Acid Precipitation in North America: The Case for Transboundary Cooperation

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* The opinions expressed in this article are those of the authors; they do not reflect the position of any office or agency of the Canadian Government.

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I. INTRODUCTION

Long-range air pollution has emerged as a serious environmental problem in Europe and North America since the early 1950s. The most critical aspect of this problem is the movement over very long distances of airborne pollutants which eventually are deposited in harmful acid compounds.[1] These pollutants originate in a multiplicity of stationary and mobile emission sources. Because the original pollutants undergo chemical changes during the atmospheric transport, the pollutants which ultimately cause damage are chemically different from the original emissions. Moreover, the pollutants, which are usually deposited in the form of rain or snow, cause harm only in special physical and biological circumstances and after long periods of accumulation.[2] Even a su-

1. A distinction should be drawn between the closely related phenomena of long-range transport and acid precipitation. The former is simply the long distance movement of pollutants through the atmosphere by wind. The latter refers to the chemical nature of precipitation, which becomes more acidic when pollutants are further oxidized, causing a release of hydrogen ions in solution. Whelpdale, Atmospheric Transport and Acidic Precipitation, in Environment Canada, Notes on the Technical Briefing on the Long-Range Transport of Air Pollutants 1-2 (Mar. 13, 1979) (unpublished paper).

2. The scientific sections of this paper are partially based upon discussion with scientists from Environment Canada and the United States Council on Environmental Quality. We gratefully acknowledge their assistance, but accept total responsibility for all interpretations, inferences, and conclusions. The technical literature on the subject is voluminous. A brief account of the problem in North America is given in UNITED STATES-CANADA RESEARCH CONSULTATION GROUP ON THE LONG-RANGE TRANSPORT OF AIR POLLUTANTS, THE LRTAP PROBLEM IN NORTH AMERICA: A PRELIMINARY OVERVIEW (Oct. 1979) [hereinafter cited as PRELIMINARY OVERVIEW]. The lay reader may also find the following popular works useful: R. HOWARD & M. PERLEY, ACID RAIN: THE NORTH AMERICAN FORECAST (1980); P. WELLER, ACID RAIN: THE SILENT CRISIS (1980). For more technical, but intelligible, information, see Hidy, Mahoney & Goldsmith, *International Aspects of the Long Range Transport of Air Pollutants*, U.S. DEP'T OF STATE, Doc. P-5252 (Sept. 1978); A. STERN, AIR POLLUTION (3d ed. 1976-77); Barnes,

perficial discussion of the acid precipitation problem brings out the special difficulties confronting policymakers who must attempt to devise effective pollution control strategies. These difficulties extend beyond the areas of science and technology to law and the social sciences.[3]

The prevailing winds in North America generally flow from west to east, but they vary seasonally, especially in the Great Lakes region (figure 1).[4]

These winds transport the pollutants which cause acid precipitation. Superimposition of a map of wind currents over a map of industrial activity and concentration of fossil-fired power generation stations (figures 2 and 3)[5] shows that certain regions, in particular eastern Canada, New England, and upstate New York, are exposed to long-range pollution emitted chiefly from an immense industrial megapolis extending from Boston and New York in the east to Chicago and St. Louis in the west. The most prevalent region of emissions in Canada is comprised of a much smaller strip of land on the north coast of Lake Ontario from Niagara Falls to Oshawa, a group of giant smelters in northwest and central Ontario centered on Sudbury, and the city of Montreal.

The primary pollutants involved in acid precipitation are nitrogen oxides (NO_x) and sulfur dioxide (SO_2). Nitrogen oxides result primarily from vehicle exhaust and power generation. Most sulfur dioxide emissions come from nonferrous smelting and fossil

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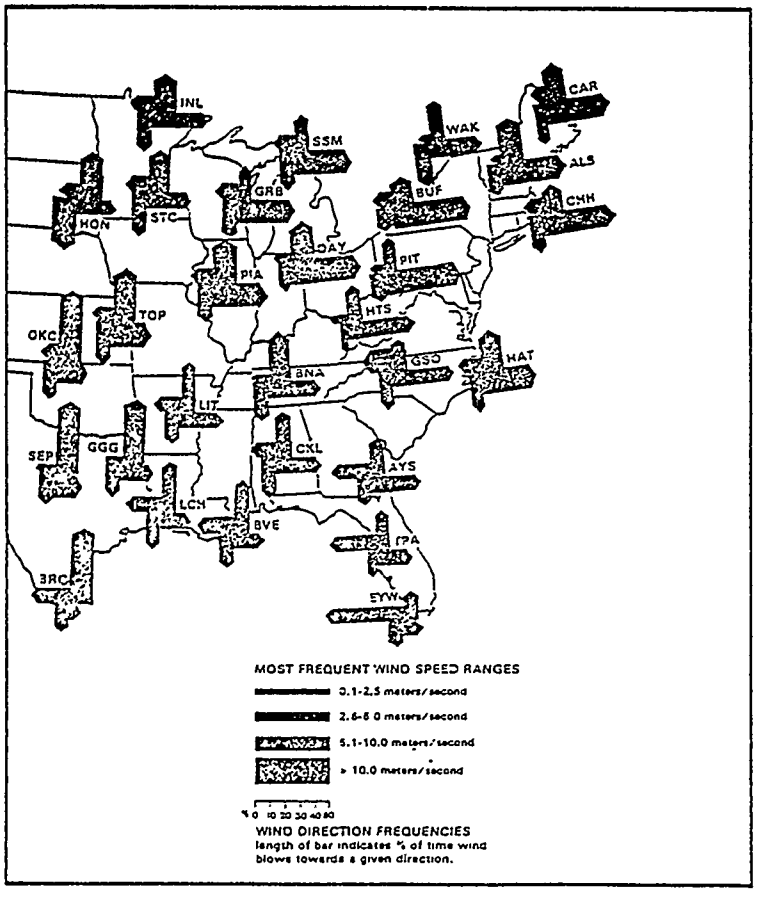
The Long-Range Transport of Air Pollution: A Review of European Experience, 29 J. OF AIR POLLUTION CONT. A. 1219 (1979); Shaw, *Acid Precipitation in Atlantic Canada*, 13 ENVT'L SCI. & TECH. 406 (1979); B. FREEDMAN & J. OGDEN, SOURCES AND CONSEQUENCES OF ACID RAIN IN NOVA SCOTIA (Nova Scotia Resources Council 1981); Likens, Wright, Galloway & Butler, *Acid Rain*, SCIENTIFIC AM., Oct. 1979, at 43; WORKSHOP ON ACID RAIN, INSTITUTE ON RESOURCE AND ENVIRONMENTAL STUDIES, DALHOUSIE UNIVERSITY, (S. Guppy ed. 1981).

3. *See, e.g.*, Hidy, Mahoney & Goldsmith, *supra* note 2; I. VAN LIER, ACID RAIN AND INTERNATIONAL LAW (1981); Campbell & Heath, *Air Pollution Legislation and Regulations*, 5 A. STERN, *supra* note 2, at 355-79; Lutz, *Managing a Boundless Resource: U.S. Approaches to Transboundary Air Quality Control*, 11 ENVT'L L. 321 (1981); Munton, Acid Rain: Silver Clouds Can Have Black Linings, INT'L PERSPECTIVES 6 (Jan.-Feb. 1981); Wetstone, *Air Pollution Control Laws in North America and the Problem of Acid Rain and Snow*, 10 ENVT'L L. REP. 50001 (1980).

4. PRELIMINARY OVERVIEW, *supra* note 2.

5. *Id.*

Figure 1


INL
SSM
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HAT
BNA
LIT
SEP
GGG
CXL
AYS
LCH
BVE
IPA
BRC
EYW
MOST FREQUENT WIND SPEED RANGES
0.1-2.5 meters/second
2.6-5.0 meters/second
5.1-10.0 meters/second
> 10.0 meters/second
% 0 10 20 30 40 50
WIND DIRECTION FREQUENCIES
length of bar indicates % of time wind
blows towards a given direction.

fuel-fired power generation. Considerably more SO_2 results from the smelting industry than from power generation and vehicular transportation. The reverse situation exists in the United States, where power generation and vehicular transportation are the major sources for SO_2 and NO_x respectively, and smelting is a far less significant source of SO_2.[6] The NO_x and SO_2 produced in Canada and the United States are transported by the prevailing winds within and between the two countries. The variability of the winds and the multiplicity of sources combine to render difficult any estimate of total transboundary movements of pollutants. It has been calculated, however, that in January and August 1979 the amount of SO_2 deposited in southern Ontario and Quebec from sources in the United States was roughly 50,000 and 68,000 tons respectively, while the amount deposited in the United States from sources in sourthern Ontario and Quebec during the same months was approximately 38,000 and 21,000 tons. Researchers have also estimated that deposits of sulfur in southern Ontario and Quebec from Canadian sources amounted to 110,000 and 100,000 tons for January and August 1977, respectively.[7] Deposits within the United States from United States sources may be assumed to be considerably higher than those from Canadian sources.

The long-range movement of SO_2 and NO_x constitutes a significant environmental threat when these primary pollutants are modified by chemical processes in the atmosphere. Because of the sensitivity of the environment, the modified chemicals are able to cause detrimental changes to ecological systems. Evidence indicates that two types of chemical changes occur between the time NO_x and SO_2 are emitted from a pollution source and the time they are returned to earth either as precipitation or in a dry form. The transformation of sulfur and nitrogen oxides to sulphuric acid and nitric acid or to sulfates represents one such change.[8] The second chemical change involves increased ozone concentrations and photochemical haze, which are associated in the sum-

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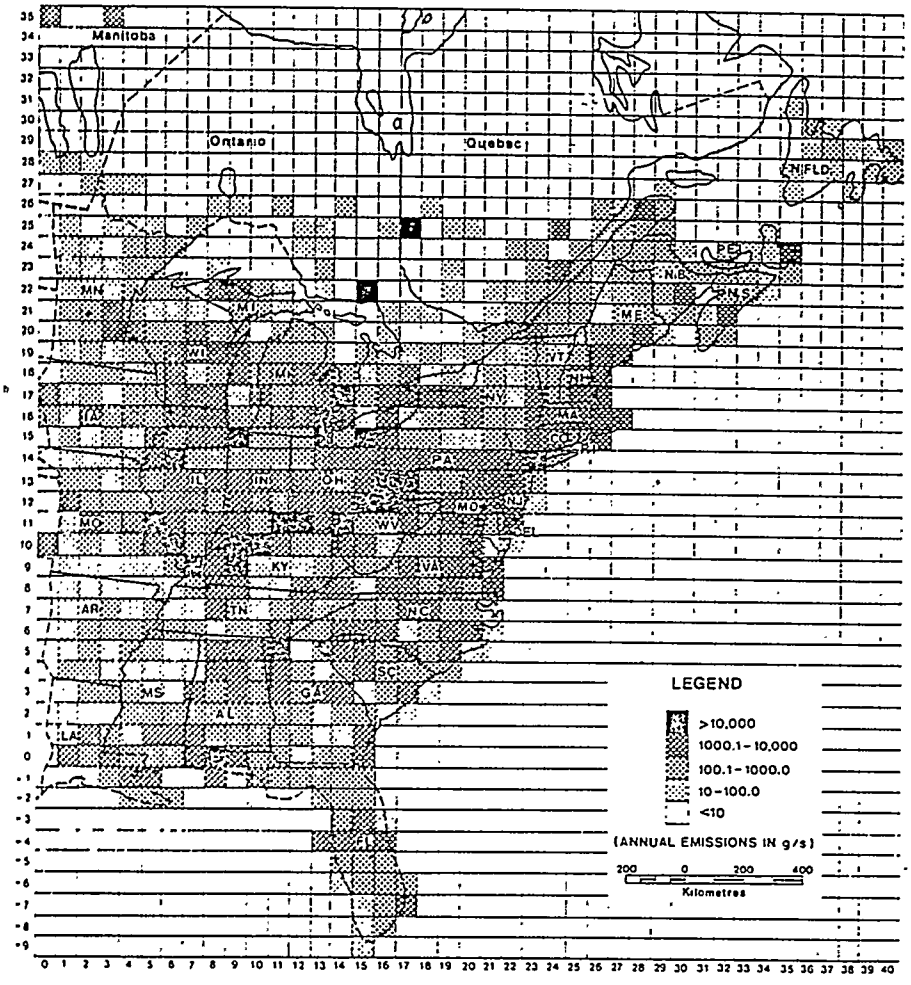
6. WORK GROUP 3A, UNITED STATES-CANADA RESEARCH CONSULTATION GROUP ON THE LONG-RANGE TRANSPORT OF AIR POLLUTANTS, STRATEGIES DEVELOPMENT AND IMPLEMENTATION (Feb. 1981) (Interim Report) [hereinafter cited as STRATEGIES, Interim Report].

