society. In particular, nature and society now evolve together based on an institutionalized condition of unequal risk that reflects the unequal interests of advanced knowledge both in its creation (e.g., in the problems that are selected as meriting attention of the leading knowledge 'producers' such as universities and government and corporate laboratories) and its use (e.g., the services it does, and does not provide). But when management and design errors unexpectedly surface, faultlines in the premise of life outside nature are starkly revealed.

The construct of environmental injustice operating in the globalized technological milieu socially and geographically maps the logic of the era. The least powerful are endangered because structuring risk differently would impede progress. The social order continues to rely on class, gender, race, and culture to decide its victims, but environmental injustice spreads in the second era to encompass not only material conditions, but knowledge structures which manage modern life. Endangering communities and ecologies generally is normalized as the fate of modern life—a necessity regardless of its implications for justice. An ideal of 'efficient' risk is sought in which the problems of communities and ecologies are allowed to stimulate scientific and technological interest in a 'just' solution—so only long as it is cost-effective and objectively based. Ellul pointedly summarized the matter: "Efficiency is a fact; justice is a slogan" in the modern era (1964).

Living in the Anthropocene

Crutzen and Stoermer (2000) have proposed a new geological era—the Anthropocene—in recognition of the fact that human activity has transformed the path of Earth's history. Human activity has altered surface conditions of the planet at the landscape scale, has disturbed biophysical processes and conditions at the global scale, constitutes a major evolutionary factor determining global biodiversity, and is creating new life forms through genetic modification. Crutzen and Stoermer suggest that the new era began in the latter part of the 18th century when geology first manifested a macro-scale imprint of our presence.

We would like to borrow their suggestion for a different purpose. Seen from the perspective of commodification (as developed here), until very recently the human imprint was confined to the geography of nature-society relations. Specific areas and discrete social and ecological systems were exploited and/or risked by modernity. However, a third phase of commodification may now be conceived in which all of nature has become available to human ends. A crucial attribute of this phase is that the 'total reach' of human impact is now recognizable, at least among members of expert sections of knowledge society. Empowered by this recognition, projects in knowledge society anticipate an ability to *embody* nature as a whole in human knowledge. From genetic modification to global ecological management, the Global North aspires to realize nature as a system organized and managed by human intelligence.

Nature will no longer be merely exploited for its particular attributes or its evolution risked in the name of progress. Rather, the possibility is being investigated of its transformation entirely from a phenomenal order to a value vector that meets the needs and interests of technological civilization. As a result, the future cannot resemble the past—nature, social relations with nature, knowledge of nature, and the purpose of social action must assume new meanings.

In this idea of an Anthropocene, human use and understanding of the natural world may no longer be based on natural ecosystems that are distinct from social ones. Nature routinely bears the imprint of human influence and the phenomenon of nature 'beyond influence,' in essence, cannot finally exist. Not only is nature denied autonomous standing and development, but its future becomes dependent upon social direction. Such an anthropomorphized nature presents humanity with 'decisions' to select which species and ecosystem attributes are to survive human influence—it is, some argue, our choice to leave aspects of nature 'as is' or to valorize them in some other way.

In this respect, nature broadly contains two modern forms of value: one that is reflected in its direct use as a commodity—its production/consumption value; and one that represents its capital value, both as a source of reproduction of ecological services and as a source of knowledge. In the Anthropocene, these values compete (Escobar, 1996) and social institutions decide the proportion of 'as is' and modified nature.

As in the previous era of commodification, scientific knowledge and technical organization provide the foundations for diagnosis of and response to environmental problems. However, living in the Anthropocene will differ from the past in significant respects.

There is the obvious matter of scale: in this era, environmental management extends to the limits of the natural order—from the genetic to the global. Furthermore, the design of social systems can be expected to evolve to 'efficiently' exploit natural resources and systems for the normal functioning of the global industrial system, while also seeking to transform the deleterious ecological effects of this activity into forms that can be managed. Hence, the advent of 'natural capitalism' (Hawken et al, 1999) and 'ecological moderization' (Hajer, 1995) can be predicted in which the repair and restitution of a harmed ecology is incorporated into the productive cycle of the global economic system.

As well, commodification will frequently become the key to managing the interaction of natural systems: the most effective means of satisfying planetary management goals is likely to be the assignment of value to all relevant elements, including those of risk, ecological harm, community well-being, ecological services, and so on. In many instances, commodification is now assumed when devising management regimes for such diverse resources as water, seeds, fish, rangelands, and forests. Once ceded to scientific and technological control, the existence of an ecological and social commons vanishes. In anthropomorphized nature, 'as is' nature and modified nature will be co-managed by coordinated social protocols.

