The Political Economy of Energy, Environment and Development*

John Byrne**
Young-Doo Wang***
Kyung-Hee Ham****
Jong-Dall Kim*****

⟨Contents⟩

I. Introduction

This paper examines the environmental implications of the emerging world order of development and underdevelopment. In particular, it considers the prospect that the environment is being socially shaped and, in a specific sense to be examined below, reconstituted by political and economic forces. In our view, what is popularly called "environment," more classically "nature," is undergoing a process of social capture which eventually may make it a "system" subject to political and economic "laws". Although the present energy-environment-development regime is only about 300 years old (dating to the

* Center for Energy and Urban Policy Research University of Delaware Originall Presented at Environmental Planning Institute Seoul National University June 1990.
** John Byrne is Director of the Center, and Associate Professor, College of Urban Affairs and Public Policy.
*** Young-Doo Wang is Associate Director of Research for the Center, and Associate Professor, College of Urban Affairs and Public Policy.
**** Kyung-Hee Ham is a Ph. D. Candidate Studying in the Center.
***** Dr. Jong-Dall Kim current, holds a research position in the Korea Energy Economics Institute.
Drs. John Byrne and Young-Doo Wang and Mr. Kyunghee-Ham are associated with the Center for Energy and Urban Policy Research in the College of Urban Affairs and Public Policy, University of Delaware.

spread of a coal-economy, steam technology and wage labor), it appears to have concurrently institutionalized a world order of social inequality unknown in previous human history and attained a level of technological sophistication that threatens several million years of climate, biological and social evolution. An effort is made below to begin construction of a theoretical framework for conceiving the social origins of this threat and its implications for society and nature. The paper is divided into four sections. The first section reviews the political economy of energy, environment and development which has prevailed since industrialization. The period is characterized as one of expanding commodification[(1)] of social existence. Nature is seen as successively drawn into the commodification process; but, until recently, its role was limited to serving mainly as a resource mine or a reservoir for the absorption of industrial waste. Under these conditions, it was analytically feasible to focus on the social structure and ignore the possibility that nature was being structurally affected. We argue, however, that commodification has spread to the natural structure—including climate, atmosphere and global temperature—and that conventional distinctions between natural and social structures and laws may now be outmoded. Indeed, the dualistic treatment of society and nature may represent an impediment to conceiving newly evolving relations in the political economy of energy, environment and development. The third section explores the meaning and implications of the social appropriation of natural order.[(2)] The paper concludes with a discussion of the links between commodification, the appropriation of nature and social inequality.

II. Industrialization and the Commodification of Society

The advent of industrialization, first in Europe in the 18th century and then spreading

(1) "Commodification" is defined as a development orientation pursued by societies in which progress is determined by increased social capacities to produce and purchase goods and services. Under this orientation, the physical environment is valued either directly, as a commodity in the form of energy, raw materials, and resources extracted for social use, or indirectly, as a "least-cost" means of disposing of wastes (thereby improving the "efficiency" of commodity production and use).

(2) By natural order we mean the chemical, biological, and other physical relations that constitute and sustain physical existence. Natural laws represent scientific efforts to generalize certain of these relations. Similarly, social order refers to political, economic, cultural, psychological, and other social relations that constitute and sustain societies, with social laws stating in general form certain of these socal relations, In no case that we know of are natural laws and natural order *scientifically* conceived as contingent upon social order and social laws.

throughout the world, signalled dramatical change in social relations including those between energy, environment and development. Where much of human history had been marked by efforts to adapt to the laws of nature and to build societies under the constraints set by nature, 18th century's science, technology and enterprise provided new instruments for exploiting nature's resources and processes on a scale never before imagined. The environmental impact of these new exploitive powers was almost immediately evident, as this mid-nineteenth century assessment of industrial life describes:

> Coketown lay shrouded in a haze of its own, which appeared impervious to the sun's rays. You only knew the town was there because there could be no such sulky blotch upon the prospect without a town. A blur of soot and smoke, now confusedly tending this way, now that way...a dense formless jumble, with sheets of cross light in it, that showed nothing but masses of darkness(Charles Dickens, 1854).

Dickens' nightmare endured into the early part of the 20th century in Europe and the U.S., as another writer has observed. Describing the condition of Western cities throughout the 19th and beginning of the 20th centuries, Lewis Mumford had this to say:

> ...the change from organized urban handicraft to large scale factory production transformed the industrial towns into dark hives, busily puffing, clanking, screeching, smoking for twelve and fourteen hours a day, sometimes going around the clock. The slavish routing of the mines, whose labor was an intentional punishment for criminals, became the normal environment of the new industrial worker. None of these towns heeded the old saw, 'All work and no play makes Jack a dull boy.' Coketown specialized in producing dull boys.
>
> Between 1820 and 1900 the destruction and disorder within great cities is like that of a battlefield, proportionate to the very extent of their equipment and the strength of the forces employed...In a greater or lesser degree, every city in the Western World was stamped with the archetypal characteristics of Coketown. Industrialism, the main creative force of the nineteenth century, produced the most degraded urban environment the world had yet seen; for even the quarters of the ruling classes were befouled and overcrowded(Mumford, 1961:446, 447).

Industrial cities were important but not unique institutions of an energy-development regime which resulted in environmental degradation. Indeed, Mumford invented a term for the new regime—Paleotechnicism—by which he meant a social order organized around the expenditure of nature's energy capital—its nonrenewable fossil fuel reserves—through the use of an allied technology of industrial development. Elsewhere, he referred to the regime as "carboniferous capitalism." What was distinctive about the new political economy was its alliance of the intellect(through science), the economy(through capitalism), technology(through the advance of Paleotechnics), the power complex(through fossil energy combustion) and political life(through the nation state) around an organizing principle for society of *quantification*(Mumford, 1961: 570; and 1934: 160):

> 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. As these activities increase in volume and in tempo, they move further and further away from any humanly desirable objectives...In short, numbers begot numbers; and concentration once well started, tended to pile up in ever-increasing ratios, claiming increase by inertia where it could no longer promise more effective economic performance.

This alliance produced goods at an unparalleled rate and magnitude, but also pollution of a type and scale hitherto unknown:

> The first mark of paleotechnic industry was the pollution of the air. Disregarding Benjamin Franklin's happy suggestion that coal smoke, being unburnt carbon, should be utilized a second time in the furnace, the new manufacturers erected steam engines and factory chimneys without any effort to conserve energy by burning up thoroughly the products of the first combustion; nor did they at first attempt to utilize the by-products of the cokeovens or burn up the gases produced in the blast-furnace. For all its boasts of improvement, the steam engine was only ten per cent efficient: ninety per cent of the heat created escaped in radiation, and a good part of the fuel went up the flue. Just as the noisy clank of Watt's original engine was maintained, against his own desire to do away with it, as a pleasing mark of power and efficiency, so the smoking factory chimney, which polluted the air and wasted energy, whose pall of smoke increased the number and thickness of natural fogs and shut off still more sunlight—this emblem of a crude, imperfect technics became the boasted symbol of prosperity. And here the concentration of paleotechnic industry added to the evils of the process itself. The pollution and dirt of a small iron works situated in the open country could be absorbed or carried away without difficulty. When twenty large iron works were grouped together, concentrating their effluvia and their waste-products, a wholesale deterioration of the environment inevitably followed.
>
> In this paleotechnic 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 lockout or an industrial depression(Mumford, 1934:168-169).

The contents of what Mumford called the "atmospheric sewage" of modern industry changed in the 20th century, but the industrial chain of energy combustion-to-environmental degradation was not altered:

> The archetypal industrial town nevertheless left deep wounds in the environment; and some

> of its worst features have remained in existercc, only superficially improved by neotechnic means. Thus the automobile has been polluting the air for more than half a century without its engineers making any serious effort to remove the highly toxic carbon monoxide gas from its exhaust, though a few breaths of it in pure form are fatal; nor have they eliminated the unburned hydrocarbons which help produce the smog that blankets such a motor-ridden conurbation as Los Angeles. So, too, the transportation and highway engineers who have recklessly driven their multiple-laned expressways into the heart of the city and have provided for mass parking lots and garages to store cars, have masterfully repeated and enlarged the worst errors of the railroad engineers. Indeed, at the very moment the elevated railroad for public transportation was being eliminated as a grave nuisance, these forgetful engineers re-installed the same kind of obsolete structure for the convenience of the private motor car. Thus much of what appears brighly contemporary merely restores the archetypal form of Coketown under a chrome plating(Mumford, 1961:479).

The alliance of science, the power complex, and the industrial economy ushered in a social order of environmental pollution as a *functional* part of human progress. In effect, pollution was normalized. Pollution became for Western industrial societies a mundane accompaniment of an existence built upon energy and economic quantification, an existence that defined progress as more energy to produce more goods to consume more things, all of which piled up the environmental waste.

A series of pollution spectaculars beginning in the late 1960s exposed the inherent problems of quantitative industrialism. One of the most significant, politically, occurred in January 1969 when an oil well off the shores of Santa Barbara, California, drilling to a depth of nearly 3, 500 feet suffered a "blowout, an uncontrolled eruption" of oil(Easton, 1972:8). The well was one of 56 slotted in a 3, 000ton platform suspended in 188 feet of water. The rig was certainly a technological marvel, performing the extraordinary feat of balancing pressures in excess of 1, 000 pounds per square inch. However, when pressures exceeded 1, 100 pounds, the well began spewing mud and oil; rock and sand fissured in the geologic formation and oil issued into the ocean waters in miniature geysers. The eruption lasted 12 days, creating an oil slick of three million gallons of oil and covering an area of 800 square miles(roughly two-thirds the size of the state of Rhode Island). Fifty-five miles of coastline were washed with a "black tid" of approximately 1. 3 million gallons of oil. The greatest danger occurred along a seven mile stretch of Santa Barbara waterfront where 390, 000 gallons of crude came ashore. 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). The well was eventually capped with a 3, 400 foot column of cement but significant seepage from rock and sand fissures caused by the blowout continued for several years. Seepage is still occurring today, 21 years after this technological accident. Only a late 20th century industrial society could have such an accident.