7. PRELIMINARY OVERVIEW, *supra* note 2, at 12-14.

8. On sulfur oxides, see Urone & Schroeder, *Atmospheric Chemistry of Sulfur-containing Pollutants*, in 1 SULFUR IN THE ENVIRONMENT 297 (J. Nriagu ed. 1978). On nitrogen oxides, see H. PERKINS, AIR POLLUTION 289-316 (1974).

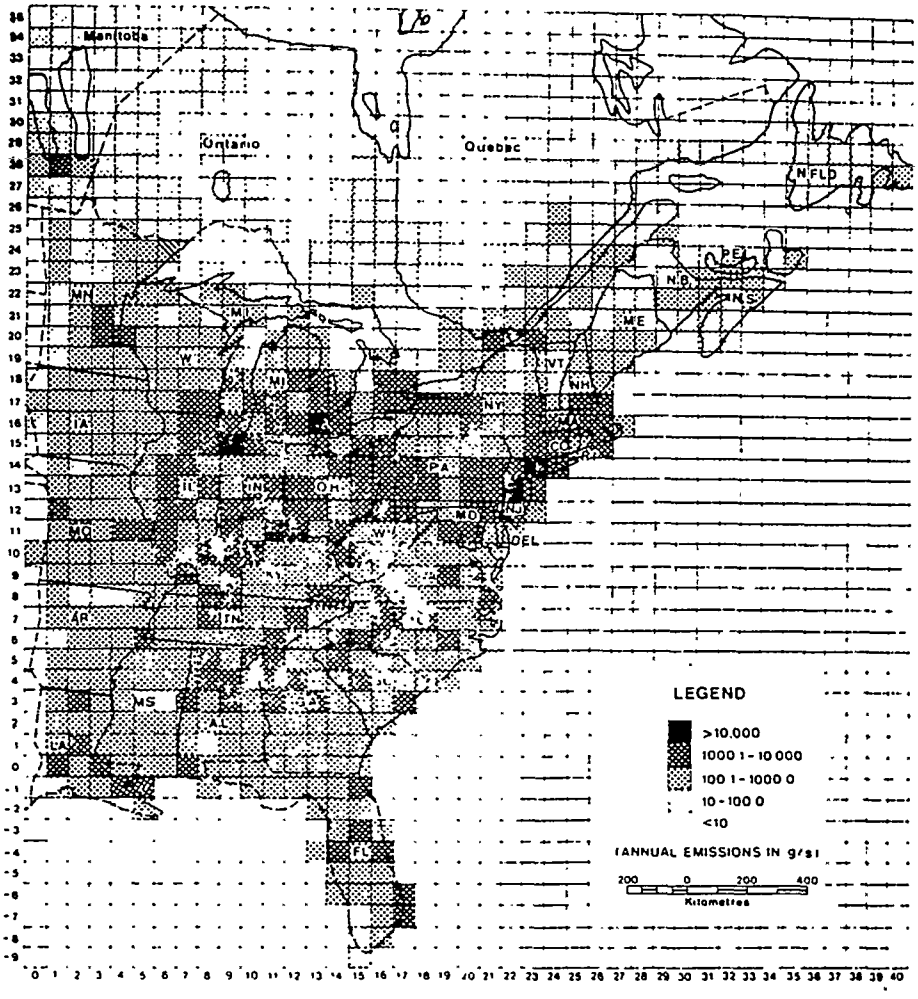
Figure 2



MAGNITUDE AND DISTRIBUTION OF SULPHUR DIOXIDE (SO_2) EMISSION IN EASTERN NORTH AMERICA

Source U.S.A. emissions from SURE □ data base.
Canadian emissions from Environment Canada.

Figure 3



. MAGNITUDE AND DISTRIBUTION OF EMISSIONS OF NITROGEN OXIDES (NO_x) IN EASTERN NORTH AMERICA

Source: U.S.A. emissions from SURE II data base
Canadian emissions from Environment Canada

mer months with long-range movement of air masses from the eastern United States to various parts of Canada.[9] Evidence suggests that this increase in summer haze may date back to 1953.[10] Finally, there is concern among some scientists that the long-range movement of toxic materials, trace metals, and organic materials may be associated with the long-range transport of SO_2 and NO_X, but this possibility has not yet been verified.[11]

The chemical transformations which produce the sulphates, acid precipitations, and ozones from SO_2 and NO_X occur quickly but not instantaneously; these secondary pollutants are deposited either in a dry form or in acid precipitation within a matter of days. Thus, the bulk of long-range pollution from SO_2 and NO_X is probably limited in scope to distances of 1000 to 1500 miles, although some reduced concentrations may travel further. The exact distances involved in the long-range transport of SO_2 and NO_X are difficult to measure with precision, but evidence exists that increased haze in Wabash, Labrador is associated with southerly flows of winds from Boston and New York.[12] Similarly, most atmospheric models suggest that emissions from the midwest United States can affect eastern Canada.[13] On the other hand, SO_2 and NO_X and associated pollutants such as organics, trace metals, and toxic materials may well be a global pollution problem. There is evidence of organic materials and trace metals in the Arctic and other remote areas which indicates that long-range air pollution may not be limited to the Western Hemisphere.[14]

The physical problem of long-range pollution is complicated by the fact that these pollutants cause harm only in certain regions.

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9. AIR MANAGEMENT SECTOR GROUP ON THE PROBLEM OF PHOTOCHEMICAL OXIDANTS AND THEIR PRECURSORS IN THE ATMOSPHERE, OECD, PHOTOCHEMICAL OXIDANT AIR POLLUTION (1975).

10. Munn, Secular Increases in Summer Haziness in the Atlantic Provinces, 11 ATMOSPHERE 156 (1973).

11. This concern was expressed in interviews with scientists in Canada and the United States.

12. Munn, *supra* note 10.

13. Whelpdale, *supra* note 1; Shaw, *supra* note 2.

14. This data was acquired through private interviews with Canadian scientists. On global environmental effects generally, see THE CHANGING GLOBAL ENVIRONMENT (S. Singer ed. 1975). *See also* WMO, PAPERS PRESENTED AT THE WMO SYMPOSIUM ON THE LONG-RANGE TRANSPORT OF POLLUTANTS AND ITS RELATION TO GENERAL CIRCULATION INCLUDING STRATOSPHERIC/TROPOSPHERIC EXCHANGE PROCESSES, WMO No. 538 (1979).

For example, it is possible for emissions to originate in Michigan and move hundreds of miles to northern New York or Ontario before encountering a region that is susceptible to harm. A susceptible area is almost always a poorly buffered geological region, and it may be affected in many ways. The impact upon lake water[15] is perhaps the best-documented of the various effects of acid precipitation. Constant deposits of acid compounds gradually reduce the buffering capacity of a susceptible lake and promote a more rapid process of acidification. As the water becomes more acidic, the fish begin to die. Young fish and the reproductive cycles of mature fish are affected first, but eventually all forms of life, including plants are affected. Acid precipitation not only affects freshwater lakes through the gradual process of acidification, but it also has a "shock" impact during short episodes of high acidification. Heavy rains or rapid spring melts expose streams, rivers, and lakes to sudden "acid shock" which can kill fish fry.[16] Acid precipitation may also have complex effects on soils in geologically sensitive regions. These effects can involve, in some cases, both an increase in soil acidity and the mobilization of possibly toxic elements such as aluminum, magnesium, or iron, chemicals which also are thought to have adverse effects on plant growth.[17] It is possible that acid precipitation and the associated photochemical processes which produce increased haze and ozone may affect some biota on direct contact. Evidence does exist which suggests that acid precipitation and other components of long-range transport are accelerating the deterioration of many

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15. *See, e.g.*, Almer, Dickson, Ekström & Hornström, *Sulfur Pollution and the Aquatic Ecosystem*, in 2 J. Nriagu, *supra* note 8, at 271-311; Beamish, Lockhart, Van Loon & Harvey, *Long Term Acidification of a Lake and Resulting Effects on Fishes*, 4 AMBIO 98 (1975); Gorham, *Acid Precipitation and its Influence on Aquatic Ecosystems: An Overview*, 6 WATER, AIR & SOIL POLLUTION 457 (1976); and Wright & Gjessing, *Acid Precipitation: Change in the Chemical Composition of Lakes*, 5 AMBIO 219 (1976).

16. Almer, Dickson, Ekström & Hornström, *supra* note 15, at 306-07; STRATEGIES, Interim Report, *supra* note 6, at 16.

17. *See, e.g.*, Knabe, *Effects of Sulfur Dioxide on Terrestrial Vegetation*, 5 AMBIO 213 (1976); Malmer, *Acid Precipitation: Chemical Changes in the Soil*, 5 AMBIO 231 (1976); Nyborg, *Sulfur Pollution and Soils*, in 2 Nriagu, *supra* note 8, at 359-90; Tamm, *Acid Precipitation: Biological Effects in Soil and on Forest Vegetation*, 5 AMBIO 235 (1976); STRATEGIES, Interim Report, *supra* note 6, at 12-15. *See also* NATO SCIENTIFIC AFFAIRS DIV., EFFECTS OF ACID PRECIPITATION ON VEGETATION AND SOILS (T. Hutchinson & M. Havas eds. 1980).

man-made structures.[18] While direct effects on health have yet to be convincingly demonstrated at the low dosages which are typical of long-range air pollution, at least one indirect impact of acid precipitation gives reason for concern. Drinking water drawn from affected lakes or streams may cause leaching in metal pipes, thus producing an increase in certain heavy metals which could be detrimental to human health.[19]

From a legal or institutional perspective, it is extremely difficult to distinguish the effects attributable to *domestic* pollution sources from those caused by *foreign* sources.[20] As a result it is scarcely possible to attribute culpability for damage to any particular emission source. Legally, therefore, the long-range transport problem must be differentiated from short-range air pollution situations in which damage can sometimes be attributed to particular sources and remedies may be provided to pollution victims within a system for the allocation of entitlements and responsibilities. Any direct regulatory approach to the establishment of effective control over the long-range transport problem seems inevitably to involve increased economic costs and, therefore, political resistance.

Long-range air pollution threatens a vast rectangular corridor of the continent whose corners are approximately represented by New York, St. Louis, Winnipeg, and Labrador City. The areas being damaged by acidification from SO_2 and NO_x pollution include the entire Canadian shield as well as other geologic regions in both Canada and the United States. Hundreds of lakes in both Canada and the United States have been severely affected, and

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18. Kucera, *Effects of Sulfur Dioxide and Acid Precipitation on Metals and Anti-Rust Painted Steel*, 5 AMBIO 243 (1976); Nriagu, *Deteriorative Effects of Sulfur Pollution on Materials*, in 1 J. Nriagu, *supra* note 8, at 1; STRATEGIES, Interim Report, *supra* note 6, at 18.

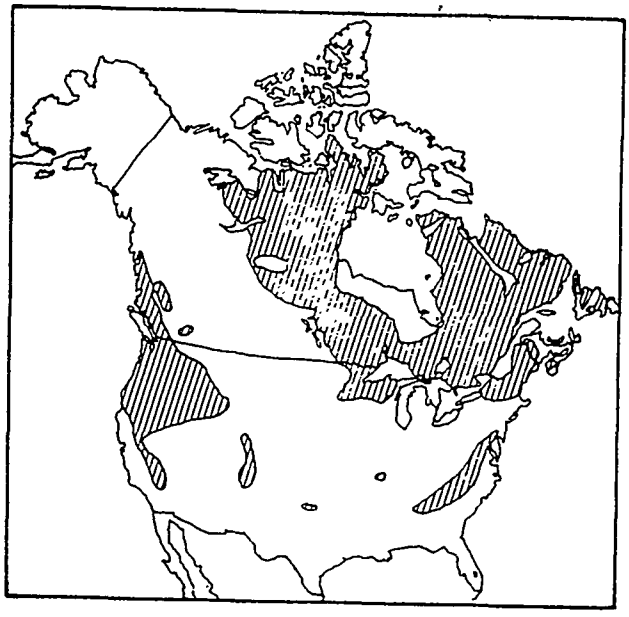
19. Coffin & Knelson, *Acid Precipitation: Effects of Sulfur Dioxide and Sulfates on Human Health*, 5 AMBIO 234 (1976); STRATEGIES, Interim Report, *supra* note 6, at 16-17. On related health concerns, see L. LAVE & E. SESKIN, AIR POLLUTION AND HUMAN HEALTH (1977); Coffin & Knelson, *Acid Precipitation: Effects of Sulfur Dioxide and Sulfate Aerosol Particles on Human Health*, 5 AMBIO 239 (1976); Goldsmith & Friberg, *Effects of Air Pollution on Human Health*, *in* 2 A. STERN, *supra* note 2, at 457-610; Knelson & Lee, *Oxides of Nitrogen in the Atmosphere: Origin, Fate and Public Health Implications*, 6 AMBIO 126 (1977); Shy, *Health Consequences of Human Exposure*, in 2 J. Nriagu, *supra* note 8, at 75-108.