From the perspective of this era, ecological justice is a challenge that can be addressed by manipulation of nature and society. It is a value added to the many values managed by the global political economy, global service, and global technology networks. In this system, if a value can be attached to ecological justice, then it can be made part of the machinations of the management process.

No current issue better presages life in the Anthropocene and its implications for ecological justice than anthropocentric climate change. As is now widely known, the combustion of fossil fuels in industrial energy systems has increased the atmospheric concentrations of key gases, including carbon dioxide, methane, and nitrous oxide, resulting in a warming of 0.6^{o}C of the planet over the last century (IPCC, 2001). Indisputably structural in character, the anthropogenically-enhanced greenhouse effect will produce higher global surface temperatures, changes in the patterns of precipitation, and other climatic factors, together with rising sea levels for at least the next few centuries.

Consequently, natural ecosystems will be affected with both the abundance and distribution of indigenous and introduced species altered (IPCC, 1996b), and the prospect of accelerated biodiversity loss assured. Terrestrial aquatic ecosystems will change; as will stream flow and flooding characteristics (IPCC, 1996b). Human systems of resource harvesting in agriculture, forestry, and fishing will experience changes in yield and location of production activities: other industries and activities, such as transport, will be altered (IPCC, 1996b). Human health will respond to climatic changes and be indirectly affected by changes in the distribution and abundance of pathogens (IPCC, 1996b).

Both the production and applications of knowledge about climate change differentiate the contemporary era from its predecessors. Only science at its most global could detect an atmospheric warning about the planet's climate, identify the anthropogenic causes, and speculate on and estimate the range of potential physical, biological, social and economic impacts. Understanding the processes and timing of global climate and its potential impacts is an enterprise of vast intellectual complexity, entailing a broad range of scientific disciplines, computer modeling that is as sophisticated as any yet attempted by humanity, and a virtual army of researchers that rivals in sophistication the one already assembled for military 'research.'

In response to this global environmental issue, an international agreement—the United Nations Framework Convention on Climate Change (FCCC)—was created. Its overall goal is to limit the concentrations of greenhouse gases in the atmosphere so as to prevent a dangerous level of climate change, defined specially as an unpredictable pattern of temperature variation. Under the FCCC, an international protocol (known as the 'Kyoto Protocol') has been negotiated to set a global target for greenhouse gas emissions reduction and to apportion this reduction among participating nations.

Having global ambitions is a characteristic shared by a growing number of international agreements, and in this respect the FCCC is unremarkable. However, in seeking to mange the global energy system that underlies modernization, the FCCC is arguably unique in the scope of its aspirations and likely effects. Two features of the FCCC stand out as signals of life in the Anthropocene; one is the role of science in attempting to understand the global climate system and human effects on it; and a second is the emergence of a global management system for greenhouse gas abatement centered on market-based tools.

Human-caused climate change now appears certain; at stake is the magnitude of change and the rate at which it occurs, which are functions of the historic and future characteristics of greenhouse gas releases. A key output from the scientific process has been the production of a series of global emission scenarios with the resulting levels of atmospheric concentration of greenhouse gases estimated (e.g. IPCC, 1990, 1996a, and 2000). Future generations and the natural environment have already been compromised by greenhouse gas releases to date, making the management of future releases a major determinant of future ecology and human prospects. Such is the character of the social structure that the manufacturing and release of greenhouse gases across the global political economy, and the understanding and management these emissions, is an issue of science-based control with few, if any, precedents. In essence, a virtual reconstruction of the technology-environment-society relation is being contemplated as a 'policy question'—How to convert the atmosphere from a commons, as it existed for all of geological time, to a commodity available for capitalization in the time frames modeled by science and valorized by society?

The outlines of the new regime are evident in recent international negiotations centered on creating markets for managing the sky. Favored strategies include emissions trading, carbon sink investments, and the transfer of emission abatement technology from wealthy nations (where emissions are high) to poor nations (where emissions are low)—all justified under the rubric of economic efficiency. A system of commercial rights of access to atmospheric 'services' is under design (Costanza et al, 1997) with advanced science enlisted to monitor performance.