The Santa Barbara disaster brought into sharp focus the price of industrial momentum; modern society progressed on the basis of a necessary tradeoff of environmental quality for increased commodity. In the wake of this disaster, the environment-development tradeoff would be extensively questioned. After a week of unchecked seepage, a supervisor for the city of Santa Barbara appeared before the U.S. Congress asking that a moratorium on offshore drilling in the Santa Barbara Channel be declared. "Gentlemen, we need help and protection," the supervisor asserted. But the supervisor and allies of the newly organizing environmental movement soon learned that environmental protection was no easy matter to produce in an industrial civilization. Industry executives were quick to remind the nation of the cost of such protection. The president of Union Oil Company, whose well had suffered the blowout, characterized the logic of a drilling moratorium as "like shutting down the California education system because there's a riot at San Francisco State [University]." While conceding that there was a problm, he urged Congress and the American public to keep things in perspective. After all, he noted, no human life had been lost; an interruption of oil pumping could hardly be justified because of "the loss of a few birds" (*New York Times*, February 6, 1999). Officials in the oil fraternity came to the defense of Union Oil Company. When a U.S. Interior Secretary proposed tightening controls on the offshore leasing program, a Gulf Oil official warned against "unwarranted protection of the environment" (*New York Times*, August 3, 1969).

The U.S. Congress debated the issue for over three years but did not legislate additional regulation. A federal court of appeals refused Santa Barbara's request to mandate hearings by the U.S. Department of Interior and none was held. In his Congressional testimony, an official of the American Petroleum Institute summed up why the natural environment could not and should not be a restraint on the technological and industrial environment:

> The nation's real goal should not be preservation...but proper development and use. The U.S. resources are not so vast that we can much afford [the] luxury of dedicating areas to nonuse. [Government restrictions on oil exploration] permanently impair the innovative economic process whereby many individuals making individual decisions assure the most productive development of resources.
>
> [N]ature flourishes under its benign stewardship: oil derricks stimulate fish to spawn, just as road building projects have opened up forage areas and migratory routes for moose. Should,

perchance, there be a spill, the American Petroleum Institute has studies on spills and beach cleanup and it offers literature for the rescue of waterfowl who have been incapacitated. (Quoted in Engler, 1977:150)

The Santa Barbara blowout underscored the commitment of industrial civilization to an environment-development tradeoff. Of course, society could go without oil retrieved from beneath the sea, or oblige investment in expensive anti-spill technology. But the industrial leadership warned that such choices would mean, potentially, surrendering greater economic growth. Perhaps more important, failure to take environmental risks could multiply problems in other sectors of the industrial system which depends upon smooth operation of the power complex. Restrictions on new oil exploration could upset the balance of the technological system in activities ranging from transportation and industrial production to electricity generation. The American public had learned from this incident just how unadaptive the industrial system is; the burden would be on society and the natural environment to adapt.

While politically important,(3) the Santa Barbara "spill" ranks a mere 46th in the cavalcade of oil spill spectaculars over the past 20 years. A far larger spill occurred on the night of March 23, 1989 when the Exxon Valdez oil tanker ran into a reef in the Alaskan Prince William Sound and spilled 37,415 tons of crude. The oil spread to five National Wildlife Refuges and three National Park areas, coating an area of more than 900 square miles—roughly three-fourths the size of Rhode Island. Hundreds of miles of shoreline were washed with a black tide, in some places up to 6 inches deep. The estimated birdkills was 100,000, including 150 bald eagles. Approximately 1,000 sea otters were also killed. Debris from the oil spill was in excess of 100 million pounds; finding a waste repository capable of handling this magnitude of garbage proved to be a challenge in itself.(4) Many tanker spills could be averted with the requirement of double-hulls for vessels.(5) Yet for 15 years, the U.S. Congress has debated the idea without result. The shipping industry is adamantly opposed to the idea as "too expensive" (*Science*, Apr. 7, 1989, p. 21), an ironic objection

(3) Protests in the aftermath of the Santa Barbara blowout were an important stimulus to the formation of the U.S. environmental movement and the establishment of the first worldwide Earth Day protest one year later.

(4) There are no incinerators in the region capable of burning the pile of waste generated from the *cleanup*.

(5) In the case of the Valdez spill, even this might not have prevented the accident. Double hulls preserve tanker integrity only for holes smaller than 6 ft.; the Valdez's major rupture was 6 ft. by 20 ft.

when one considers that the commercial value of the spilled oil in a typical accident is $ 40~50 million and the cleanup costs(paid by others, usually) are ten to twenty times this amount. Exxon dismissed criticism of the accident by referring to the Valdez as state-of-the-art in tanker design, built in 1986 as one of the "new, clean variety" (*Science*, 1989:21). And, the national government pronounced itself guiltless, despite the fact that it had ignored its own analyses on the probability of tanker accidents in this ecologically fragile bay. (6)

The Santa Barbara and Valdez disasters are instructive for their exposure of social acquiescence in the industrial orbit to larger and larger scale pollution incidents. Oil spill spectaculars are fast becoming recognized as the norm of advanced political economy. While public opposition to further oil exploration in the Arctic National Wildlife Refuge in Alaska escalated in the wake of the Exxon Valdez grounding, President Bush(after Valdez), representing the reasoning of advanced political economy, bluntly summed up the situation: it would be "irresponsible to leave the reservoirs untapped" (*Science*, 1989:20). The recent Persian Gulf War only fortified this belief, leading to a National Energy Strategy which calls for opening the Alaskan coaskan coastal plain to oil exploration and the U.S. President declaring that a national energy policy which lacks this provision would be vetoed.

Oil spills are only one category of environmental disaster experienced as part of the normal operations of contemporary industrial political economy. In addition, there has been a ubiquitous tolerance for the rapid destruction of forests. While the Western media presently focus on the deforestation of the Southern hemisphere, it is important to recognize that the strategic significance of Southern forests is amplified in part by the two-century neglect of the problem in the North. What remains of the Northern forests is under environmental attack by the energy-based atmospheric wastes of industrialism. Approximately 35 percent of the U.S. and Europe's forests are succumbing to the airborne battle of energy-economic quantification(Table 1).

Also threatened are the interior waterways of the industrialized territories into which are dumped the liquid and solid effluvia of modern civilization. Waste dumping is undeniably obnoxious, but dated in its sophistication. Like coal slag, the dumping of industrial wastes

(6) A 1972 environmental impact statement prepared by the U.S. Department of the Interior on the Valdez Port projected significant spills of one per year, dumping as much as 140,000 barrels of oil per incident. The Exxon tanker spill was equal to two years of the worst-case scenario. Yet, the U.S. imposed no special precautions against the predicted disaster.

Table 1. Estimated Forest Damage in Europe: 1988

Country or Area	Total Forest Area[1]	Estimated Area Damaged	Share of Total
	(thousand hectares)		(percent)
Czechoslovakia	4,578	3,250	71
Greece	2,034	1,302	64
United Kingdom	2,200	1,408	64
Estonia, Soviet Union	1,795	933	52
West Germany	7,360	3,827	52
Tuscany, Italy	150	77	51
Liechtenstein	8	4	50
Norway[2]	5,925	2,963	50
Denmark	466	228	49
Poland	8,654	4,240	49
Netherlands	311	149	48
Flanders, Belgium	115	53	46
East Germany	2,925	1,300	44
Bulgaria	3,627	1,560	43
Switzerland	1,186	510	43
Luxembourg	88	37	42
Finland	20,059	7,823	39
Sweden	23,700	9,243	39
Wallonia, Belgium	248	87	35
Yugoslavia	4,889	1,564	32
Spain	11,792	3,656	31
Ireland[2]	334	100	30
Austria	3,754	1,089	29
France	14,440	3,321	23
Hungary	1,637	360	22
Lithuania, Soviet Union	1,810	380	21
Bolzano, Italy	307	61	20
Portugal	3,060	122	4
Other[3]	13,474	NA	NA
Total[4]	140,956	49,647	35

1. For areas where only conifers were surveyed, "total forest area" means total forested area of conifers. For Yugoslavia, which conducted only a regional survey, "total forest area" means total area surveyed.
2. Conifers only. In Ireland, only trees less that 60 years old were assessed.
3. Includes unsurveyed portions of countries that have done regional and conifer-only surveys.
4. Does not include Turkey or any of the Soviet Union except for Estonia and Lithuania.

Source: Worldwatch Institute, based on U.N. Environmental Program and U.N. Economic Commission for Europe, "Forest Damage and Air Pollution: Report of the 1988 Forest Damage Survey in Europe," Global Environment Monitoring System, 1989.

in streams, rivers and lakes is a product of old-fashioned technology. The manufacture of "acid rain" is the more modern and insidious technique for fouling waters. The important elements of acid deposition—sulfur dioxide and nitrogen oxides—are transformed chemically in the atmosphere and fall to earth as acidic rain, snow, fog or dry particles. Damage to aquatic resources, estuaries and costal waters, timber and recreational resources, buildings and public health are the result.

In wide expanses of eastern North America and northern and central Europe, the pH of rain and snow averages between 4 and 4.5. Compared to a pH in the range of 5.6 in preindustrial times, recent precipitation in many industrial regions is 10～30 times more acidic(7) (Postel, 1984:18). Examples of the devastation wrought by this pollutant source are given in Table 2. Losses of this magnitude can hardly go unnoticed; social acceptance of them as ordinary is essential to their persistence. Much of this acidic pollution is traceable to the energy appetite of industrial civilization. Sixty-five percent of the sulfur dioxide emissions in the U.S., for example, is generated by power plants, which also account for 29 percent of the nitrogen oxide stream.(8)

Table 2. Evidence of Acidified Lakes, Selected Countries

Country	Evidence
Canada	More than 14,000 lakes strongly acidified, and 150,000 in the East(one in seven) suffering biological damage.
Finland	Survey of 1,000 lakes indicates that those with a low acid-neutralizing capacity are distributed across the country; 8 percent of these lakes have no neutralizing capacity; most strongly acidified ones are located in southern Finland.
Norway	Fish eliminated in waters covering 13,000 square kilometers and otherwise affected in waters over a further 20,000 square kilometers.
Sweden	14,000 lakes unable to support sensitive aquatic life and 2,200 nearly lifeless.
United Kingdom	Some acidified lakes in southwestern Scotland, western Wales, and the Lake District.
United States	About 1,000 acidified lakes and 3,000 marginally acidic ones, according to the Environmental Defense Fund; a 1984 government study found 552 strongly acidic lakes and 964 marginally acidic ones.