20. On international aspects generally, see Hidy, Mahoney & Goldsmith, *supra* note 2; Lutz, *supra* note 3, at 365-72.

thousands of others are potentially threatened (figure 4).[21] The undetermined effects on forestry and agriculture could be economically devastating, especially in those areas of Canada which are dependent on these industries. While one might attempt to quantify the potential environmental damages resulting from long-range pollution by SO_2 and NO_x, this data could never convey the magnitude of the potential disaster. The endangered areas of Canada and the United States encompass a forested region which is interspersed by thousands of lakes and steams. The ruin has begun, and it may soon be irreversible.

Figure 4

North American Areas Containing Lakes That Are Sensitive to Acidification by Acid Precipitation



Source: James N. Galloway and Ellis B. Cowling, "The Effects of Precipitation on Aquatic and Terrestrial Ecosystems — A Proposed Precipitation Chemistry Network," *Journal of the Air Pollution Control Association* 28, no. 3 (March 1978): 229-235, figure 5.

21. PRELIMINARY OVERVIEW, *supra* note 2.

II. Control Issues and Techniques

The resolution of any air pollution control problem requires an analysis of two basic issues:[22] the anticipated harm, and the spatial dimensions that should be considered relevant in addressing that harm. For example, let us assume that the air pollution control agency in a hypothetical medium-sized city is concerned with eye irritation, odor, and possible health problems caused by fly ash resulting from NO_x and SO_2 emissions from a number of local power plants. With regard to the first issue, the emission levels should be reduced sufficiently to eliminate eye irritation and other adverse health effects; in addition, the odor of the pollutants must be brought down to a tolerable level. An analysis of the second issue might result in a conclusion that emission controls should reduce the level of pollution over the entire city and its suburban areas.

This hypothetical situation illustrates the type of information needed in the evaluation or selection of any air pollution control strategy. In the example above, the desired degree of control at street level in the city and suburbs could be achieved through one of two means (figure 5).

The total pollutants emitted from the plants might be *removed or reduced* through various techniques; alternatively, the emissions could be dispersed by siting plants in a more satisfactory manner, building taller smoke stacks, or releasing emissions only when winds are above a certain speed. For the most part, dispersal techniques are a cheap, simple, and practical first step toward achieving a desired level of control in a given spatial area. More complex and expensive processes which remove pollutants, rather than disperse them, are used when dispersal techniques alone would fail to achieve the desired level of control at ground level in a certain spatial area. Removal techniques, historically have been thought necessary only when pollutants that clearly pose a risk to human life are involved.

Air pollution control legislation in North America is based upon the assumption that most pollutants can be rendered harmless by downwind dispersal. Consistent with this premise,

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22. For a conceptual introduction to air pollution control, see First, *Control of Systems, Processes and Operations,* in 4 A. Stern *supra* note 2, at 3-39.

Figure 5

Air Pollution Control Techniques
The Principal Modes

Dispersal Techniques			*Removal or (Loading) Reduction Techniques*		
1	2	3	4	5	6
site placement	high stacks	controlled release	fuel switching	fuel alteration	a variety of techniques for the removal of SO_2 and NO_x flue gas (e.g. scrubbing)
Note: All three dispersal techniques depend upon a scientific assessment of "assimilative capacity" for a given locality or region.			*Note:* Techniques 4 and 5 are adopted at the precombustion stage. Technique 6 is implemented at the post-combustion stage.		

the United States and Canadian Clean Air Acts, whose major purpose is to establish minimal air quality standards in designated regions, impose more stringent industrial emission control standards only on new plants (under the United States statute) and on hazardous substances (under both United States and Canadian legislation).[23] The legislative approach adopted by each nation generally reflects a basic disinclination to impose stringent controls for the removal or reduction of SO_2 and NO_x emissions from existing industrial plants except when a danger to life is believed to exist. This reluctance is easily understood in light of the economic costs involved in imposition of such controls.[24]

Many of the techniques available for the dispersal, reduction, or removal of SO_2 and NO_x from emissions involve considerable initial capital outlays and high operating expenses.

Dispersal techniques such as site placement, high stacks, and controlled release in optimal wind conditions are typically the cheapest forms of local pollution control. These techniques do not affect the total amounts of pollution deposited downwind, how-

23. *See* text part III(C) *infra* and accompanying footnotes.

24. *See, e.g.*, Babcock, *Sulfur Dioxide Emission Control: Costs and Benefits*, in 1 J. Nriagu, *supra* note 8, at 85-122.

ever, and may actually exacerbate long-range pollution by permitting the distribution of emissions into the air currents rather than permitting deposition to take place locally. Clearly, dispersion must be recognized as part of the problem, rather than the solution, of long-range pollution by acid precipitation. The real solution must be found in a combination of removal and reduction techniques. First, there are a number of pre-combustion techniques for reducing the "loading" of pollutants. In certain circumstances, fuel switching for power stations or process conversion for nonferrous smelters can be effective and inexpensive methods of reducing SO_2 and NO_x emissions.[25] Fuels can also be chemically converted from coal to gas to achieve very substantial reductions in emissions, but with the present cost of fuel the process is not economically feasible. It is also possible by various physical or chemical processes to remove up to one third of the sulfur from fuels such as coal or oil prior to use. Desulfurization is expensive, but in certain circumstances it produces useful and saleable by-products.

Once the fuel is burned, a variety of techniques must be used to remove SO_2 and other pollutants. These post-combustion reduction techniques are costly, however, and the resulting solid or liquid wastes cause difficult disposal problems and further expenses. Although flue gas scrubbers of various designs are capable of removing large quantities of sulfur from emissions from power plants or smelting operations, the required equipment is costly and may be susceptible to breakdowns from corrosion and mechanical problems.[26] Flue gas cleaning may also be accomplished through the use of electric precipitators or other techniques (figure 6). The normal approach to the reduction of NO_x emission has been to alter the combustion process itself. This

25. Mullan, *Reduction of Sulfur Oxide Emissions by Fuel Modification*, in INDUSTRIAL AIR POLLUTION CONTROL 91 (D. Noll ed. 1973). *See also* H. PERKINS, *supra* note 8, at 262-67.

26. There is wide variance in expert opinion concerning the costs and difficulties associated with removal of SO_2 from flue gases. One specialist suggests that reliability is a serious concern. H. PERKINS, *supra* note 8, at 273-85. Another emphasizes the cleaning and maintenance problems due to the build-up of limestone and other materials on cleaning devices. Dewees, *The Costs and Technology of Pollution Abatement*, in APPROACHES TO CONTROLLING AIR POLLUTION 304-05 (A. Friedlander ed. 1978).

Figure 6

REMOVAL EFFICIENCY FOR SO_2

Removal efficiency level, %	*Process*
Higher than 90%	1. Double alkali scrubbing 2. Limestone scrubbing with promoters 3. Coal gasification[a] 4. Regenerable scrubbing processes
90%	1. Limestone scrubbing with promoters 2. Limestone scrubbing 3. Double alkali scrubbing
50-90% (high-sulphur coal)	1. Limestone scrubbing 2. Fluidized bed combustion[a] 3. Chemical coal cleaning[a] 4. Low sulphur fuel substitution 5. Limestone injection multistaged burner[a]
50-90% (low-sulphur coal)	1. Spray drier process 2. Limestone scrubbing
Below 50%	1. Physical coal cleaning (highly variable effectiveness due to coal properties) 2. Blending with low sulphur coal

[a]Used in combination with others if necessary to achieve the required reduction.

has resulted in both the redesign of automotive engines and new methods of operating power stations (figure 7).[27]

Since the expense and difficulty of removing SO_2 and NO_x increase more than proportionately to the degree of control required, the amount of removal necessary is an obvious control issue. There is no easy answer to this question; to some people the value of an undisturbed environment is very great, while to others it may be considerably less. Moreover, the issue regarding the sufficiency of pollutant removal may receive different treatment in the jurisdiction of origin than in the jurisdiction experiencing most of the harm.

It is technically possible to remove more than 99 percent of the SO_2 in industrial emissions and to reduce significantly the emissions of NO_x. This high level of control would impose a heavy financial burden, possibly more than four billion dollars in annual capital costs in the United States for a period of ten years. Canadian costs might be as much as four hundred million dollars per

27. Figures 5 and 6 are drawn from STRATEGIES, Interim Report, *supra* note 6, at 28-29.

year. A complicating problem is that the imposition of stringent controls in either country separately, or the gradual imposition of less than stringent controls in both nations together, can only mitigate the current rate of damage to sensitive ecological systems. The problem is cumulative in nature: the rate of damage can be slowed by a reduction of total deposition, but the damage can be stopped only by the nearly complete elimination of deposits. The amount of removal which is sufficient is easy to determine from an environmental perspective, but difficult to accept or achieve in economic terms. Even if an acceptable level of pollution control were to be agreed upon, the existing legislation in Canada and the United States is ill-suited to the task of controlling long-range air pollution. Each statute was designed to address different air pollution problems and rests on the assumption that pollutants should be controlled through natural dispersion. Moreover, both nations have relied on implementation and enforcement by the states and provinces, an approach which has proven inconsistent and unreliable. Finally, a strict regulatory approach to the problem of air pollution may generate strong ideological resistance in certain quarters, especially in the United

Figure 7

REMOVAL EFFICIENCY FOR NO_x

Removal efficiency level, %	*Process*
90% or higher	1. Catalytic reduction with more than normal amount of catalyst, preceded by combustion modification (except for coal)
50-80%	1. As above, with normal amount of catalyst 2. Combustion modification (all types) followed by non-catalytic reduction (ammonia injection without catalyst) 3. Combustion modification alone (for low part of range so as to minimize boiler problems) 4. Low-NO_x burners (under development)
Below 30%	1. Staged combustion[a] 2. Low-NO_x burners[a] 3. Gas recirculation (except for coal)[a]

[a]Used in combination with others if necessary to achieve the required reduction.

States.[28] Without political backing, there is no way of dealing effectively with acid precipitation in North America.

III. Environmental Control Strategy: Legal and Institutional Approaches

A. *Judicial Remedies: Private Nuisance*

The history of private environmental litigation may seem far removed from the contemporary problem of controlling the long-range transportation of atmospheric pollutants across national boundaries. A brief survey of that history, however, may shed some light on the attitudes of the attorneys and policymakers who are involved in devising an effective strategy for the control of acid precipitation in North America.

The mainstream doctrine of private tort law theoretically provides the remedies of damages and injunction to persons injured as a result of pollution which can be traced to another's wrongful act or omission.[29] To succeed in a tort action, it is generally necessary for the plaintiff to establish a duty of care owed by a defendant who failed to act reasonably in fulfilling that duty. The evidentiary requirements associated with the doctrine of negligence can sometimes be avoided when a strict liability standard is imposed, but such a standard may be both difficult to employ and inequitable in cases not involving ultrahazardous products.[30] Similarly, the law of trespass—a hybrid subset of tort and property law—has proven too technically confining to provide a fruitful

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28. The distaste for excessive government regulation is a familiar feature of political life in North America, and it seems to be on the rise in the United States. This sentiment is normally associated with conservative ideology, rather than with social or personality psychology. For a psychiatrist's view of conservatism, see Wilson, *The Concept of Conservatism*, in The Psychology of Conservatism 3 (G. Wilson ed. 1973).

29. Perhaps more than any other branch of the law, the law of torts is a battleground of social theory. Its primary purpose, of course, is to make a fair adjustment of the conflicting claims of the litigating parties. But the twentieth century has brought an increasing realization of the fact that the interests of society in general may be involved in disputes in which the parties are private litigants.