In the late 1980s, Harvard economist Thomas Schelling reasoned that it might be better for the U.S. to respond to the future impacts of forecasted global warming when they occur, rather than to invest in contemporary measures to reduce greenhouse gas emissions (Schelling, 1989). A decade later, the Chair of the U.S. President's Council of Economic Advisors (CEA) described research that estimated meeting the Kyoto Protocol on greenhouse gas reduction targets would increase each U.S. household's annual energy bill by US$70-110 in 2008-2010 (Yellen, 1998). In spring 2001, a newly elected U.S. President concluded that a precautionary stance similar to that in the 1998 CEA report was too costly and a 'no regrets' strategy—as Schelling's approach is often termed—would be premature. Instead, the U.S. government withdrew from international negotiations, preferring to wait for further scientific proof that global action is needed. All three pronouncements evoked criticism from those alarmed at the apparent readiness of the world's largest national source of greenhouse gas emissions to base social action on the value of 'atmospheric services.' However, modern management justifies evaluations and considerations such as these in order to produce acceptable decisions.

Ecological justice is poorly served by the existing response to climate change. The impacts of modernist progress on climate are likely to disproportionably harm poorer nations and communities and the ecosystems not favored by the wealthy. The failure of the world's wealthiest nations to reduce their greenhouse gas emissions to date is, in this respect, an act of "environmental colonialism" (Agarwal and Narain, 1993). Existing environmental agreements wrangle over 5% reduction targets under the Kyoto Protocol, when 60% reductions are estimated to be needed to stabilize atmospheric concentrations of greenhouse gases (IPCC, 1992 and 1996c). Even here, the intent of the wealthy is to transfer technology—and the burden of change—to the poor in order to meet targets unrelated to ecological sustainability (Byrne et al, 1998; and Byrne and Glover, 2000). Future generations and future ecological conditions will bear the burdens of climate change resulting from present practices, due to the lag effect in the climate system, so that the consequences of current modernization are saddled on those not responsible for their creation.

While the biophysical processes of the atmosphere for millions of years had no design feature producing such unequal consequences, life in the Anthropocene changes this circumstance. Having altered the chemistry of the atmosphere *and* globalized a social system of unequal conditions and unequal risks, the modern order now promises to turn climate into a problem of political economy. The atmosphere needs scientific management, at a minimum, to determine if human-induced changes to its chemistry can alter global temperature. This minimal activity has already engendered a potential triage situation as discussion of significant action is postponed until scientific understanding of such factors as clouds, water vapor, and pollutant aerosols improves. In the meantime, islands are threatened by the early warning signal of sea level rise and continental populations, which are less harmed in the early stages, survey their rational options.

However, the forces of environmental colonialism and triage are simply a prelude of the management project immanent in the Anthropocene. The semiotic conquest (Escobar, 1996) of the sky in the context of efforts to rescue the planet from the consequences of modernization will mean that problems of ecological injustice associated with climate change will *inhabit* the atmosphere in the way that these problems now inhabit urban neighborhoods. Of course, the totality of the atmosphere makes its capture and use in the production of unequal political economy and unequal nature a distinctively new order of commodification; and as far as we can see, the completion of the process of transforming the phenomenal order into a vector of commodity values.

Thus, in the Anthropocene we will be confronted with a form of world political economy in which global warming and other totalizing commodifications are risked in the pursuit of progress. Whereas the initial stages of commodification tested the statics of nature (namely the absorption capacities of land, water, and air), the Anthropocene challenges the dynamics of nature, in particular, the seasons, the tides, the breathing of the planet, and the reproductive cycles of living things.

While the emblems of advancing industrialism remain waste, pollution, and risk, there has been a fundamental breach of the nature-society relation in the Anthropocene. Modern life transpires not simply outside the constraints of nature, but relegates nature to commodity status, to be purchased and sold in the world along with other products and services.

The contemporary world political economy presumes that sustainability is a scientific, technological, and economic matter. Although this presumption is typically manifested in economic terms and thus continues to be most concretely presented in discussions of trade-offs between environmental protection and material progress, its deeper implication is the demise of any idea of the inviolability of nature. There is *nothing* in the modern logic beyond the reach of knowledge and its manipulation: not the climate, not the atmosphere, and not the diversity of species. Nature is stripped altogether of an autonomous status.

The issues of ecological justice that accompany third-era commodification are, literally, inescapable. Ecological justice can only find a place in the Anthropocene by assuming a commodity value itself and becoming part of the emerging management regime. In this way it would join the atmosphere, which is already well underway in its transition from a commons to a commodity, as a mere value, competing with other expressions of value for the right to shape the nature-society relation. The endless contest for the efficient result determines the final meaning of environmental justice.

The transformation of social and ecological existence into a value vector is far from complete. The Athropocene, in our view, is an evolving, not a completed era. Yet, recent experience with the global climate offers a sobering view of the meaning of a world that finally values only commodities.