Sources: Jim Ketcham-Colwill, "Acid Rain: Science and Control Issues," Environmental and Energy Study Institute Special Report, July 12, 1989; U.N. Economic Commission for Europe, "Current Geographical Extent of Acidification in Rivers, Lakes, and Reservoirs in the ECE Region"(draft), June 15, 1988.

(7) The pH scale, commonly used to express acidity, ranges from 0 to 14, with anything less than 7 considered acidic. The scale is logarithmic, and therefore, a decrease of two units means a 100-fold increase in acidity.

(8) Energy for transportation produces another 41 percent of the U.S. NO_x total—see MacKenzie, 1987).

Table 3. Import-Export of Sulfur Pollution in Selected European Countries: 1988[1]

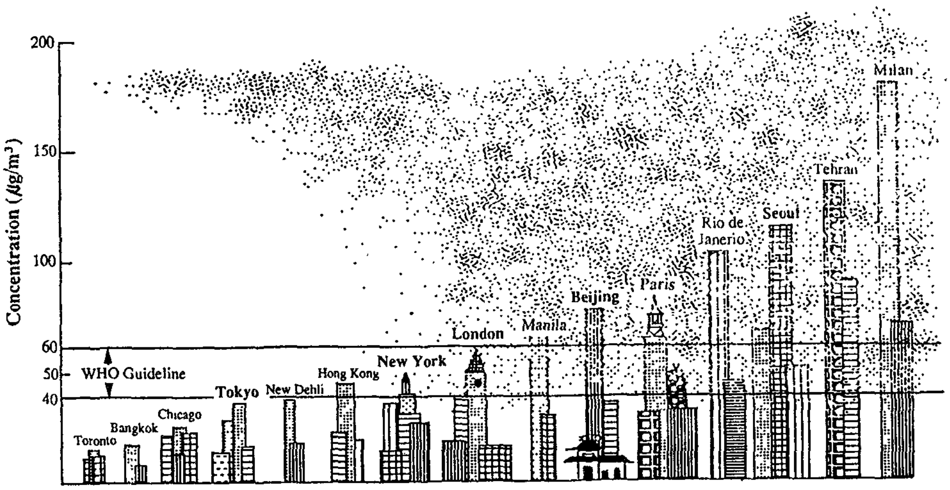
Country	Total Emission[2]	Total Deposition	Share of Emissions Exported[3]	Share of Deposition Imported
	(thousand tons)		(percent)	
Norway	37	210	76	96
Austria	62	181	74	91
Sweden	110	302	69	89
Switzerland	37	65	81	89
Netherlands	145	104	80	72
France	760	622	67	59
West Germany	750	628	63	59
Czechoslovakia	1,400	659	75	47
Poland	2,090	1,248	68	46
Soviet Union[4]	5,150	3,201	61	38
Italy	1,185	510	72	36
East Germany	2,425	787	75	22
Spain	1,625	590	72	22
United Kingdom	1,890	636	71	15

Notes: 1. Sulfur is generally emitted as sulfur dioxide but may fall to earth as a variety of its chemical derivatives, including sulfuric acid and sulfates.
2. Unless otherwise noted, emissions figures are preliminary 1988 data. Data of Austria, Sweden, and France are for 1987; Italy, 1986; and Spain, 1983.
3. May be deposited either in another country or over a body of water.
4. Only the European part of the Soviet Union; thus export figure includes exports to the Asian part of the Soviet Union.

Sources: Worldwatch Institute, based on emissions data in Economic Commission for Europe, "Annual Review of Strategies and Policies for Air Pollution Abatement"(draft), September 26, 1989; and transboundary flows data supplied by the European Monitoring and Evaluation Program.

An added feature of the air-transported acids of industrialism is the capacity to transfer the environmental consequences of economic activity to distant communities. As shown in Table 3, a thriving import-export market has emerged on the European continent for trading acid pollution, underscoring the triumph of industrialism over Old World politics. Invasion via the environment is now an acceptable political-economic strategy in the contemporary order.

Human health is not exempt in the industrial degradation of nature. As the air is fouled with technological and economic advance, 20th century cities, like their 19th century counterparts, are afflicted with the worst pollution. Residents of virtually all of the world's large urban centers breathe air unfit for human health(Figure 1). Pollution circulating through a technologically-manufactured worldwide urban cloud of chemical waste(most of it energy-based) exacts the price of industrial existence—life threatened by the involuntary,

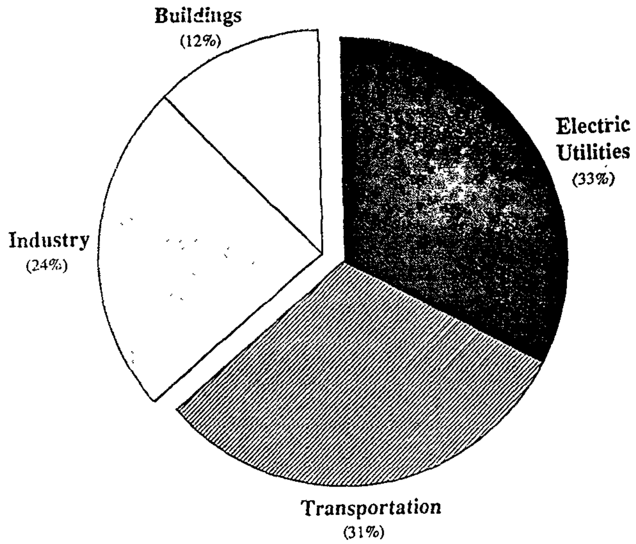


Sources: World Health Organization (WHO) and United Nations Environmental Programme (UNEP) 1987. ***Global Pollution and Health***; Center for Energy and Urban Policy Research, University of Delaware.

Figure 1. Summary of the Annual SO_2 Averages in Selected GEMS/Air Cities: 1980~1984

heretofore life-giving, act of breathing. Chronic bronchial, lung, circulatory and heart problems are the special mark of industrial civilization(French, 1990).

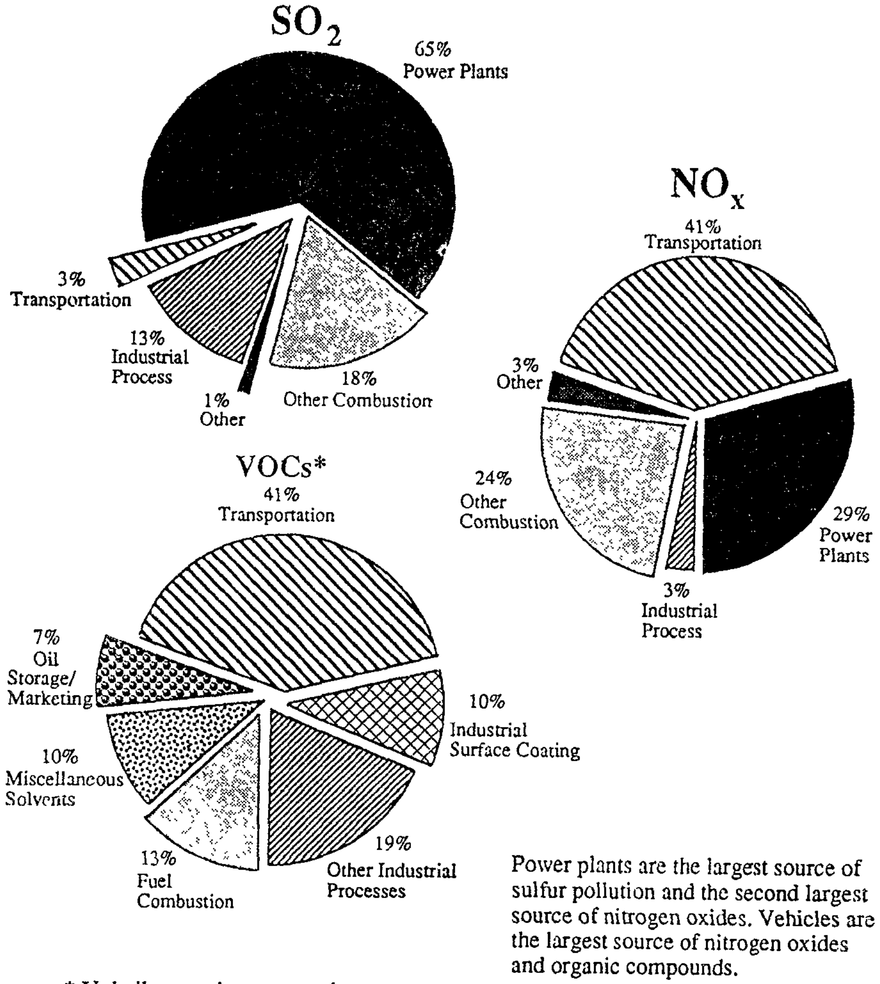
That the pollution of the environment and the human frame is directly tied to industrial *progress* can no longer be in doubt. Civilization is delivered by power plants, factories and



Source: James J MacKenzie 1989 *Breathing Easier: Taking Action on Climate Change, Air Pollution, and Energy Security.*

Figure 2. U.S. Sources of Carbon Dioxide

motorized transport in the modern order, and each of these technologies is responsible for major shares of the chemical waste cloud found, increasingly, throughout the world. Advanced industrialization only ensures greater magnitudes of the problem and deeper dependence on technological advances to solve it. Reliance for economic growth on improvements in transportation and electricity (as has the U.S. political economy, for example, throughout this century) promises higher carbon emissions which will exacerbate problems of urban smog and acid rain(Figures 2 and 3). The only other alternative to maintain high energy consumption levels is to resort to risky technology options like



* Volatile organic compounds.