W. Prosser, Handbook of the Law of Torts 14-15 (4th ed. 1971).

30. Campbell & Heath, *supra* note 3, at 358-59. *But see* Krier, *The Pollution Problem and Legal Institutions: A Conceptual Overview*, 18 U.C.L.A. L. Rev. 429 (1971).

line of development in the law of pollution.[31] Indeed, the only area of tort law regarded as highly relevant to pollution control strategy is that of nuisance.[32]

Common law recognizes two distinct types of nuisance. Public or common nuisance is an act or omission which inflicts damage or injury upon the public at large, materially reducing the level of comfort or convenience to which that public is reasonably entitled. As a general rule, however, a private individual or group of individuals has no right of action against the creator of a public nuisance for damages or injunction unless a particular loss or damage is inflicted upon the plaintiff beyond that commonly suffered by the affected public.[33] Accordingly, the optimal pollution control strategy in tort law rests with the second type of nuisance. A private nuisance is simply "an interference with the use and enjoyment of land."[34] With regard to an action concerning pollution, private nuisance requires proof of a wrongful act or omission which causes or allows the escape of a deleterious substance into the land of another. Such a substance might be in the form of water, smoke, smell, fumes, gas, noise, heat, vibrations, electricity, disease, or germs.[35] Although quite distinguishable from each of these other sources of pollution, acid precipitation can be analogized with smoke, fumes, gas, and germs. Acid rain or snow is arguably an example of an actionable private nuisance, especially in light of the modern tendency to emphasize the element of continuity or repetition as a definitive factor of private nuisance. If acid precipitation can be analogized with these other substances, the plaintiff need only show the existence of the nuisance and the fact that defendant occupies the land from which it emanates in order to discharge the burden of proof.

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31. Campbell & Heath, *supra* note 3, at 357-58.

32. Air pollution was held to be a nuisance as early as 1611 in William Alfred's Case, 77 Eng. Rep. 816 (K.B. 1611), when an injunction and damages were awarded to the plaintiff, whose air was being adulterated by the defendant's pigsty. Nuisance is currently the most widely used remedy in environmental actions, especially in the United States. *See* Russell, *Common Law Environmental Liability Under Federal Statutes,* 11 FORUM 778, 784-90 (1976).

33. W. PROSSER, *supra* note 29, at 604.

34. *Id.* at 591.

35. During the Industrial Revolution in England, courts first began to recognize that the emission of noxious fumes might provide ground for an action in nuisance at common law. *See, e.g.,* St. Helen's Smelting Co. v. Tipping, [1865] 11 H.L.C. 642; Salvin v. North Brancepeth Coal Co., [1974] L.R. 9 Ch. 705.

The matter is not so simple, however. The plaintiff may have to overcome at least three formidable obstacles before he can recover damages or obtain an injunction. The plaintiff first will have to establish damage or injury. The damage need not be pecuniary loss, but it must be material or substantial and not merely speculative—something that might be difficult to prove in an acid rain action for private nuisance. The plaintiff presumably would choose to prove loss of productivity of his property (fresh water or soil) rather than attempt to show injury to his person or to the health, comfort, or convenience of the occupiers of the land subjected to the nuisance. Yet it may be difficult to show that the injury was due to an unreasonable use of the defendant's property if it is utilized for a normal industrial activity. Leading cases involving private nuisance were prevalent in 19th century England, when plaintiffs first complained of injuries due to factory smoke. In one such case, Lord Romilly suggested that the real question was "whether the annoyance is such as materially to interfere with the ordinary comfort of human existence."[36] The inconvenience should be, in the words of an even earlier English court, "more than fanciful, or as one of mere delicacy or fastidiousness," but rather "an inconvenience materially interfering with the ordinary comfort, physically, of human existence, not merely according to elegant or dainty modes of habits of living, but according to plain, sober and simple notions among English People."[37] In a more modern pronouncement, Lord Dunedin stated that the court should look for evidence of "a substantial diminution in the productivity of [the property] and a substantial interference with the amenities, comfort and so on of the people who live there."[38]

The second obstacle to the plaintiff's recovery occurs when the defendant is a body acting under statutory powers. In these situations, the defense may prevail on the ground that the pollution at issue is the inevitable result of an act authorized by legislation.[39] The criterion of inevitability is "not what is theoretically possible, but what is possible according to the state of scientific knowledge at the time, having also in view a certain commonsense apprecia-

36. Crump v. Lambert, [1867] L.R. 3 Eq. 409, 412-13, *aff'd*, 17 L.T.R. (n.s.) 133.

37. Walter v. Selfe, [1851] 20 L.J.K.B. (n.s.) ch. 433, 435 (per Knight Bruce, V. C.).

38. Manchester Corp. v. Farnworth, [1930] A.C. 182.

39. W. STEER, THE LAW OF SMOKE NUISANCES 17-18 (rev. ed. 1938).

tion, which cannot be rigidly defined, of practical feasibility in view of the situation and of expense."[40] In the case of emissions causing acid rain, this defense would normally prevail if the private nuisance complained of was perceived as the inevitable result of an authorized industrial act which conforms with existing statutory control requirements. Accordingly, the sufficiency of private nuisance litigation as a control strategy will depend finally upon the adequacy of emission controls, even if it becomes easy for litigants to avail themselves of common law and equitable remedies in this area of tort law.

The third and most fundamental obstacle to a plaintiff's recovery is that when a substantial injury can be proven and the defense of statutory authority can be overcome, the plaintiff is likely to have extreme difficulty attributing the injury to any one polluter or group of polluters. The insidious and cumulative nature of the acid rain phenomenon seems virtually certain to defeat most efforts to recover damages under the law of private nuisance from the culpable sectors of industry.

Some important lessons can be learned from the history of the doctrine of private nuisance. First, the effectiveness of a pollution control strategy based on traditional tort doctrine depends on the willingness of the judiciary to adjust such doctrine in accordance with changing social needs and opportunities.[41] Second, legal action may not be a viable strategy for dealing with pollution problems shared by two or more countries with different legal traditions. Although the English and United States legal systems proceed from common origins, different judicial attitudes have developed within each country. Specifically, the two have differed markedly in their willingness to balance the equities in private nuisance actions when the plaintiff seeks the equitable remedy of injunction.[42] Third, in the North American context, it should be

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40. Manchester Corp. v. Farnworth, [1930] A.C. 182, 183 (per Lord Dunedin).

41. Provine, *Balancing Pollution and Property Rights: A Comparison of the Development of English and American Nuisance Law*, 7 ANGLO-AM. L. REV. 31 (1978).

42. In preindustrial England, the reasonableness or importance of the defendant's activities had no bearing on the question of liability in a nuisance case. When attempts to obtain the equitable remedy of injunction became more common in nuisance litigation in the mid-19th century, industrial defendants began to argue that the importance of their polluting activities to the local economy had to be considered. The British and Americans acknowledged that nuisance

assumed that Canadian judges will continue to adhere to the English view rather than to the United States attitude toward the function of judicial process in socially controversial areas of legal development. Convergence of the Canadian and United States judicial handling of common law theories in the area of environmental law does not appear likely in the near future.[43]

B. *Public Health Legislation: Statutory Nuisance*

Concern with environmental health problems can be traced back to the first century A.D., when Pliny the Elder called for the use of protective masks by workers engaged in mining and grinding operations which generated dust and other harmful particles. By the 17th century a few individuals had become concerned about the injurious effects of smoke in urban areas. In 1661 John Evelyn, the famous diarist, published an early warning of such dangers in his pamphlet entitled *Fumifugium or, the Inconvenience of the Aer, and Smoake of London Dissipated.*[44] Bernardino Ramazzini provided the first scientific study associating health with the working environment; his systematic treatise, *De Morbis Artificium Diatriba,* was published in 1700.[45] The field of public health has since rested upon a scientific foundation, although another 150 years would pass before public health legislation emerged as an approach to environmental protection.

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law had to be remolded to prevent litigants from unduly interfering with economic development, but their methods of judicial treatment were fundamentally different.

> While the English courts relied on an indirect approach to remodelling nuisance, many American judges more directly confronted the problem of adapting agrarian principles to changed conditions. At the same time that the English were stoutly refusing to adopt the theory that the defendant's economic importance should be taken into account in determining relief, some American courts were straight-forwardly protecting industrial defendants from injunctions on just these grounds.

Id. at 43-44; *see* Horwitz, *The Transformation in the Conception of Property in American Law,* 1780-1860, 40 CHI. L. REV. 248 (1973). For a recent appraisal of the balancing-of-equities test in United States environmental law, see Winner, *The Chancellor's Foot and Environmental Law: A Call for Better Reasoned Decisions on Environmental Injunctions,* 9 ENVT'L L. 477 (1979).

43. *See, e.g.,* INSTITUTE FOR RESOURCE AND ENVIRONMENTAL STUDIES, PROCEEDINGS OF CONFERENCE ON WATER AND ENVIRONMENTAL LAW (held at Dalhousie Univ., Halifax, N.S., Sept. 14-16, 1979) 41-95, 177-97 (1981).

44. W. STEER, *supra* note 39, at 10.

45. R. DESANTO, CONCEPTS OF APPLIED ECOLOGY 153 (1978).

Smoke provides one of the earliest sources of industrial pollution which is easily analogized with acid precipitation. Both forms of pollution result primarily from coal burning, and any control strategy of either seems to require restriction of industrial practices. The legal history of smoke control in Great Britain sheds light upon this issue.[46] Coal was first used as an industrial fuel at the start of the 13th century, and in the early 14th century (1309) Edward I promulgated the first ordinance to restrict coal burning. Smoke pollution was a concern of British rulers, as evidenced by Elizabeth I's prohibition of the burning of sea coal in London while Parliament was in session. In 1648 Londoners petitioned Parliament to ban the importation of coal from Newcastle. Environmental health problems in England were greatly aggravated following the Industrial Revolution. Concern with smoke emissions, in particular, was reflected in most of the public health legislation of the latter half of the 19th century.[47]

Most public health laws enacted in England between the first major statute in 1848 and the Public Health Act of 1936 suffered from two deficiencies. First, they rested largely upon the increasingly complex concept of nuisance. Second, national health standards and directives could not be implemented easily without the consent and cooperation of local government. Before the whole field of statutory law governing matters of environmental health (*e.g.*, sanitary, nuisance, sewer, and disease prevention legislation) had accomplished few material improvements, either because the courts were unable or unwilling to apply nuisance law rigorously or because the local authorities were reluctant to comply with national directives in areas of traditional local autonomy.[48] The Public Health Act of 1875[49] eliminated this stagnation by introducing criminal penalties for smoke emissions constituting nuisances. A new Public Health Act enacted in 1936 added even more momentum to this statutory development.[50] Section 101 of

46. W. STEER, *supra* note 39, at 10-15.

47. *Id.* After ten years of Royal Commission reports and public campaigns, Parliament introduced the first Public Health Act in 1848—the year of revolutions! This was followed by a variety of other public health legislation, such as the Nuisance Removals Acts of 1855, 1860, and 1863, and the Public Health Act of 1875. *Id.*

48. M. Flinn, *Introduction,* in A. STEWART & E. JENKINS, THE MEDICAL AND LEGAL ASPECTS OF SANITARY REFORM 9-19 (reprinted ed. 1969).

49. 38 & 39 Vict., c. 55.

50. 26 Geo. 5 & 1 Edw. 8.

this statute provided that any installation consuming fuel which did not take the most practicable steps possible to prevent the emission of noxious smoke into the atmosphere should be charged with statutory nuisance and dealt with pursuant to the sanctions of the Act.[51] This approach to smoke abatement, however, had a number of defects. For example, it was extremely difficult in practice to establish to the satisfaction of the court that a nuisance existed; the defense of "best practicable means" was too readily available; and the process of obtaining a nuisance abatement order from the court typically proved clumsy and time-consuming.[52]

United States federal health law also has depended largely upon the consent and cooperation of state and municipal authorities.[53] Ideological and political resentment against federal intrusion into the health field is a familiar feature of political life in the United States. Moreover, there are serious constitutional constraints on the use of the federal police power in the public health field.[54] In Canada, as well, federal-provincial difficulties complicate the efforts of the central government to implement environmental health directives for the general welfare.[55]

By the 1950s, for some time it had been apparent in both North America and the United Kingdom that public health legis-

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51. *Id.* c. 49.