Conclusion

The scientific revolution and the rise of capitalism initiated the reconceptualization of the relation between society and nature. A new worldview emerged which emphasized rationality, order, and power as the underlying principles of human and natural development. This worldview demystified the physical and biological worlds so that nature could be "construed as ordered systems of mechanical parts subject to predictability through deductive reasoning" (Merchant, 1980: 214). Scientific knowledge about the environment has been achieved through the conceptual "death of nature" and the use of analytic methods predicated on the deconstruction of nature into its constituent parts (Merchant, 1980). In this view, nature is made up of "modular components or discreet parts . . . the parts of matter, like the parts of machines being dead, passive, and inert" (Merchant, 1980: 229).

The emergence of the modern view has led directly to the legitimation of the commodification process and the repudiation of earlier organic visions of the unity of social and natural reality. In contrast to the normative structures of organicism which regarded the exploitation of nature as a violation of life, the modern order treats nature and its exploitation as objective reality; there can be no normative content in nature when "matter is made up of atoms, colors occur by the reflection of light waves of differing lengths, bodies obey the law of inertia, and the sun is the center of the solar system" (Merchant, 1980: 193). With the embrace of modernity, civilization seeks to act without normative constraint. Limits on society's actions are almost exclusively instrumental: economy, efficiency, and scientific validity identify the boundaries of action. It is in this context that contemporary nature-society relations have evolved.

In an initial era of commodification, ecological conditions aligned with wealth; pollution and resource depletion became the habitat of poor families, poor communities, poor regions, and poor nations. Aided by science and technology, industrialization became global in reach, generating risks commensurate with its scale, and a pattern of injustice that was class, race, gender, and culture-focused.

Spawning a second era of commodification, progress necessitated commitments to advancing knowledge and its application, along with the distinctive threats that only modernity could augur. Societies are obliged to place their faith in experts, technocratic systems, and management institutions in the expectation that these offer social and environmental protection. At the same time, catastrophe-scale 'mistakes' are inevitable. Here, justice becomes a technical problem with analysis as the source of 'solution sets.' Those least equipped to 'model' their problems become the 'lab mice' as human intelligence works out management schemes to respond to objectively discovered cases of injustice.

In a third phase of commodification, we embark on a project in which ecological justice is allocated through our manipulation of the structure of nature and society. Interactions between human and natural systems in the era of the Anthropocene will require global management so as to temper the effects of modernization on nature and society. One rationale for the management regime will almost certainly be to shape and control nature to meets the aims of a rhetoric of ecological justice. In this phase, ecological justice becomes a commodity whose value must compete with others for modern attention.

Recognition of the Anthropocene might be regarded as fatalistic. We would agree that, conceptually, the transformation of phenomenal nature to commodified nature signifies a crossing of commodification's final frontier. Moreover, it is evident that powerful institutions of the global regime have an interest in, and potent capabilities for, the pursuit of an Anthropocene. And it is clear that human existence outside earth's atmosphere is technologically plausible.

However, these facts hardly justify the destruction of the basis of life on earth, as all species have ever experienced it. In this respect, rather than being fatalistic, our diagnosis of the Anthropocene offers ideas on how to oppose and prevent its completion. The discourse of ecological justice to which it contributes is necessarily rooted in resistance. Indeed, the viability of the discourse would appear to depend on a successful challenge to the onset of the Anthropocentric "death of nature."

Notes

[1] Social relations refer here to collective relations among human beings; while ecological relations refer to the interaction of humanity with all other forms of life and with the natural order as a whole. Regarding the terms environmental and ecological justice, we follow the approach used by Low and Gleeson (1998) and others. Environmental justice refers specifically to human transformations of nature that institutionalize social disadvantage. Ecological justice is applied more broadly so as to embrace the presence of existing social disadvantage, the interests of future generations, and the intrinsic interests of nature in the present and future. Ecological justice cognizes a commonality of interests between nature and society, thereby reflecting a radical reconceptualization of the human regard of ecology.
[2] The term 'commodification' is used here to refer to a social process by which phenomena (social and natural) are transformed from their intrinsic and autonomous existence into a social, political, and/or economic value. This transformation from phenomeneon to value delivers a thing, person, etc. to to society as a fungible object available for use and exchange.
[3] The phrase "Global North" is used here to refer to urban communities and societies throughout the world that rely on science and technology development since the Enlightenment, along with industrial wealth, to organize economic, political, and intellectual life.

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