Source: James J. MacKenzie. 1989. ***Breathing Easier: Taking Action or Climate Change, Air Pollution, and Energy Security.***

Figure 3. Sources of Precursors of Ozone and Acid Deposition

nuclear power (taken up below). In this context, modern society is increasingly found to be struggling with itself: a captive of the environmental problems that it is uniquely capable in all of social history of creating; *and* a captive of the technological solutions which, once employed, invariably breed new, more difficult social and environmental problems.

III. Toward a Structural Analysis(9)

Three hundred years of industrialization have rendered social and ecological relations(10) 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 probably know and, certainly, more complex in their effects than we understand. This reality is structured and motivated by the logics of technological advance and capital accumulation. 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 services and upon individual capacities to obtain and consume goods and services, as though nature was incidental to the human drama. As Mumford 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 "recreational good."

There have been concerted efforts to develop social analyses which can both characterize the commodification process and challenge its hegemony over social and ecological relations. But even the most comprehensive social frameworks conceive only the possibility of social activities which degrade the environment. In every social theory of which we aware, the *rules* or *laws of nature* are understood to operate literally *outside* the *laws of social motion*. Structural transformation of the environment is presumed by prevailing social theory to be beyond the reach of social influence. Social behaviors are conceived as limited in their

(9) "Structure" is used in this paper to refer to physical or social relations that provide regularity and continuity to certain phenomena. Thus, physical relations, which continuously regulate the surface temperature of the earth, are a natural structure; and social relations, which underpin a development orientation that routinely treats the physical environment as a commodity, are a social structure.

(10) Social relations refers here to individual and collective relations among human beings; while ecological relations refers to the interaction of humanity with all other forms of life and with the natural order as a whole.

impacts to the disruption or degradation of "environmental quality." Left intact is the distinction between society and nature as phenomenal structures.

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

Implicit in the dual-realities premise, from a social point of the view, is the assumption of the permanence of nature, particulary as a reservoir for social wastes. It is presumed that virtually anything can be socially practiced and repeated with the principal environmental consequences 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. 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 their social sphere. The permanence of a natural reservoir is not obviated or negated by human disasters.

The natural point of view is similarly predicated on nature's analytic autonomy. 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 naturally, physically, about order within the reigning paradigms without, at the every least, assuming a distinct order for nature. 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.

From either perspective, behaviors of one domain can penetrate the other and produce change, but only at the behavioral level. Social behaviors do not redesign nature; and natural behaviors do not redesign society.

However, a range of environmental issues point to the difficulty of maintaining the assumption of a dual reality—one natural and one social—at the structural level. Indeed, the very meanings of "structure" and "behavior" are challenged by these issues. The rapid and widening decomposition of stratospheric ozone at the polar caps during certain times of the year, and the documented changes in the chemical composition of the earth's atmosphere which portend a rise in the planet's surface temperature, certainly constitute structural phenomena from the point of view of natural and physical inquiry. Yet, they are perplexing because the source of the chemical restructuring of nature appears to be in the practices (behaviors) of the *other* sphere, the social structure. While as noted above, the possibility of behaviors of one structure affecting the other is not in itself surprising, an interaction between the two realities which might induce restructuring of the other's domain is theoretically arresting! Such a prospect defies the analytic boundaries upon which social and natural inquiry operate.

For our purposes, the most important scenario for analyzing the possible breakdown of a dual reality of society and nature is that the commodification process has functionally spread to the architecture of nature itself.[11] In this scenario, the potential for social activity to affect its own natural context[12] may 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 practices. Under the scenario we are proposing for study, 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. The contrast would be between capital-and technology-guided decisions 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—advanced industrial society—guides behaviors which adversely impact nature at the

(11) To date, commodification would seem to impinge specifically on the chemistry of the atmosphere. Other components of the natural architecture are not, as yet, speculated to be affected.

(12) The term "context" is carefully chosen. It is ordinary that social activities can affect social structure utterly, to the point where a new structure displaces an earlier one (this is true in nature also); thus, the passage from feudalism to capitalism. While such things may be historically extraordinary/rare, they are by no means unique or exceptional from a structural-analysis perspective. Frequently, social theorists employ the word "environment" to mean the same thing as "context" here, but for obvious reasons it would be better to have the meaning of "environment" restricted to the one developed in this paper.

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 idiosyncratic to restructure nature. In the latter example, the social structure threatens to cause a different natural order to evolve.

Below we offer an interpretation of energy, environment and development relations that 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 advanced political economy. In the following section, two examples of the commodification of the natural structure is explored: the spread of nuclear technology and the prospect of global warming.

IV. The Commodification of Nature

Human beings and their technological, economic and political systems produce behaviors within an energy-development-environment regime. Recent evidence indicates that the whole effect of these behaviors and systems is greater than the sum of their parts. The utilization of nuclear power technology is one important example. An accident in the operation of this technology has the potential of destroying the means of natural life over a large geographic area for thousands, and even tens of thousands, of years. The wastes generated by normal operation of this technology potentially pose a similar scale of threat to life. The military applications of this technology intensify and magnify the threat, bringing into clear view the capacity of nuclear systems to jeopardize the conditions of social and natural life. Similarly, the greenhouse effect portends a restructuring of the environment which, as Dr. Nicholas Shackleton, a climatologist at Cambridge University has suggested, means "we are going outside what nature has experienced in the recent past 500, 000 years" (*New York Times*, January 16, 1990). These cases will be used to explore the thesis that nature is being transformed by the social process of commodification.

1. *Nuclear Power*

The arrival of nuclear energy heralded the supersession of autonomous nature experience by technological society. With knowledge of nuclear fission, the human race 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. Equally, though, the future of much of non-human life depends upon social decisions/actions. Natural order in this specific sense can be affected by social institutions organized to promote and regulate the use of nuclear energy.

It is not simply nuclear weapons that thrust society into the forefront. As was learned in the Chernobyl accident, civilian applications(13) pose a sizable threat too. While the damage from the explosion at Plant No. 4 was mostly regional, nearly 400 million people in 15 nations were put at risk of radiation exposure; and forecasts range from 5, 000 to 75, 000 additional cancer deaths as a result of the accident. Yet, the immediate consequences of the accident are only part of the issue; an even more serious question is raised by its aftermath. As shown in Table 4, traces of iodine-131 and cesium-137 in milk throughout

Table 4. Maximum Reported Radiation Levels in Europe after Chernobyl[1]

Country	Ground Exposure Rate	Iodine-131 in Milk		Cesium-137 in Milk
		Reported	National Safety Guideline	
	(micro-Röentgen/hour)		(Becquerels/litre)	
Soviet Union[2]	15,000	—	2,000	—
Poland	1,000	2,000	1,000	—
Sweden	500	2,900	2,000	44
Romania	350	2,900	185	10
Austria	240	1,500	370	—
Czechoslovakia	200	1,000	1,000	110
West Germany	200	1,184	500	300
Switzerland	150	1,850	3,700	629
Yugoslavia	150	1,000	—	380
Turkey	100	360	—	—
United Kingdom	100	1,136	2,000	443
Italy	—	6,000	500	230

Notes: 1. Measured April 29 to May 13, 1986, except for Czech, Italian, and Yugoslavian Cs-137 data, measured early June.

2. Soviet figure for edge of evacuated zone. Levels would have been higher closer to the plant.

Source: World Health Organization, "Summary Review of Measurement Results Relevant for Dose Assessment, Update Revision No. 7", Copenhagen, 1986.

(13) Amory Lovins and colleagues in a classic paper, "Nuclear Power and Nuclear bombs" (1980) challenge the distinction between weapons and power plants on several grounds; and Joseph Camilleri (1984) has offered historical support for this position. It is not feasible to take up this issue here.

Europe underscore the enormously hazardous risks associated with the use of nuclear reactions to produce electricity. And it must be recognized that the gases, and their components, released in the accident are the *same* as those to be found in a safely operating reactor. The rubble at the Chernobyl site is dangerous to human health and natural habitat for tens of thousands of years; but so are the interior surfaces of the containment vessels of nuclear plants retired after decades of successful, accident-free operation. Indeed, the rubble is no different in the long-term risk it poses than the waste products generated from the normal operation of a nuclear plant.

In this respect, nuclear technology and the accidents that can accompany its use are catastrophe-prone. For this reason alone, nuclear energy can never be like any other technology. It requires, as an *inherent* condition of its use, that protective social institutions are constructed to shield society and nature from the potentially disastrous effects of this technology's accidents *and* successful use. These institutions have operated outside the mainstream of civil society, dominated by scientific experts and the military. Further, these institutions must last longer than any in the human record. Indeed, management of the nuclear waste stream requires 1,000 year nuclear security zones and 100,000 year surveillance mechanisms(Weinberg, 1979:94-95; Anderson et al., 1980:30). Alvin Weinberg, one of the architects of the U.S. nuclear program, captured the point in his now-famous Faustian metaphor:

> We nuclear people have made a Faustian bargain with society. On the one hand, we offer—in the catalytic burner—an inexhaustible source of energy...But the price that we demand of society...is both a vigilance and a longevity of our social institutions...In a way, all of this was anticipated during the old debates over nuclear weapons...In exchange for atomic peace, we have had to manage and control nuclear weapons...[W]e have established a military priesthood which guards against inadvertent use of nuclear weapons, which maintains...a precarious balance between readiness to go to war and vigilance against human errors that would precipitate war...[P]eaceful nuclear energy probably will make demands of the same sort on our society, and possibly of even longer duration.

In this analysis, Weinberg mixes the histories of nuclear bombs and plants because, in the end, they represent the same challenge—to devise authoritarian social institutions which secure the technology from realizing its catastrophic character in *normal* operation. Only successful *social* management can prevent the social and natural order from utter destruction.

The origin and spread of nuclear energy is traceable to the deeply rooted industrial belief that energy is an essential facet of progress—that, as Lovins derisively depicted it, "the more energy we use, the better off we are" (1977:4). Western pursuit of this ideal brought into being political economies of extraordinarily high energy intensity. Indeed, an ideology of high energy consumption appears so ingrained in the Western psyche that one writer was prompted to label it the "energy—civilization equation," a pervasive if often implicit assumption that over the past 300 years high and growing energy consumption was responsible not only for improvement in physical comfort, economic well-being, and military strength, but for social, moral and intellectual achievements as well—in short, for the progress of civilization (Basalla, 1980:40).