52. J. GARNER & R. CROW, CLEAN AIR: LAW AND PRACTICE 5-7 (3d ed. 1969). Section 93 of the 1936 Act compelled local authorities to serve abatement notices when they were persuaded that a statutory nuisance existed. *Id.* When the notice was not absolutely complied with, the local authority could itself abate the nuisance and recover the cost of its actions. *Id.* A somewhat expedited procedure was provided in section 26 of the Public Health Act, 1961, 9 & 10 Eliz. 2, c. 64.

53. McKray & McKray, *Federal Health Law in the United States,* in LEGAL ASPECTS OF HEALTH POLICY: ISSUES AND TRENDS 33 (R. Roemer & G. McKray eds. 1980).

54. Fleischer, *The Law of Basic Public Health Acitivities: Police Power and Constitutional Limitations,* in *id.* at 3.

55. Under the British North America (BNA) Acts, British North America Act, 1867, 30 & 31 Vict., c. 3; Parliament of Canada Act, 1875, 38 & 39 Vict., c. 38, neither the central Government nor the provincial governments have express authority to deal with health and disease prevention or control. Despite a common sense appreciation that health requirements observe no political boundaries, the primary role in the administration of health services has tended to fall on the provinces, pursuant to section 92(7) (hospitals and charities). 30 & 31 Vict., c. 3. In practice, federal-provincial cooperation has been essential to the effective provision of health care in Canada. *See* ROYAL COMMISSION ON HEALTH SERVICES, REPORT (1965).

lation and the doctrine of statutory nuisance were unlikely to be effective means of combatting air pollution in modern industrial society. The inadequacy of the traditional approach to smoke control was due not only to the legal and institutional defects inherent in the concept and application of statutory nuisance, but also, and more fundamentally, to the defects in the sciences that lay behind it. Modern environmental medicine demonstrates that these 19th century statutes, though commendable in their day, rested upon an inadequate appreciation of the health effects of smoke.[56]

C. *National Air Quality Management: The Clean Air Acts*

The most recent development in national air pollution control strategy is the onset of direct air quality management. Since the 1950s the premise of this approach has been that scientific research can produce meaningful standards of air quality. There are essentially two legislative approaches to the direct regulation of air quality: the establishment of ambient air quality standards or the utilization of performance or emission standards. The former approach involves the prescription of permissible levels of contaminants, while the latter focuses on the specific emissions from a single source rather than the general level of contaminants in the ambient air.[57] In the United Kingdom, the United States, and Canada, national air quality management programs reflecting one or both of these approaches have been implemented under clean air acts.

1. United Kingdom

The purposes of the Clean Air Act of 1956[58] essentially conformed with the major recommendations of the Beaver Report:[59]

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56. COMM. ON SMOKING & ATMOSPHERIC POLLUTION, ROYAL COLLEGE OF PHYSICIANS OF LONDON, AIR POLLUTION AND HEALTH 11-13 (1970).

57. Campbell & Heath, *supra* note 3, at 368-72. These authors attempt to ascribe one or the other of these two legislative approaches to various countries round the world, but they admit this method of description is not always apt and may sometimes conceal as much as it reveals, especially in the case of Canada and the United States. *Id.* at 375-76.

58. 4 & 5 Eliz. 2, c. 52.

59. The final report, BEAVER REP., CMD. No. 9322 (1954), was issued in November 1954. An interim report had been published earlier in December 1953. BEAVER REP., CMD. No. 9011 (1953); J. GARNER & R. CROW, *supra* note 52, at 3-

first, the prohibition of "dark smoke," subject to certain qualifications; second, the prohibition of the installation of new industrial furnaces unable to operate without emitting smoke; third, the minimization of grit and dust emissions from existing industrial furnaces, and the provision of grit-arresting equipment in new furnaces burning pulverized fuel or large quantities of other solid fuel; and last, the establishment of smoke control areas.[60]

The 1956 Act and its successor, the Clean Air Act, 1968,[61] deal with smoke, grit, and dust. Control is still exercised by local authorities, but under the 1968 Act the Secretary of State for the Environment is empowered to compel local authorities to establish smoke control areas in which it is an offense to emit smoke from any chimney unless the premises concerned have been exempted.[62] The effect of the Clean Air Acts is further extended by the Clean Air regulations,[63] which specify the maximum permitted quantities of grit and dust that may be emitted by any industrial furnace. Vehicle pollution is governed by the Control of Pollution Act, 1974.[64]

On January 1, 1973 the United Kingdom joined the European Economic Community (EEC). In November of the same year, the Council of Ministers approved the EEC's "Programme of Environmental Action,"[65] which envisages the establishment of minimum anti-pollution standards throughout the EEC.[66] Steps are being taken in that direction, but British air pollution control legislation is still among the most effective in Europe, and it may take several years before the other member nations of the EEC catch up.[67]

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60. J. GARNER & R. CROW, *supra* note 52.

61. C. 62.

62. *Id.* § 8.

63. STAT. INST. No. 162 (1971). *See also* STAT. INST. No. 625 (1971).

64. C. 40.

65. BULL. EC 3-1973. *See also* BULL. EC 5-1976. For a British evaluation see Booth & Green, *The European Community Environmental Programme and United Kingdom Law,* 1 EUROPEAN L. REV. 444, (1975-1976).

66. S. JOHNSON, THE POLLUTION CONTROL POLICY OF THE EUROPEAN COMMUNITIES 2-5 (1979).

67. On recent EEC developments in air pollution control, see *id.* at 50-76.

2. United States

The Act of July 14, 1955[68] was the first major national effort to establish air quality management in the United States. In its original form, this federal statute did little more than encourage states to take whatever steps they deemed appropriate to abate pollution. The states were authorized to develop methods and programs to correct air pollution[69] and it was expressly recognized that the "primary responsibilities and rights" for the control of pollution rested with the states.[70] No federal guidelines to these ends were provided, however. Response from individual states was totally inadequate, and in 1967 Congress authorized a greatly expanded research effort under the Air Quality Act.[71] This legislation led to a more comprehensive approach under the Clean Air Amendments of 1970.[72]

Similar in approach to the Water Pollution Control Act, the 1970 Clean Air Amendments provide elaborate schemes for the control and elimination of pollution that endangers the public health or welfare. The Act's feature is its requirement for the obtaining of a permit prior to any discharge of pollutants.[73] Although the states bear primary responsibility for establishing and operating these programs,[74] the initiative rests with the Environmental Protection Agency (EPA) to adopt uniform "national ambient air quality standards."[75] Each state is required to adopt an implementation plan designating specific emission limitations for each major source so that these federal air quality goals may be met and subsequently maintained.[76] New plants likely to contrib-

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68. Ch. 360, 69 Stat. 322 (1955). For a codified review of this and other early initiatives in United States national air pollution legislation, see Kneese & Williams, *Air Quality Issues and Approaches in the Southwest*, 19 NAT. RESOURCES J. 537, 538-43 (1979).

69. Ch. 360, § 2, 69 Stat. 322, 322 (1955).

70. *Id.* § 1.

71. Pub. L. No. 90-148, 81 Stat. 485 (1967).

72. Pub. L. No. 91-604, 84 Stat. 1676 (1970).

73. *Id.* § 4(a), 84 Stat. 1680.

74. *Id.*, 84 Stat. 1678.

75. *Id.*, 84 Stat. 1679-80.

76. *Id.*, 84 Stat. 1680. Before promulgating an ambient standard, the Environmental Protection Agency (EPA) must develop a "criteria document" to provide scientific support for the Agency's conclusions regarding the health and welfare threats associated with exposure to specific pollutants. *Id.*, 84 Stat. 1678-79. Two standards must therefore be promulgated: one designed to protect pub-

ute significantly to air pollution must usually conform to more stringent controls through "new source performance standards."[77] The Act also initiates a federal "prevention of significant deterioration" program, which is designed to limit deterioration of air quality in the nation's "clean air" regions.[78] Other programs are concerned with the protection of visibility and the regulation of motor vehicle emissions.[79] Virtually all of the states have now adopted permit systems which enable them to set limits on the amount of pollutants which each source may discharge.

This complex and sophisticated statute does not address the problem of long-range transport of atmospheric pollutants. Ambient standards have been promulgated under the Clean Air Act for sulfur dioxide and nitrous compounds, but the compounds most directly responsible for acid deposition (*i.e.*, sulfates and nitrates) are not directly regulated. Compliance with the standards set forth in the Act does not directly prevent substantial emissions of sulfur dioxide and nitrogen oxides. Compliance concerns focus upon ground-level concentrations, rather than upon higher altitudes where long-range transport of pollutants is effected. Moreover, many problems arise from inherent weaknesses in the system of implementation plans developed and enforced on a state-by-state basis.[80] As in other matters, the states have a very uneven record of effectiveness in air pollution control.

Although a limited approach to national air quality management, the Clean Air Act has received much comment and criticism in recent years. Some commentators still argue for the retention of local controls over environmental problems,[81] but most

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lic health (the "primary" standard), and the other designed to protect the public welfare (the "secondary" standard). *Id.*, 84 Stat. 1679-80. States are allowed three years after institution of their "state implementation plan" to attain the primary standard and a "reasonable time" to attain the secondary standard. *Id.*, 84 Stat. 1680. If a plan is not adequate to meet these ambient standards within the prescribed period, EPA may either withhold federal funds or intercede and promulgate an implementation plan of its own. *Id.*, 84 Stat. 1681-82. Wetstone, *Air Pollution Control Laws in North America and the Problem of Acid Rain and Snow*, 10 ENVT'L. L. REP. 50001, 50004 (1980). *See also* Walston, *State Control of Federal Pollution: Taking the Stick Away from the States*, 6 ECOLOGY L. Q. 429 (1977).

77. Pub. L. No. 91-604, § 4(a), 84 Stat. 1683-84.

78. *Id.*, 84 Stat. 1686-87.

79. *Id.* §§ 6-12, 84 Stat. 1690-1709.

80. This paragraph is based on Wetstone, *supra* note 76, at 50004.

81. *See, e.g.*, Zerbe, *Optimal Environmental Jurisdictions*, 4 ECOLOGY L. Q.

concentrate on the need to strengthen the national system at the center. It is generally recognized that earlier state and federal air pollution control efforts failed because of the primitive state of emission control technology, but whether the Clean Air Act Amendments of 1970 were properly designed to succeed in their aim of forcing innovations in technology is a matter subject to dispute.[82]

In 1976 the United States Supreme Court held that states have the authority under these Amendments to require stationary (*i.e.*, industrial) sources of air pollution to comply with regulatory standards or be shut down, even if the state's emission control requirements are economically or technologically infeasible.[83] The Court's finding that Congress intended the Amendments to induce rapid improvements in air pollution control technology was confirmed when Congress enacted the Clean Air Act Amendments of 1977[84] with a view to further raising ambient air quality standards.

Despite increased legislation, national air pollution control strategy in the United States is still in disarray.[85] The most controversial issue is whether to retain the present state-oriented framework of ambient standards or to replace it with a preemptive, federally imposed framework of uniform national standards. The existing policy of ambient standards involves the establishment of specific minimum levels of ambient air quality which varies from area to area. This diversified approach does not require polluters to take affirmative action to eliminate or reduce their discharges except to the extent necessary to prevent lowering the level of quality of ambient air below acceptable minimums.[86] The

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193 (1974).

82. Kramer, *Economics, Technology and the Clean Air Amendments of 1970: The First Six Years*, 6 ECOLOGY L.Q. 161 (1977). *See also* Ayres, *Enforcement of Air Pollution Controls on Stationary Sources under the Clean Air Amendments of 1970*, 4 ECOLOGY L.Q. 4441 (1975).

83. Union Electric Co. v. EPA, 427 U.S. 246 (1976); *see* Note, *Forcing Technology: The Clean Air Act Experience*, 88 YALE L.J. 1713 (1979).

84. Pub. L. No. 95-95, 91 Stat. 685 (1977).

85. Mandelker & Sherry, *Emission Quota Strategies as an Air Pollution Control Technique*, 5 ECOLOGY L.Q. 401 (1976).

86. These minimums may be prescribed under different criteria, such as general health and safety or higher-quality considerations of comfort, convenience, or aesthetic values. Hines, *A Decade of Nondegraduation Policy in Congress and the Courts: The Erratic Pursuit of Clear Air and Clean Water*, 62 IOWA L. REV. 643 (1977).

alternative strategy of uniform standards, which has been gaining adherents among EPA officials, is based on the proposition that discharges should be treated uniformly without regard to ambient resource conditions. This strategy focuses on the imposition of specific limitations on the pollutants discharged through factory stacks so as to reduce total loadings. All firms would be required to apply their best efforts to eliminate or reduce emissions within the bounds of economic and technological feasibility.[87] Reference would be made to ambient conditions only to escalate the control requirements imposed by uniform standards. In other words, more stringent discharge limitations would be prescribed in those areas where the uniform control requirements were not sufficient to provide a satisfactory level of ambient air quality.[88]

The Environmental Law Institute of the United States has recently compared nine alternative strategies for the control of acid deposits and related problems associated with long-range transport of air pollutants.[89] In particular, two of these proposals would require bold federal initiatives to reduce existing source emissions. One proposal (a variant of the uniform standards strategy) seeks to reduce total emissions by imposing uniform control requirements on existing major sources in specified industrial sectors which are responsible for a large share of total emissions. These new federal standards would preempt existing state limitations for the specified pollutants and identified sectors if the state standards were less stringent.[90] The second proposal envisages a less direct approach to the same end, whereby the federal govern-

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87. To differentiate between discharges on the basis of more or less favorable geographical locations for ambient resource quality is tough to be administratively infeasible and equitably undesirable. Under [the uniform standards] approach every factory within an industry must apply the same degree of pollution control, whether located in downtown Los Angeles or rural Iowa.

Id. at 644.

88. *Id.*

89. G. WETSTONE & P. REED, INSTITUTIONAL ASPECTS OF TRANSPORTED POLLUTANTS: AN EXAMINATION OF STRATEGIES FOR ADDRESSING LONG-RANGE AIR POLLUTION PROBLEMS (Final Report of the Environmental Law Institute, prepared for the National Commission on Air Quality, Feb. 1981). *See also* J. Futrell & P. Reed, U.S. and Canadian Perspectives on Environmental Policy: Legislative and Regulatory Alternatives for Coping with Transboundary Pollution Problems (March 26, 1981) (mimeographed material).

90. For an evaluation of this proposal, see G. WETSTONE & P. REED, *supra* note 89, at 52-64.

ment would specify an emission loading ceiling for each state, thus allowing the state flexibility in determining how to encourage or require controls needed to achieve that ceiling. This proposal is designed to reduce pollutant loadings at the least possible cost consistent with the continued attainment of the national ambient air quality standards under the existing state-oriented, institutional framework for air pollution control.[91] Whether the present federal administration is prepared to follow either of these courses is doubtful.[92]

3. Canada

The major federal initiative in Canadian air pollution control is the Clean Air Act of 1971,[93] which is administered by the Environmental Protection Service of Environment Canada. The emphasis of this statute, similar to that of the United States, is on federal determination of national ambient air quality objectives. These objectives may reflect three ranges of quality with respect to any air contaminant: the tolerable, the acceptable, and the desirable range of concentrations.[94] National emission standards

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91. *Id.* at 65-81.

92. At the time of this writing, it appears that the Reagan Administration intends to reduce drastically the operating budgets of EPA, the Council on Environmental Quality, and other environmentally oriented agencies. Many of the current cutbacks on environmental programs seem to be based on economic grounds, but some of the new austerity may be attributed to an ideological distaste for government regulations, in general, and environmental controls, in particular. This has, however, provoked a strong reaction by United States environmentalists, many of whom have rallied around the Clean Air Act. This lobbying effort has focused partly on the acid rain issue. National Clean Air Coalition, The Clean Air Act: A Briefing Book for the Members of Congress 69-79 (July 1981).

93. Can. Stat., 19-20 Eliz. II, c. 47.

94. *Id.* § 4.

> The maximum acceptable level is intended to provide adequate protection against effects on visibility, personal comfort and well-being. It represents the realistic objective today for all parts of Canada. When this level is exceeded, control action by a regulatory agency is indicated. The maximum desirable level defines the long term goal for air quality and provides a basis for an anti-degradation policy for the unpolluted parts of the country and for the continuing development of control technology. At this level there would be no adverse biological effect on any receptor. The maximum tolerable level is intended to indicate the onset of an "imminent danger" requiring immediate abatement action. Air pollution episodes which sometimes result when pollutants accumulate during adverse weather condi-

and guidelines may be prescribed to establish the maximum quantities and concentrations of contaminant emissions in circumstances where the emissions "constitute a significant danger to the health of persons" or are "likely to result in the violation of a term or terms of any international obligation entered into by the Government of Canada relating to the control or abatement of air pollution in regions adjacent to any international boundary or throughout the world."[95] This restriction to health hazards and treaty commitments reflects the fact that in Canada jurisdiction over matters of environmental control is provincial rather than federal.[96] Accordingly, the three levels of national ambient air quality objectives are merely recommendations to the provinces. Provision is made in the statute for voluntary federal-provincial agreements to achieve air quality standards,[97] but no such agreements have yet been implemented. Most of the provinces have their own air pollution legislation, but none of their statutes purports to deal with the problem of acid precipitation or to implement the policy or provisions of the Clean Air Act. On the other hand, in the limited case of "federal works, undertakings or businesses,"[98] the federal Minister of the Environment is authorized, and in certain circumstances obligated, to recommend specific emission standards to the Governor in Council (*i.e.*, the federal cabinet).[99] These specific emission standards represent the maximum concentration of the air contaminant in relation to which national air quality objectives have been recommended.[100]

In sum, the Canadian approach to air pollution control is considerably less complex, less sophisticated, and less formal than that of the United States. It is also less stringent in its demands on the industrial and political systems. Because of the more diffuse nature of Canadian industrial development, there is even

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tions would fall into this category.

CANADIAN INDUSTRIES LIMITED, A DIGEST OF ENVIRONMENTAL POLLUTION LEGISLATION IN CANADA: AIR AND SOIL, F-10 (1973).

95. Can. Stat., 19-20 Eliz. II, c. 47, § 7(1)(a)-(b).

96. The federal power over public health legislation is discussed at note 55 *supra*. On the vexing question of the treaty power in Canadian constitutional law, see Leeson, *Foreign Relations and Quebec*, in CANADIAN FEDERALISM: MYTH OR REALITY 510-25 (J. Meekison, ed., 3d ed. 1977).

97. C. 47, § 19.

98. *Id.* §§ 10-18.

99. *Id.* § 11.

100. *Id.*

wider resort than in the United States to dispersion, rather than emission control at the source, as a national approach to air quality management. The provinces have greater autonomy in these matters than the American states. In view of current disorders in the Canadian political system, it might not be easy to muster the political will to negotiate the federal-provincial sharing of costs involved in the application of a federally designed national emission control policy.[101]

D. *General Principles of International Law*

Judicial remedies, public health legislation, and national air quality management are unlikely to provide a solution to a problem that is international in scope. The range of transmission of atmospheric pollutants is so extensive that an international control strategy is needed to supplement domestic and even bilateral measures. It may be useful, therefore, to examine the general principles of international law that are relevant to the formulation of an international control strategy.

Determining the foundations of international environmental law is actually a matter of jurisprudential choice.[102] Although

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101. For a balanced evaluation of the Canadian approach, see Wetstone, *supra* note 76, at 50011-50015. An effort has been made to bring the existing Clean Air Acts of Canada and the United States into some degree of alignment. The United States statute (section 115)

> provides for action by the U.S. Federal Government to initiate revision of state implementation plans on air quality in those cases where there is reason to believe that pollution from U.S. sources endangers public health or welfare in a foreign country, so long as that country provides "essentially the same rights to the United States."

DEP'T STATE BULL., Feb. 1981, at 33. On December 16, 1980, the Canadian House of Commons unanimously adopted a measure which would provide the necessary reciprocity under the Canadian Clean Air Act. *Id.* The amending legislation received royal assent the following day. 114 Cana. Gaz. 7941 (Dec. 27, 1980).

102. The more one feels compelled by the strictures of the positivist school to look for international law in precise, clearly established, firmly sanctioned, obligatory rules, based on the universal consent of nation states, the more likely one is to emphasize the recent and still tentative character of international environmental law. The more warmly one responds to the imagery of natural law, projecting concepts of natural order, human reason, and moral authority, the more likely one is to find the roots of international environmental law buried deep in the classical principles of the international legal system. Others, declining to make a choice between the inchoate and the immanent, may be content to note the "ante-

there is no general legal prohibition against pollution, it cannot be said that states, in the absence of treaty constraints, possess an unqualified license to pollute. Under customary international law, all states must observe the general duty of due diligence[103] and comply with the rule prohibiting the abuse of rights.[104] In addition, pursuant to the general principle of good neighborliness states are forbidden to allow their territories to be used in a manner prejudicial to other states.[105] This latter principle, which is closely identified with the maxim *sic utere tuo ut alienum non laedas,*[106] has often been applied to transboundary pollution situations. The celebrated *Trail Smelter* arbitration[107] between Canada and the United States provides the most famous application of this principle toward air pollution control. In its final decision of 1941, the tribunal held:

> [U]nder the principles of international law, as well as of the law of the United States, no state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.[108]

Several years later, in *The Corfu Channel Case,*[109] the International Court of Justice held Albania liable for damage to a foreign warship in its territorial sea on the ground that it had violated its

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cedents" of modern normative developments in international environmental law within a broadly conceived, multi-factoral framework of legal development.

D. JOHNSTON, THE ENVIRONMENTAL LAW OF THE SEA: EARLY ADJUSTMENTS (1981) (in press).

103. Dupuy, *Due Diligence in the International Law of Liability,* in OECD, LEGAL ASPECTS OF TRANS-FRONTIER POLLUTION (1977) [hereinafter cited as OECD LEGAL ASPECTS]; I. VAN LIER, *supra* note 3, at 132-34.

104. A. KISS, L'ABUS DE DROIT EN DROIT INTERNATIONAL (1953); Schwarzenberger, *Uses and Abuses of the Abuse of Rights in International Law,* in THE GROTIUS SOCIETY, PROBLEMS OF PUBLIC AND PRIVATE INTERNATIONAL LAW 147-79 (1957); I. VAN LIER, *supra* note 3, at 143-45.

105. Dupuy, *International Liability of States for Damage Caused by Transfrontier Pollution,* in OECD LEGAL ASPECTS, *supra* note 103, at 349-59; I. VAN LIER, *supra* note 3, at 134-43.

106. L. OPPENHEIM, 1 INTERNATIONAL LAW: A TREATISE 313, 1-114 (7th ed. 1948).

107. 3 REP. INT'L ARB. AWARDS 1905 (1941).

108. *Id.*

109. Corfu Channel Case, [1949] I.C.J. 4.

international legal obligation "not to allow knowingly its territory to be used contrary to the rights of other States."[110]

In more recent years, several international conferences have attempted to apply general principles of international law to the problems of pollution control. At the global level, Principles 21 and 22 of the 1972 Declaration on the Human Environment, endorsed by the United Nations General Assembly after the Stockholm Conference on the Human Environment, advanced the following principles of international environmental responsibility:

> Principle 21
>
> States have, in accordance with the Charter of the United Nations and the principle of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.
>
> Principle 22
>
> States shall co-operate to develop further the international law regarding liability and compensation for victims of pollution and other environmental damage caused by activities within the jurisdiction or control of such States to areas beyond their jurisdiction.[111]

The Stockholm Declaration also prescribes in Principle 6 that

> [t]he discharge of toxic substance or of other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon ecosystems . . . .[112]

The Third United Nations Conference on the Law of the Sea has recently formulated general principles of international marine environmental responsibility in its Draft Convention on the Law of the Sea.

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110. *Id.* at 22.

111. Report of the United Nations Conference on the Human Environment, U.N. Doc. A/Conf. 48/14 (1972), *reprinted in* 11 INT'L LEGAL MATERIALS 1416, 1420 (1972); J. BARROS & D. JOHNSTON, THE INTERNATIONAL LAW OF POLLUTION 301 (1974).

112. 11 INT'L LEGAL MATERIALS 1416, 1418 (1972); J. BARROS & D. JOHNSTON, *supra* note 111, at 300.

Article 192

States have the obligation to protect and preserve the marine environment.