Nuclear energy was, and continues to be, promoted as the ideal "abundant energy machine" (Byrne and Rich, 1986). Economic justification was irrelevant to its initial promotion. Nuclear power was not the invention of enterprise; there was no market demand for it; and there was no economic supply of it prior to its institutionalization. As an energy source, nuclear power was not technologically available and could not be demonstrated when the U.S. undertook its development. An institutional framework for promoting nuclear power was initiated with the Manhattan Project, which brought together three of the most powerful institutions in American society—the military, large industry and technoscience—to create nuclear bombs. This apparatus was then authorized in 1946 by the U.S. Congress to deliver the peaceful atom, eleven years before the idea could be technologically expressed and seventeen years before the successful demonstration of the first turn-key plant. In effect, the society set about to discover and affirm the advantages of nuclear power and to discount its costs without any knowledge of its economic practicality and before the technical means to deliver it existed. The social desirability and technical viability of nuclear power were evaluated ***in the context of its active promotion*** and not the other way around (Byrne and Rich, 1986:153).

Nuclear power was, and continues to be, a technological "fix" to the fundamentally unsustainable ideal of industrial progress. Rapid depletion of fossil resources merely amplifies the social "need" for the technology. In fact, nuclear advocates often cite the shrinking availability of fossil fuels as an important reason for supporting nuclear technology development. For example, an official of the U.S. Department of Energy agreed recently that "nuclear is the only non-fossil energy source that will be available to us in sufficient amounts to support our current civilization and to fuel progress for the foreseeable future" (Agnew, 1983:1). In the wake of Chernobyl, enthusiasm continues, especially in the Third World, for the technology. It is seen as ally in the race for development in a world of diminished natural resources. In reality, this appeal presently serves the needs of a moribund nuclear power industry. Alvin Weinberg also anticipated a concerted effort to sell nuclear power to the poor:

> The amount of [nuclear] energy...is truly enormous: enough to last mankind on any reasonable energy budget for many millions of years! Thus the development of the breeder would provide man with...reasonably cheap energy, essentially forever. What emerges is the outline of an autarkic world...in which the primary energy source, based on the breeder reactor...is available to all countries, not only to countries that possess indigenous fossil fuel, or are rich enough to import such a fuel from others. (1971:416)

Third World users of the technology will deepen their dependence on the West as the capital requirements to purchase plants will typically leave them in debt to the banks of the industrialized countries; waste disposal problems will lead to reliance on Western expertise; and the need to obtain fuel will force them to enter into contracts with the selected few countries who can provide it.

Continued spread of the technology will increase the frequency of accidents and enlarge the stockpile of long-lived, toxic waste, bringing into sharp focus the hegemony of commodity values over life-affirming ones. All but lost in this scramble are the alternatives of reduced energy use, resource conservation and resource sharing. Yet, in the current world political economy such options evoke the apocalyptic visions, *not* nuclear power:

> We foresee a doomed civilization with tractors paralyzed in the fields, abandoned automobiles rusting on weed-choked freeways, factories as quiet as tombs, and our haggard descendants facing a life of everlasting drudgery...A retreat from rising energy consumption under those circumstances means far more than the minor discomfort of living in a warmer house in the summer and a cooler one in the winter, or driving a smaller car less frequently and more slowly. As less energy is available per capita the nation is thought to lose its standing among the world's civilizations (Basalla, 1980:39, 40).

It is precisely the ideology of abundance which, if not abandoned, may thrust the world into social and natural calamity. Indeed, a restructuring of the international political economy on the principle of energy conservation could well be our best hope of avoiding social and natural disaster.

2. *Global Warming*

Nuclear technology threatens the natural order with the prospect of sudden catastrophes triggered by the release of highly toxic, long-lived wastes manufactured in the atomic

Table 5. Greenhouse Gases

Gas	Concentration in Air		Present Rate of Increase (per year)
	Pre-Industrial	1986	
Carbon Dioxide(CO_2)	275ppm	346ppm	1.4ppm(0.4%)
Methane(CH_4)	0.75ppm	1.65ppm	17ppb (1%)
Fluorocarbon-12(CCl_2F_2)	Zero	400ppt	19ppt (5%)
Fluorocarbon-11(CCl_3F)	Zero	230ppt	11ppt (5%)
Nitrous Oxide(N_2O)	280ppb	305ppb	0.6ppb (0.2%)
Ozone, Tropospheric(O_3)	15ppb	35ppb	0.3ppb (1%) Northern Hemisphere Only
Other Fluorocarbons	Zero		(5 to 15%)

* ppm=parts per million, ppb=parts per billion, ppt=parts per trillion

* Source: Ralph Cicerone, "Global Warming, Acid Rain, and Ozone Depletion" in Dean E. Abrahamson(ed.). 1989. *The Challenge of Global Warming*. Washington D.C.: Island Press.)

Table 6. Major Greenhouse Gases and Their Characteristics

Gas	Atmospheric Concentration	Annual Increase	Life Span	Relative Greenhouse Efficiency	Current Greenhouse Contribution	Principal Sources of Gas
	(ppm)	(percent)	(years)	(CO_2=1)	(Percent)	
Carbon Dioxide	351.3	0.4	X*	1	57	
(Fossil Fuels)					(44)	Coal, Oil, Natural Gas,
(Biological)					(13)	Deforestation
Chlorofluorocarbons	0.000225	5	75~111	15,000	25	Foams, Aerosols, Refrigerants, Solvents
Methane	1.675	1	11	25	12	Wetlands, Rice, Fossil Fuels, Livestock
Nitrous Oxide	0.31	0.2	150	230	6	Fossil Fuels, Fertilizers, Deforestation

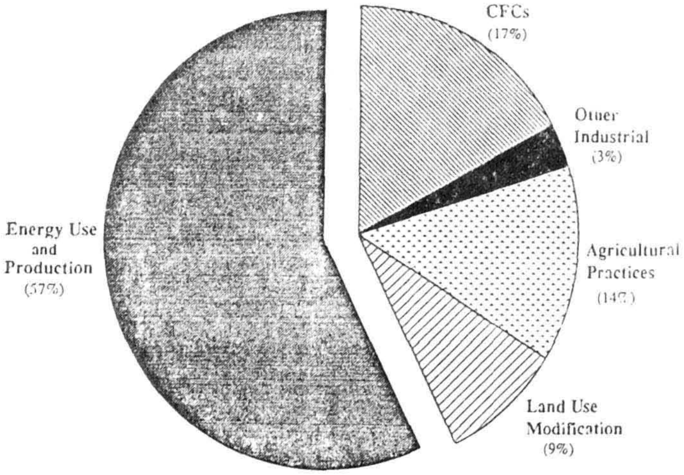
* Carbon dioxide is a stable molecule with a 2~4 year average residence time in the atmosphere.

Sources: Worldwatch Institute, based on various sources including, U.S. Environmental Protection Agency, *Policy Options for Stabilizing Global Climate Change* (Washington, D.C.: U.S. Environmental Protection Agency, 1989, draft); V. Ramanathan et al., "Trace Gas Trends and Their Potential Role in Climate Change," *Journal of Geophysical Research*, June 20, 1985; James Hansen et al., "Greenhouse Effect of Chlorofluorocarbons and Other Trace Gases," *Journal of Geophysical Research*, November 20, 1989.

reaction. Socially induced global warming augers a different type of natural transformation. First, it is caused by the steady buildup of mostly *non-toxic* gases over the life of industrialization. In addition, it represents an insidious process of social disruption of the natural order, rather than a sudden, catastrophic rupture as in the case of unclear power.

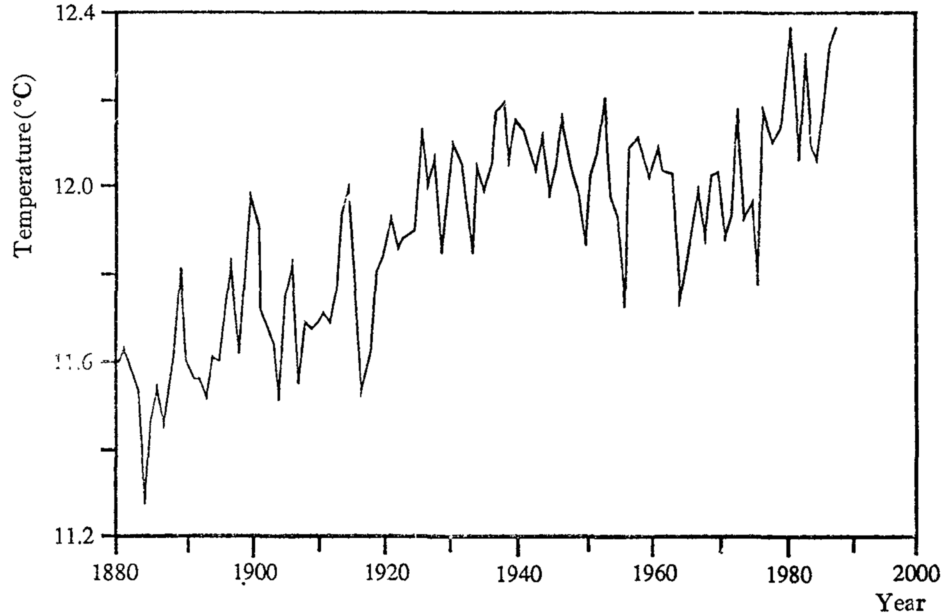
As Table 5 indicates, the principal "greenhouse" gases—CO_2, N_2O, O_3, CH_4 and CFCs—have continuously concentrated in the atmosphere since the pre-industrial period. The primary source of these gases is fossil-fuel combustion, which accounts for nearly one-half of the CO_2 increase and is an important source of higher N_2O(Table 6). If we sum across social activities, nearly 60 percent of worldwide greenhouse emissions are associated with energy production and use(Figure 4), Greenhouse theory hypothesizes that an atmosphere composed of high concentrations of these gases will result in higher surface temperatures. Data on global mean temperatures over the past 100 years of worldwide industrialization indicate that the planet is warming(Figure 5). Although the precise magnitude and physical dynamics of the greenhouse effect remain the subject of much debate, a scientific consensus appears to have formed on its existence(Flavin, 1989:15-16; COSEPUP, 1991).