Article 194

1. States shall take all necessary measures consistent with this Convention to prevent, reduce and control pollution of the marine environment, *from any* source, using for this purpose the best practicable means at their disposal and in accordance with their capabilities, individually and jointly as appropriate, and *they shall endeavor to harmonize their policies in this connexion.*
2. States shall take all necessary measures to ensure that activities under their jurisdiction and control are so conducted that they do not cause damage by pollution to other States and their environments, and that pollution arising from incidents or activities under their jurisdiction or control does not spread beyond the areas where they exercise sovereign rights in accordance with this Convention.
3. The measures taken pursuant to this Part shall deal with all sources of pollution of the marine environment. These measures shall include, *inter alia,* those designed to minimize to the fullest possible extent:

(a) Release of toxic, harmful or noxious substances, especially those which are persistent:
(i) *from land-based sources;*
(ii) *from or through the atmosphere . . . .*

Article 195

In taking measures to prevent, reduce and control pollution of the marine environment, States shall act so as not to transfer, directly or indirectly, damage or hazards from one area to another or transform one type of pollution into another.[113] (Emphasis added.)

Though not dealing specifically with air pollution, these guidelines seem to reflect a clear trend toward international acceptance of the responsibility of states to take effective action to combat environmental problems such as long-range transport of atmospheric pollutants. The United States and Canadian governments should take special note of the concept that states have a duty to attempt to harmonize their policies with respect to pollution control, preferably by means of a formalized treaty arrangement.

General principles of international law, such as the good neighborliness principle, have traditionally been applied primarily to

113. U.N. Doc. A/Conf. 62/WP 10 Rev. 3 (Aug. 27, 1980), *reprinted in* 19 INT'L LEGAL MATERIALS 1131 (1980).

neighboring states. Yet acid precipitation, which can affect several states, may provide the framework for the global extension of previously limited international principles. The appropriate analogy is that of riparian states sharing the same river in which the upstream users are obligated not to pollute the water in such a degree as to cause substantial harm to the downstream users.[115] If the riparian approach were accepted as the proper one, the problem could be treated either as an issue in the allocation of entitlements or as a problem in resource management requiring special institutional arrangements. If the acid precipitation problem were received simply as a matter of entitlement in international law, buttressed by municipal analogies to property rights and tortious harms, then one would logically look first to the concept of environmental injury under the doctrine of state responsibility—the largely undeveloped area of international tort law. In the context of state responsibility, one can proceed to a number of derivate procedural principles such as the duties to prevent, inform and consult.[116] The problem is arguably less a matter of entitlement than an opportunity for institutional cooperation, however, and in the case of shared or neighboring resources the fundamental norm might be the principle of a solidarity (equitable sharing).[117] With this in mind, one would examine institutional, as well as juridical, analogies.

E. *Bilateral Boundary Treaty Arrangements*

If acid precipitation in North America is simply another terri-

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115. The most developed expression of international river law is a nonbinding codification known as the Helsinki Rules, which was adopted at the 1966 conference of the (nongovernmental) International Law Conference held in Finland. These Rules contain the provision (in article X) that states do not have the right to pollute their own water in a manner which causes "substantial injury" to another state. Provision is also made for abatement of such pollution and compensation in the event of extra-territorial injury. For selected portions of the text, see J. BARROS & D. JOHNSTON, *supra* note 111, at 77-82. For an appraisal, see Utton, *International Water Quality Law*, in INTERNATIONAL ENVIRONMENTAL LAW 154-86 (L. Teclaff & A. Utton eds. 1974).

116. *See* I. VAN LIER, *supra* note 3, at 150-62.

117. *Id.* at 145-50. Some commentators regard a common airshed as a shared resource. *See, e.g.*, OECD, PROBLEMS IN TRANSFRONTIER POLLUTION 299-313 (1974). Others deny the applicability of the principle of solidarity to air pollution. *See* E. KLEIN, UMWELTSCHUTZ IM VÖLKERRECHTLICHEN NACHBARRECHT 231-33 (1976).

torial problem in Canadian-United States relations, the history of successful boundary treaty arrangements between these neighboring states is important. Geography dictates that a negotiated accommodation between Canada and the United States will be central to any effective approach to the North American problem of long-range transport of atmospheric pollutants.

The Boundary Waters Treaty of 1909[118] is the first, and perhaps the most famous, bilateral boundary arrangement for water resource management. Its major concern is with the use, obstruction, and diversion of Canadian-United States boundary waters, but article IV specifically provides that these waters "shall not be polluted on either side to the injury of health or property on the other."[119] The International Joint Commission (IJC) created by the Treaty was given powers both in relation to questions concerning the use, obstruction, or diversion of waters and in relation to "any other questions or matters of difference arising between [the parties] involving the rights, obligations or interests of either in relation to the other or to the inhabitants of the other along the common frontier between the United States and the Dominion of Canada."[120] Article IX limits these powers to examination and report, although article X gives the Commission powers of decision subject to the consent of the two parties. With this broad mandate, the IJC has become involved in studies of both air and water pollution. Under a 1975 agreement,[121] the IJC has acquired a specific mandate to maintain a permanent air pollution monitoring service in the Detroit-Windsor and Port Huron-Sarnia areas.[122]

The Columbia River Treaty of 1961[123] is one of the most controversial of all Canadian-United States boundary arrangements.[124] It represents an important example of a negotiated allo-

118. United States-Canada, 36 Stat. 2448, T.S. No. 548.

119. *Id.* at 2450.

120. *Id.* at 2452.

121. *See* Beaupre, *A Survey of Water and Air Pollution Cases Involving the International Joint Commission (Canada-United States),* in OECD, ENVIRONMENTAL PROTECTION IN FRONTIER REGIONS 439, 445 (1979).

122. *Id.* at 444-46.

123. United States-Canada, 15 U.S.T. 1555, T.I.A.S. No. 5638.

124. N. SWAINSON, CONFLICT OVER THE COLUMBIA: THE CANADIAN BACKGROUND TO AN HISTORIC TREATY (1979); J. KRUTILLA, THE COLUMBIA RIVER TREATY: THE ECONOMICS OF AN INTERNATIONAL RIVER BASIN DEVELOPMENT (1967). For a more popular account, see D. WATERFIELD, CONTINENTAL

cation of riparian entitlements in the form of equitable joint utilization of the hydroelectric resources of a major international river.[125] A continuing controversy, as a matter of special sensitivity in Canada, is whether the system of allocation is indeed equitable.[126] The politically sensitive history of this difficult Treaty clearly will play an important role if negotiations concerning the acid rain problem are attempted within a framework of similar arrangements for the allocation of industrial costs associated with stringent emission controls.

A third Canadian-United States treaty model is the 1972 Agreement on Great Lakes Water Quality.[127] Based on the concept of a shared water basin, the Agreement represents the most detailed and technical effort in any region to develop a joint regulatory approach to the control of pollution in transboundary waters. Article II describes five general water quality objectives, the so-called "five freedoms."[128] Annex I to the Agreement sets forth

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WATERBOY: THE COLUMBIA RIVER CONTROVERSY (1970).

125. The treaty provided that Canada was to build three storage projects in its section of the Columbia River's watershed, and detailed the manner in which they were to be operated over its sixty-year lifetime. It gave the United States an option to build a fourth project, with a reservoir which would flood back into Canada, and it included some guarantees of and some limitations on the right to divert within the watershed. The treaty also made provision for Canada to receive the monetary equivalent of one-half the flood control benefits which Canadian storage would produce in the United States.

N. SWAINSON, *supra* note 124, at 1. In 1964 the parties signed a protocol modifying the Treaty and an agreement whereby Canada sold its downstream power entitlement for cash over a thirty years period starting with the completion of its three reservoirs. Annex to Exchange of Notes Regarding the Columbia River Treaty, Jan. 22, 1964, 15 U.S.T. 1579, T.I.A.S. No. 5638. The entire package of arrangements was ratified on September 16, 1964.

126. *See, e.g.*, McDougall, *The Development of International Law with Respect to Trans-Boundary Water Resources: Co-operation for Mutual Advantage or Continentalism's Thin Edge of the Wedge?* 9 OSGOODE HALL L.J. 261 (1971).

127. United States-Canada, 23 U.S.T. 301, T.I.A.S. No. 7312, *reprinted in* 11 INT'L LEGAL MATERIALS 694 (1972), and *reprinted in part in* J. BARROS & D. JOHNSTON, *supra* note 111, at 83-89.

128. The waters covered by the Agreement should be:

(a) Free from substances that enter the waters as a result of human activity and that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect aquatic life or waterfowl;

(b) Free from floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be

in technical language a list of specific water quality objectives which represent the minimum desired levels of water quality in the boundary waters of the Great Lakes system. Article IV provides that the standards of the parties (the two federal governments) must be consistent with the achievement of these objectives and it commits the parties to use their "best efforts" to ensure that the standards of the Great Lakes states and provinces are similarly consistent with those objectives. The Agreement initiates various programs for water pollution abatement and control and significantly broadens the powers, responsibilities, and functions of the International Joint Commission. Further, a regional office and two advisory boards are created to facilitate the implementation of the Agreement.[129] Whether this treaty structure may serve as a model of transnational atmospheric pollution control is debatable, but it is at least certain that the history of the Agreement since 1972 is relevant to any feasible joint Canadian-United States approach to the control of acid precipitation.[130]

F. *Regional Initiatives: Europe*

Regional analysis of the problem of acid deposition originated in Scandinavia. The problem first became prominent at the intergovermental level in 1971, when the Swedish government submitted a case study of the problem of transboundary air pollution by sulfur to the 1972 United Nations Conference on the Human

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unsightly or deleterious;

(c) Free from materials entering the waters as a result of human activity producing colour, odour or other conditions in such a degree as to create a nuisance;

(d) Free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life;

(e) Free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae.

Id. at 304.

129. For a description and analysis, see F. Moseley, The United States-Canadian Great Lakes Pollution Agreement: A Study in International Water Pollution Control 82-124. (Ph.D. dissertation 1978). On the system of implementation, see *id.* at 162-98.

130. For a sober assessment of the prospects of the Agreement, see Bilder, *Controlling Great Lakes Pollution: A Study in United States-Canadian Environmental Cooperation,* 70 MICH. L. REV. 469 (1972). This assessment seems to have been vindicated by the experience under the Agreement since 1972.

Environment.[131] This detailed document underscored the seriousness of the problem in Northeast Europe and heightened awareness of the acid rain problem in North America. In the years following, the Nordic Council provided a forum for the discussion of this problem for the ministers of the environment of the member countries (Denmark, Finland, Iceland, Norway, and Sweden). These discussions resulted in the preparation of a draft convention which was submitted in 1978 to the United Nations Economic Commission for Europe (ECE).

1. Economic Commission for Europe

A Working Party on Air Pollution Problems was established within the Economic Commission for Europe as early as 1969. By 1971 it had adopted a recommendation calling for abatement of sulfur pollution on the strength of the Swedish report of that year. In 1978 the ECE's Committee of Senior Advisers on Environmental Problems established a Special Group on Long-Range Transboundary Air Pollution, largely at the urging of the Nordic states. At its second meeting, this Special Group received the "Nordic Proposal" whose final text, known as the Convention on Long-Range Transboundary Air Pollution,[132] was adopted by the ECE in November 1979.[133]

Under article 2 of the ECE Convention, the contracting parties pledge to "endeavour to limit and, as far as possible, gradually reduce and prevent air pollution including long-range transboundary air pollution." In article 3 they agree to develop relevant policies and strategies without undue delay through exchanges of information, consultation, research, and monitoring.

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131. ROYAL MINISTRY FOR FOREIGN AFFAIRS AND ROYAL MINISTRY OF AGRICULTURE, SWEDEN, AIR POLLUTION ACROSS NATIONAL BOUNDARIES: THE IMPACT ON THE ENVIRONMENT OF SULFUR IN AIR AND PRECIPITATION (1971) [hereinafter cited as SWEDEN CASE STUDY].

132. Convention On Long-Range Transboundary Air Pollution, U.N. Doc. ECE/HLM.1/R.1 (1979), *reprinted in* 18 INT'L LEGAL MATERIALS 1442 (1979) [hereinafter cited as Long Range Convention].

133. The Convention was adopted by acclamation by the High-Level Meeting within the Framework of the Economic Commission for Europe on the Protection of the Environment. This meeting also adopted a resolution on long-range transboundary air pollution. *Id.* at 1450. The Convention has been signed by almost all of the 34 ECE member states, and also by the Holy See, Liechtenstein, San Marino, and the EEC. It is, therefore, the first truly continental air pollution treaty.

Article 6 binds the parties to "develop the best policies and strategies including air quality management systems and, as part of them, control measures compatible with balanced development, in particular by using the best available technology which is economically feasible and low and non-waste technology."