Indisputably structural in character, the greenhouse effect includes not only the prospect of higher temperatures, but changes in sea level and the distribution and location of dry and wet land areas, as well as the alteration of a host of other biological and climatological



Source: Daniel A. Lashof and Dennis A. Tirpak (ed.). *Policy Options for Stabilizing Global Climate: Draft Report to Congress*, U.S. Environmental Protection Agency, February 1989.

Figure 4. Activities Contributing To Global Warming



Sources: James E. Hansen et al., "Regional Greenhouse Climate Effects," in John Topping, ed., *Coping with Climate Change* (Washington, D.C.: The Climate Institute, 1989); (as reproduced in Christopher Flavin, *Slowing Global Warming: A Worldwide Strategy*, Worldwatch Paper 91, 1989).

Figure 5. Global Average Temperatures: 1880~1988

processes. Heretofore, climate changes of these kinds were determined by the confluence of three astronomical cycles which regulate the earth's orbital ellipse, axial tilt and wobble. The orbit cycle which fixes the earth's travel within the solar system takes approximately 100, 000 years to complete the series of elliptical modifications involved; the tilt cycle lasts about 41, 000 years and completes a series of axial corrections; and the elapse of the wobble cycle is nearly 23, 000 years. Together, these cycles control the timing of global warming and cooling by altering the angles and distances from which solar energy reaches the earth.

These very long-lived cycles must be placed alongside the 300 years of industrialization (with the last 100 years representing, by far, the most carbon-intensive), which are cumulatively believed to have begun a *social* process of temperature change, to appreciate the magnitude of social interference. The time disjuncture in these terms of reference points to the immense capacity assembling in the world political economy to threaten nature. Even skeptics of the present status of the greenhouse effect should be awed by the potential for social engineering to change the natural structure, which, if not available presently, almost certainly will soon be. The carbon buildup that has accompanied industrialization is a testament to the systematic imposition of commodity values on the society-nature relation. It is the environmental expression of energy-economic quantification. The depth to which commodified nature is presumed by the existing social order can be exemplified by considering how the carbon dependence of modern development might be slowed or reversed.

In a series of scenario analyses for a U.S. Environmental Protection Agency(EPA) report on *Policy Options for Stabilizing Global Climate*(Lashof and Tirpak, 1989), some indication of the carbon dependency of the world political economy is given. Using a 110-year planning horizon, the EPA study first sought to identify global carbon-reduction strategies which might stabilize atmospheric greenhouse gases at a concentration which assumes a 1.5～2.0C° increase in global average temperature. That is, the first scenario ***assumed*** that global warming is inevitable, but that we can hope to place a ceiling on the magnitude of warming. Introducing policy options iteratively into the climate change model used for the project, the researchers discovered that single, or even limited numbers of, policy steps could achieve chemical stability. Rather, ***eleven*** major initiatives would be needed which ranged from a phaseout of CFCs use by the year 2003; a major reforestation effort worldwide; adoption of a series of energy-efficiency improvements including the achievement of a global fleet-average auto fuel efficiency of 50 miles per gallon(mpg); and government-sponsored speedup of the commercialization of solar technologies. Even with these substantial responses implemented, the study relied upon increased nuclear power production[14] to meet the goal of a warming commitment of 1.5～2.0C°(Lashof and Tirpak, 29～45 and, especially, Figure 8).

A second simulation defined the objective as no *additional* warming beyond the year 2000. Again, policy planning was stretched over the period from the present to 2100. The conclusion of this analysis was that it would be necessary to implement all strategies in the atmospheric chemical stabilization scenario, ***and*** eight additional policy responses. High carbon emission fees would have to be imposed on the production of fossil fuels in proportion to CO_2 emissions potential; and an excise tax on fossil fuel use would need to be enacted for the industrialized countries. Separate auto fuel efficiency standards would be

(14) Although, to rationalize the technology's promotion, it was necessary to assume annual 0.5% ***decreases*** in construction costs, something the world has yet to experience in 40 years of operation of the industry.

imposed which require 50mpg fleet averages by 2000 and 65mpg by 2025. And, deforestation would have to be halted worldwide by 2000, and reforestation efforts doubled over the stability scenario(Lashof and Tirpak, 1989:29-45 and, especially, Figure 9).

These above analyses of nuclear power and global warming are intended to illustrate the structural implications of 300 years of commodification on the natural order. They suggest that industrial societies are pursuing a development path that will eventually alter natural structures. Indeed, it oppose that the momentum for commodification of nature is so strong as to require unheard of global cooperation merely to moderate its *effects*. To begin to undo the commodification of the nature, global cooperation will not be enough—steps toward the restructuring of industrial societies appear necessary, including an abandonment of the abundant energy ideal and commodity-based industrialism. In sum, removal of the prospect of restructuring nature depends upon structural action in the social sphere. Nature and society are now structurally related.

V. Conclusion: Commodification of Nature and Global Inequality

The argument developed here is that contemporary energy-environment-development relations commit us to a form of world political economy in which nuclear catastrophe and global warming are implicitly accepted as the necessary risks of progress. Advanced technology and chemistry, in conjunction with an energy appetite based on an unsustainable ideology of abundance, have created a machine world with the capacity to directly alter the cycles and processes of nature. Whereas the initial stages of carboniferous capitalism tested the statics of nature, namely, the absorption capacities of land, water and air; the advanced industrial order of global capital and markets challenges the dynamics of nature, in particular, the seasons, the tides, the breathing of the planet, and even the reproductive cycle of the atmosphere. While the emblems of advanced industrialism, like carboniferous capitalism, remain waste and pollution, there has been a fundamental breach of the nature-society relation. Advanced industrial life transpires not simply outside the constraints of nature, but relegates nature to commodity status, to be purchased and sold in the world political economy along with other products and services. The contemporary world political economy *presumes* that sustainability is a technological and economic matter. Although this presumption is most concretely presented in discussions of trade-offs between environmental protection and material progress, its deeper implication is the demise of the idea of nature's sustainability. There is ***nothing*** in advanced industrial logic beyond technological manipulation; not the climate, not the atmosphere, not species diversity. Nature is stripped altogether of autonomous status.

In this context, the manufacture of acid rain and holes in the upper ozone, the extinction of plant and animal species(and the engineering of new ones), the reduction of the planet's capacity to breathe(due to deforestation, among other things), the manufacture of highly toxic, long-lived poisons which are so dangerous that they require 1,000 year security zones, and the creation and satisfaction of consumptive appetites which in their aggregate portend a change in global climate—all have become rational and efficient. The debate over global warming and the possible need to restrict world carbon dioxide emissions is illustrative of the advanced industrial mind. In a recent article in the *New York Times* (November 19, 1989), Harvard economist Thomas Schelling points out that, "both the will and technological ability to adapt to radically different weather [has changed rapidly]. In 1860 two percent of Americans lived outside temperate or subtropical zones. By 1980 the percentage had increased to 22 percent." Schelling further argues that "the appealing idea of bequeathing the biosphere intact seems arbitrary. The quality of life in 100 years... will depend as much or more on the endowment of technology and capital as on the percentage of carbon dioxide in the air. And if money to contain carbon emissions comes out of other investments, future civilizations could be the losers." Citing a study by the U.S. Environmental Protection Agency which estimates the cost of protecting American coastal cities from a three-foot sea rise at $73 to $111 billion, the article notes that is "a lot of money but not so much compared with the likely cost of prevention." The reporter concludes from interviews with Schelling and other economists and technologists for the article that an analytical consensus is emerging: "it may be cheapest to deal with the effects of global warming rather than the causes."

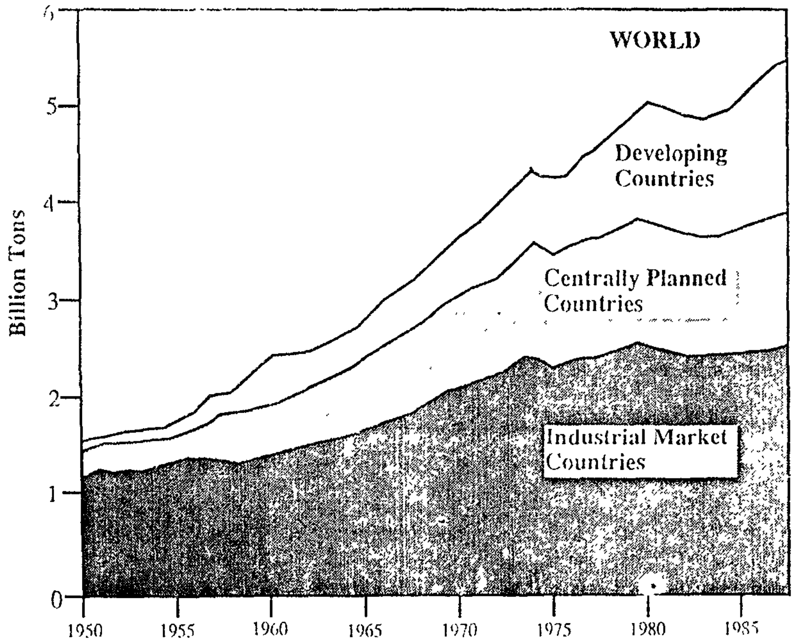
Schelling's argument repeats premises of the quantitative ideology which have produced the threats of global warming and nuclear catastrophe: measuring environmental and social debacle in the numeraire of "costs" and "benefits" at the margin; assuming that the value of life to future generations is less than the technological conveniences to present "consumers;" treating the health of the poor as a negotiable commodity to be traded for the comfort-desires of the rich; in sum, regarding the issues of development and environment as an endless series of tradeoffs. The argument encourages view of society and nature as forms of technology and capital that can be manipulated to productive effect! In this logic, there is no brake on commodification, and efforts to construct one are vigorously rejected as anti-progressive. Yet, because human existence outside earth's atmosphere is technologically conceivable and, under certain institutional circumstances, perhaps, economically rational, hardly justifies the destruction of the basis of life on earth as we have known it.

Moreover, for the industrialized countries to heed Schelling's advice and confine their attention to the "cheapest" strategy of coping with the effects of technological accidents and climate change is to disregard the central role of the industrial system in creating the problem. The industrialized countries are, by far, the largest polluters in the world system. Total and per capita carbon emissions are much higher for those countries than for the poor countries of the South(Table 7). Likewise, cumulative contributions to the carbon buildup which forebodes global warming are largely the responsibility of the industrialized countries(Fig. 6). And, the industrialized world is the primary source of all other

Table 7. Carbon Emissions from Fossil Fuels, Selected Countries 1960 and 1987

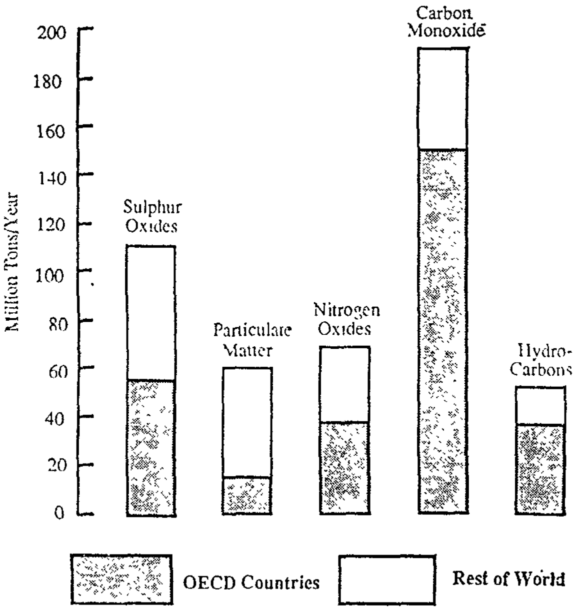
Country	Carbon		Carbon per Dollar GNP		Carbon per Capita	
	1960	1987	1960	1987	1960	1987
	(million tons)		(grams)		(tons)	
United States	791	1,224	420	276	4.38	5.03
Canada	52	110	373	247	2.89	4.24
Australia	24	65	334	320	2.33	4.00
U.S.S.R.	396	1,035	416	436	1.85	3.68
Saudi Arabia	1	45	41	565	0.18	3.60
Poland	55	128	470	492	1.86	3.38
West Germany	149	182	410	223	2.68	2.98
United Kingdom	161	156	430	224	3.05	2.73
Japan	64	251	219	156	0.69	2.12
Italy	30	102	118	147	0.60	1.78
France	75	95	290	133	1.64	1.70
South Korea	3	44	274	374	0.14	1.14
Mexico	15	80	446	609	0.39	0.96
China	215	594	—	2,024	0.33	0.56
Egypt	4	21	688	801	0.17	0.41
Brazil	13	53	228	170	0.17	0.38
India	33	151	388	655	0.08	0.19
Indonesia	6	28	337	403	0.06	0.16
Nigeria	1	9	78	359	0.02	0.09
Zaire	1	1	—	183	0.04	0.03
World	2,547	5,599	411	327	0.82	1.08

Source: Worldwatch Institute.



Sources: Oak Ridge National Laboratory; Worldwatch Institute.

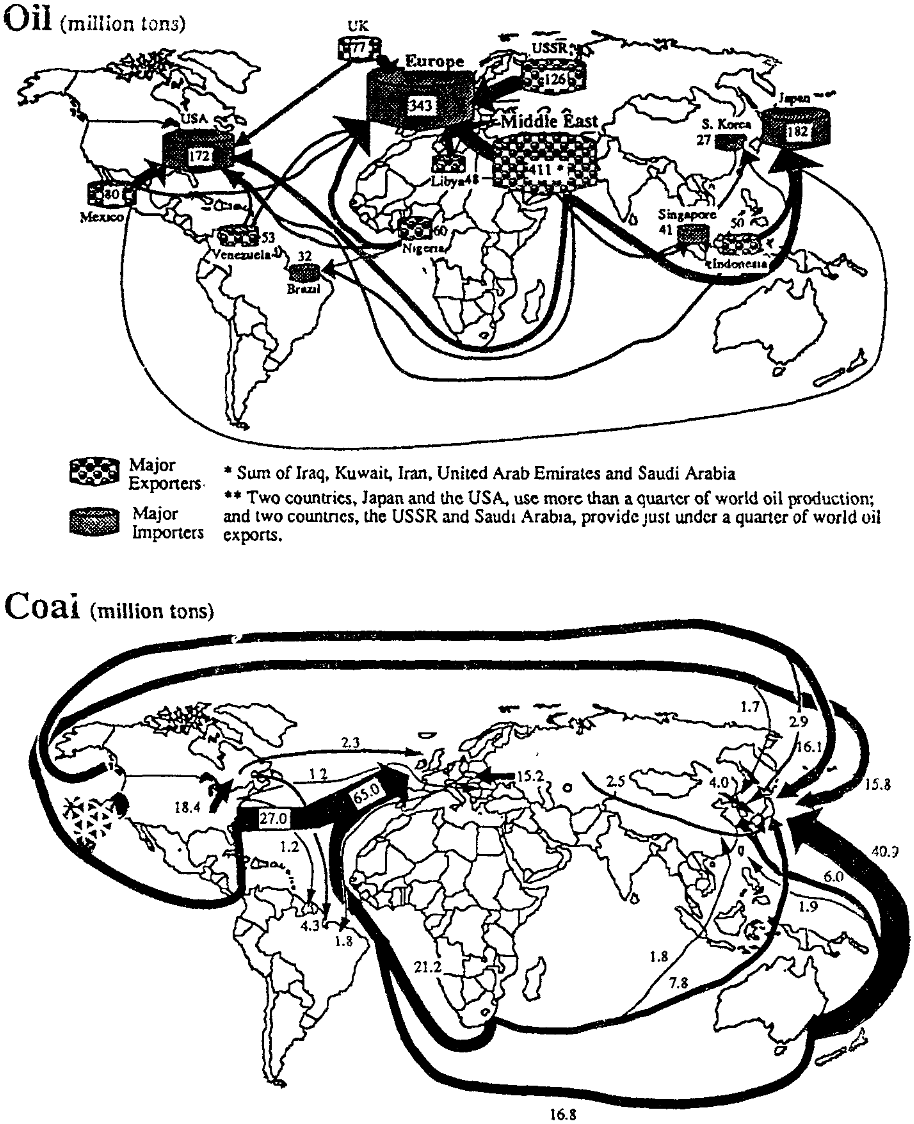
Figure 6. Carbon Emissions from Fossil Fuels: 1955～1988



Source: United Nations Environment Programme. 1987. *The State of the World Environment.*

Figure 7. Total World Emissions of Common Air Pollutants from Human Activities in 1980

greenhouse gases, lagging the rest of the world only in the release of dust into the air (Fig. 7). In this circumstance, the concentration of national efforts in the industrialized orbit on the economical(to them) strategy of combatting the effects rather than the causes of global warming is tantamount to demanding international acceptance of the long-standing inequality of responsibility in the degradation of nature. The industrialized world's



Sources: UN, *Yearbook of World Energy Statistics* ; *BP* ; CIA, *World Oil Market* (as produced in *The New State of the World Atlas*, 1987)

Figure 8. International Movement of Oil and Coal: 1984 commitment to commodification deprived the South of its right to choose the appropriate relation of society with nature. At the very least, the industrialized countries owe the South the opportunity now to decide their relation with nature without further damage from the (in) actions of the North.

As the principal source of global environmental and technological threat, the existing world political economy of inequality and its corresponding development regime of commodified nature cannot be assumed as the structural context for designing rational, efficient or feasible solutions. Burden sharing, emissions trading and related proposals, when contemplated within the current institutional framework, can all too easily become forms of industrial escape from problems the industrialized countries have caused (and benefiitted by). Instead of an exploitive politics of efficiency, industrial efforts should be guided by principles of equality and ecological balance in restructuring their social relations of energy, environment and development. This specifically requires a redistribution of economic and technological capacity sufficient to end the underdevelopment of the South and to redirect world development along as ecologically balanced, equitable path.

Indeed, it would be irresponsible for the industrialized orbit to choose the "cheaper" strategy when *only* they have this option available. The poor countries cannot afford the consequences of a decision by the rich to wait and see. As the beneficiaries of a structure of worldwide inequality in energy supply(Fig. 8), industrial capacity(Fig. 9), capital(Fig. 10), and purchasing power(Fig. 11), these countries have enjoyed the material fruits of commodification at the expense of the world commons. Addressing only the effects of 300 years of commodification destines the poor to remain poor. Unless conditions of global inequality are changed, the poor will be forced to adopt development choices which largely imitate the energy-intensive economies of the industrialized group. After all, the borrowed capital, transferred technology and traded commodity which dominate transactions between rich and poor will continue to be the product of energy-intensive economics. But the spiral of commodified nature deepens with each addition of imitators. This is why, as Durning has observed, the environmental crisis and the crisis of unequal development must be solved together. They are, structurally, the same problem(Durning, 1989:67):

> Over the long run, fossil use in industrial countries may be the most important determinant of the global poverty rate. Every year that passes without an international accord to reduce greenhouse gas emissions in effect dooms millions more to live as paupers. Conversely, insofar as deforestation contributes to global warming, and poverty to deforestation, poverty alleviation has a place in any comprehensive climate protection plan.

(value of gross manufacturing output)

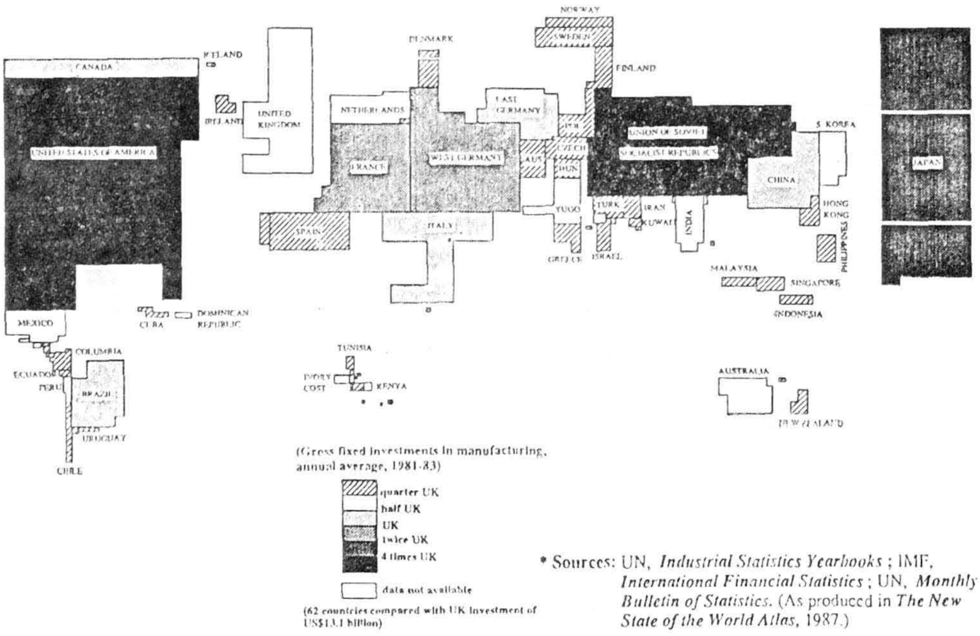


Figure 9. International Distribution of Industrial Power: 1981~1983

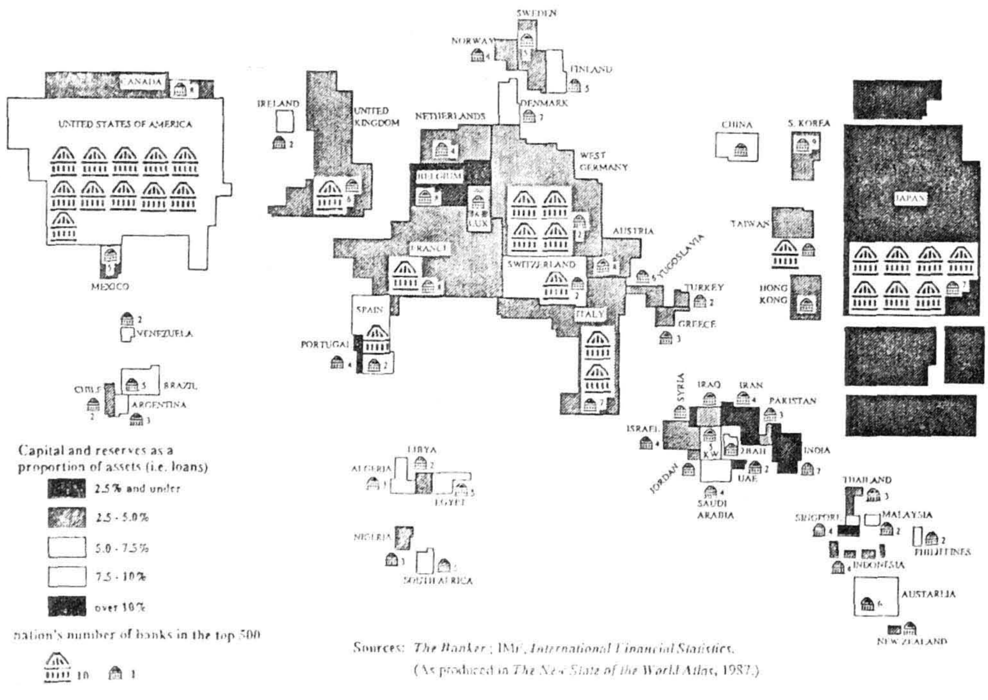


Figure 10. International Distribution of Commercial Capital: 1985

(national shares of total world GNP)

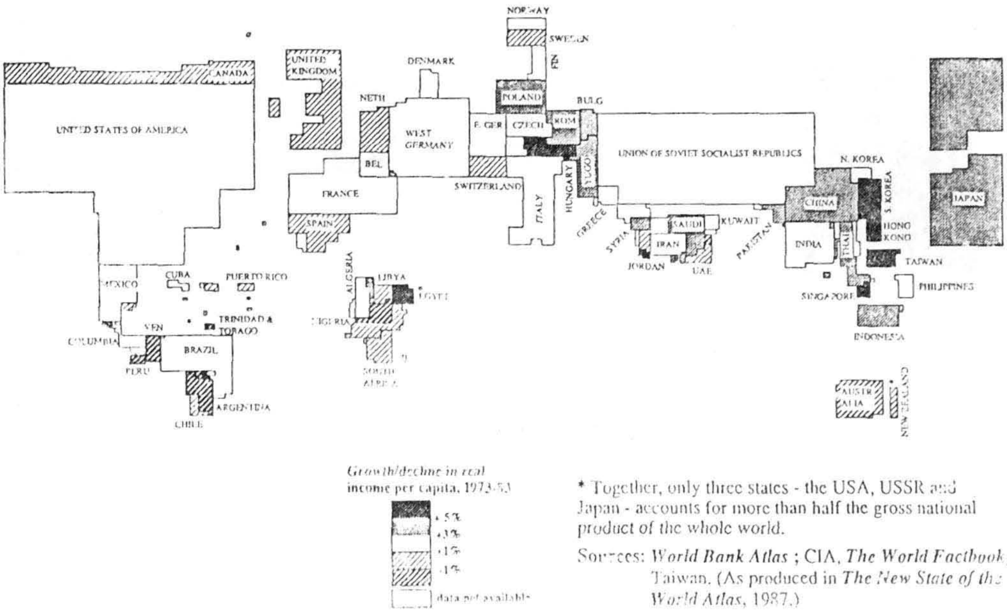


Figure 11. International Distribution of Purchasing Power: 1984~1985

Until now, alternative paths of energy, environment and development have been opposed by the industrialized countries, leaving economic imitation or isolation as the practical realities of Third World choice. In this circumstance, the Third World's future is held hostage by the twin forces of unequal development and environmental degradation. It is in the common interest of these societies to break free of the spiral of poverty by restructuring not only their economic relations with the already industrialized, but their energy and environmental relations, as well. It is in the interest of all who desire a peaceful, democratic future to demand responsible action by the industrialized countries to correct the problems they have created. Finally, it is in the common interest of life on earth for human prosperity to be realized through sustainable development, as called for in the report of the World Commission of Environment and Development(1987), rather than environmental and social commodification.

〈References〉

Agnew, Harold B. "Civilian Uses of Nuclear Power: Status and Future." *Proceedings of the Symposium on Energy: Challenges and Opportunities for the Middle Atlantic States*, vol. 2. Baltimore, MD: Johns Hopkins University, Energy Research Institute. 1983.

Anderson, Jane et al. "Decommissioning Commercial Nuclear Power Plants." Minneapolis, MN: Center for Urban and Regional Affairs, University of Minnesota. 1980.

Basalla, George. "Energy and Civilization." In Chauncey Starr and Philip C. Ritterbush (eds.), *Science Technology and the Human Prospect*. New York, NY: Pergamon Pres. 1980.

Byrne, John and Daniel Rich. "In Search of the Abundant Energy Machine." in J. Byrne and D. Rich, (eds.) *The Politics of Energy, Research and Development*. New Brunswick, NJ: Transaction Books. 1986.

Byrne, John and Steven M. Hoffman. "Nuclear Power and Technological Authoritarianism." *Bulletin of Science, Technology and Society*, Vol. 7:658-671. 1988.

Camilleri, Joseph A. *The State and Nuclear Power: Conflict and Control in the Western World*. Thetford, Norfolk, U.K.: Wheatsheaf Books. 1984.

Committee on Science, Engineering and Public Policy(COSEPUP). *Policy Implications of Greenhouse Warming*. Washington, DC: National Academy Press. COSEPUP is a joint committee of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine(U.S.). 1991.

Dickens,, Charles. *A Tale of Two Cities*. New York: Bantam Books. Originally published in 1859), 1983.

Durning, Alan B. *Poverty and the Environment: Reversing the Downward Spiral*. Worldwatch Paper 92. 1989.

Easton, Robert. *Black Tide: The Santa Barbara Oil Spill and its Consequences*. New York: Delacorte Press. 1972.

Engler, Robert. *The Brotherhood of Oil: Energy Policy and the Public Interest*. Chicago: the University of Chicago Press. 1977.

Flavin, Christopher. *Slowing Global Warming: A Worldwide Strategy*. Worldwatch Paper 91. 1989.

French, Hilary F. *Clearing the Air: A Global Agenda*, Worldwatch Paper 94. 1990.

Lashof, Daniel A. and Dennis A. Tirpak(eds.). *Policy Options for Stabilizing Global Climate: Draft Report to Congress*. U.S. Environmental Protection Agency. 1989.

Lovins, Amory B. *Soft Energy Paths: Toward a Durable Peace*. New York: Harper and Row. 1977.

Lovins, Amory B., et al. "Nuclear Power and Nuclear Bombs." *Foreign Affairs* (Summer): 1137-1177. 1680.

MacKenzie, James J. *Breathing Easier: Taking Action on Climate Change, Air Pollution, and Energy Insecurity*. World Resources Institute. 1989.

Mumford, Lewis. *Technics and Civilization*. New York: Harcourt Brace. 1934.

Mumford, Lewis. *The City in History: Its Origins, Its Transformations, and Its Prospects*. New York: Harçourt Brace Jovanovich. 1961.

Postel, Sandra. *Air Pollution, Acid Rain, and the Future of Forests*. Worldwatch Paper 58. 1984.

Schell, Jonathan. *The Fate of the Earth*. New York: Knopf. 1982.

Weinberg, Alvin M. "Nuclear Energy." *Foreign Affairs*. Vol. 49, No. 3(April):407-418. 1971.

Weinberg, Alvin M. "Social Institutions and Nuclear Energy." *Science*. Vol. 177, No. 4043(July):27-34. 1972.

Weinberg, Alvin M. "Salvaging the Atomic Age." *Wilson Quarterly*(Summer):88-112. 1979.

World Commission on Environment and Development. *Our Common Future*. New York: Oxford University Press. 1987.