The Convention is primarily a general statement of intent which does not commit the parties to any single category of control techniques.[134] It serves only as a framework for consultation and collaboration in research and related activities. No binding obligations are created and no enforcement mechanism is provided. The attempt to include a provision containing a rule on state liability for transboundary air pollution damage, as suggested in the "Nordic Proposal," was unsuccessful.[135] Although its provisions are weak as a matter of legal obligation, the text is of some diplomatic and political importance as the first international agreement directly dealing with the problem of acid precipitation. At minimum, it symbolically points the way to the future by recognizing the international significance of long-range air pollution transport.[136]

2. Council of Europe

The Council of Europe merely has the power of recommendation, but it has played an important role as a laboratory of ideas since the early 1960s in its effort to promote regional cooperation in the field of air pollution control. The Council's most important contribution in this field was the Declaration of Principles on Air Pollution Control,[137] which was adopted by the Committee of

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134. The operative language in article 6 leaves open the question whether the parties will treat acid precipitation in Europe as a simple air quality control problem or if they will attempt to drastically reduce the accumulated loadings by direct, stringent, and uniform emission controls applied to the appropriate sectors of industrial technology. *Id.* at 1444.

135. The European emissions seem to cause most of the damage through acid precipitation in Scandnavia. A liability approach would have fixed responsibility on the United Kingdom, France, West Germany, and the other major industrial nations of Western Europe.

136. For a brief description of the Convention, see I. VAN LIER, *supra* note 3, at 194-97.

137. Comm. of Ministers, Council of Europe, Resolution (68)4 (adopted by the Ministers Deputies, Apr. 8, 1968), *reprinted in* 15 INTERNATIONAL PROTECTION OF THE ENVIRONMENT: TREATIES AND RELATED DOCUMENTS 7523-25 (B. Rüster & B. Simma eds. 1979).

Ministers in 1968. This document contains an affirmation of the "polluter-pays" principle and of the responsibility to prevent air pollution.[138] The Declaration was not converted into a binding document, however, and the subject recently has been left to other organizations.

3. Organization of Economic Cooperation and Development

Like the Council of Europe, the Organization for Economic Cooperation and Development (OECD) has only the power of recommendation. Since 1972 the OECD has been extremely active in the field of air pollution control. It has issued a stream of nonbinding but influential recommendations[139] and continues to be the most influential European source of collective approaches to the problem of transboundary air pollution. For example, in June 1974 the Council recommended that governments should adopt the following objectives in respect to stationary emission sources: to encourage the use of clean fuels; to ensure the adequate supply of clean fuels; to limit the maximum sulfur content of distillate fuels; to encourage the confinement of high-polluting fuels to large installations equipped with tall chimneys and/or desulfurization facilities; and to encourage the efficient use of fuels.[140] In November 1974 the Council adopted a number of additional recommendations, including one that called on governments to reduce emissions of sulfur oxides and particulate matter by means of abatement as well as increased efficiency, to develop and apply measures for reducing emissions of nitrogen oxides and hydrocarbons, and to monitor and assess the effects associated specifically with the deposition of sulfur compounds and of other forms of acid precipitation.[141] On the same day it also urged the implementation of the "polluter-pays" principle[142] and instructed its

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138. *See generally* Kiss, *La Protection de lênvironnement et les organisations Europeenes*, 19 ANNUAIRE FRANCAIS DE DROIT INTERNATIONAL 897 (1973).

139. *See, e.g.*, OECD, OECD AND THE ENVIRONMENT PASSIM (1979). Much of the "soft law" is based on the Declaration on Environmental Policy, which was adopted by the Environment Committee, at Ministerial Level on November 14, 1974. *Id.* at 21-22.

140. Council of 18th June, 1974, OECD, *Guidelines for Action to Reduce Emissions of Sulfur Oxides and Particulate Matters from Fuel Combustion in Stationary Sources*, in OECD, *supra* note 139, at 45-50.

141. Council of 14th Nov. 1974, OECD, *Measures Required for Further Air Pollution Control*, in OECD, *supra* note 139, at 50-51.

142. Council of 14th Nov. 1974, OECD, *Implementation of the Polluter-*

Environment Committee to elaborate upon those principles of international law applicable to transnational pollution, such as the principles of international solidarity, nondiscrimination, information, consultation, and equal right to a hearing.[143] As a result of this directive, the Council of OECD was able to adopt another recommendation in May 1977 which represented a further development in the "regime of equal right to access and non-discrimination in relation to transffrontier pollution."[144] In May 1979 the Council adopted another relevant recommendation on the use of coal.[145] Despite the absence of the East European countries, the OECD serves as a valuable mechanism for the pooling of ideas and data, for stimulating collaborative research, and for influencing the shape of relevant national legislation in the member countries.[146]

4. European Economic Community

Since Norway and Sweden, Europe's two leading victims of acid precipitation, are not members of the European Economic Community (EEC), the EEC is not the most appropriate forum to discuss that problem or to take preventative measures. Yet the EEC environmental action programs adopted in 1973 and 1977[147] reflect determination by member states to deal vigorously with a range of transboundary pollution problems. In the 1977 program the EEC studied pollution problems arising in certain industrial sectors (including the energy industry), and priority was given to sulfur and nitrogen oxides along with a number of other kinds of emissions.[148] Moreover, since 1970 the Council has adopted a number of directives which specifically address the reduction of

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Pays Principle, in OECD, *supra* note 139, at 28-30.

143. Council of 14th Nov. 1974, OECD, *Principles Concerning Transfrontier Pollution,* in OECD, *supra* note 139, at 106-12. *See also* OECD, LEGAL ASPECTS OF TRANSFRONTIER POLLUTION 11-18 (1977).

144. Council of 17th May, 1977, OECD, *Implementation of a Regime of Equal Right of Access and Non-Discrimination in Relation to Transfrontier Pollution,* in OECD, *supra* note 139, at 115-20. *See also* OECD, LEGAL ASPECTS OF TRANSFRONTIER POLLUTION 29-34 (1977).

145. Council of 8th May, 1979, OECD; *Coal and the Environment,* in OECD, *supra* note 139, at 39-42.

146. *See generally* I. VAN LIER, *supra* note 3, at 210-26.

147. I. VAN LIER, *supra* note 3.

148. *Id.* at 206-07. *See also* S. JOHNSON, *supra* note 66, at 75-76.

designated kinds of emissions.[149]

G. *Conclusions*

Problems of environmental control have become a matter of increasing concern and frustration. In most situations, traditional legal thought has contributed relatively little to the prevention and control of environmental pollution. Indeed, the traditional legal concern with the establishment of remedial rights and liabilities sometimes has served as an impediment to clear thought concerning environmental policy and strategy options. The problem of acid deposits is probably the most elusive and insidious of all environmental concerns, and controls must soon be established at local, national, regional, and global levels of social organization. No other issue in environmental control poses such a formidable challenge to the legal imagination.

None of the above legal and institutional approaches represents a potential solution to the problem of long-range transboundary acid precipitation in North America. Questions of liability in private tort law, under the doctrine of private nuisance or otherwise, have little to contribute to the development of solutions to a societal problem of this magnitude. Determinations of liability in a court of law seem unlikely to have more than a modest and indirect deterrent effect on industrial polluters. Public health legislation is equally useless as a model approach to the problem of controlling acid precipitation. Given the present state of medical knowledge, it cannot be easily demonstrated that sulfur dioxide and nitrous compounds constitute hazards to health. Moreover, respect for local autonomy is subversive of any organized effort to deal effectively with a problem such as acid rain or snow. Resort to the doctrine of public nuisance would simply add clumsiness to the catalogue of deficiencies in the public health approach. National experience in air quality management is principally a history of failure. Although the clean air acts may represent the statutory structure necessary for the control of acid precipitation, the substance of such legislation is quite inadequate. Even if the objectives of these acts were extended specifically to cover acid precipitation, the present provisions and the policies they reflect

149. I. VAN LIER, *supra* note 3, at 207-10; S. JOHNSON, *supra* note 66, at 50-74. *See also* Brusasco-Mackenzie & Kiss, *Quelques Relfexions sur l'Action des Communautes Europeenens en Materier de Protection de l'Environment*, 218 REVUE DU MARCHE COMMUN 310 (1978).

are too weak to provide effective protection from this kind of environmental harm.

Neither international law nor international diplomacy has contributed more than general ideas and instructive analogues to an effective solution of the problem of acid precipitation. The general principles of international environmental law are too imprecise to define the kinds of national or industrial conduct that are legally unacceptable in the world community. Mechanisms for the enforcement of these principles are woefully weak. International controversy has generally focused on individual sources of transboundary pollution or on instances of short-range pollution confined to an identifiable source. International tribunals have seldom been allowed to adjudicate any issues concerning transboundary pollution. Moreover, the international legal doctrine most relevant to the problem of acid rain is still remedial rather than preventive in orientation, although this is gradually changing. This compensatory liability approach is simply insufficient to deal with an international problem of potentially irreversible pollution.[150]

The optimal solution lies in innovative, cooperative, treaty-based arrangements designed to develop and apply common standards and compatible industrial controls over the affected transboundary region. The structure of the Canadian and United States clean air acts may be appropriate for the elaboration of such controls in North America, but an unprecedented political effort must be made to introduce rigorous provisions for the application of a variety of removal and reduction techniques and to negotiate implementation arrangements with the states and provinces.

IV. The Quest for a North American Approach

One of the serious difficulties in dealing effectively with acid precipitation lies with the scientific ambiguities concerning the phenomenon. A variety of disciplines, including chemistry, biology, meteorology and engineering, relate to this problem. Nonetheless, North American and European scientists were able to ac-

150. Other examples of potentially irreversible international pollution problems which clearly do not lend themselves to the remedial (compensation or liability) approach, are the depletion of the ozone layer due to the emission of chlorofluorocarbons and the warming of the earth from the build-up of carbon dioxide emissions. Wetstone, *supra* note 3, at 50017.

quire an understanding of the acid precipitation problem within two decades after the first important clues had been uncovered. The first scientific breakthrough came when North American chemists engaged in the analysis of precipitation noted increased acids and sulfates in 1952.[151] No link was immediately made, however, between this phenomenon and related observations in other disciplines. Even in 1967 skeptical chemists, manifesting little curiosity about the possible effects of this phenomenon, attributed increased acidity and sulfides to local pollution sources and natural causes.[152] Acidification of aquatic ecosystems, one of the most obvious effects of acid precipitation, was noted by North American biologists as early as 1968, but few distinguished between acidification from local sources, where the pollutants entered the ecosystem in high dosages, and long-range low-dose pollution.[153] The distinction was not crucial from the perspective of the ecosystem. Moreover, this distinction was blurred by the high-dosage local sources of sulfur dioxide pollution.

Meterologists are able to establish definite links between local meteorological effects, such as increased haziness, and the wind currents from distant sources. In 1973 decreased visibility in Labrador City was demonstrated to be associated with southerly wind currents. In addition, meteorologists traced the pattern of declining visibility back to 1953.[154] Such evidence was gradually drawn together by individual scientists such as H. Harvey, E. Gorham, G. Hendry, and D. Schindler, in the early seventies. In recent years, especially since 1975, research has resulted in clarification of the phenomenon and widespread dissemination of knowledge about the problem. The North American scientific community was supported in this endeavour by the evidence of long-range transport of air pollution which European scientists, especially

151. Eriksson, *Composition of Atmospheric Precipitation: Nitrogen*, 4 TELLUS 215 (1952); Eriksson, *Composition of Atmospheric Precipitation: Sulfur Chloride and Iodine Compounds*, 4 TELLUS 280 (1952). *See also* Egner & Eriksson, *Current Data on Chemical Composition of Air and Precipitation*, 7 TELLUS 267 (1955); Gorham, *Acidity and Salinity of Rain*, 7 GEOCHIM. ET COSMOCHIM, ACTA 231 (1955).

152. Rutherford, *A Preliminary Study of the Composition of Precipitation in Southeast Ontario*, 4 CAN. J. OF EARTH SCI. 1159 (1967).

153. Gorham & Gordon, *Some Effects of Smelter Pollution upon Aquatic Vegetation near Sudbury, Ontario*, 41 CAN. J. OF BOTANY 371 (1963).

154. Munn, *supra* note 10.

those from Scandinavia, had already uncovered.[155] The research of the Europeans was perhaps five to ten years more advanced than North American research at this time. This foresight may be attributed to the advanced impacts of acid precipitation in Europe which were less obscured by local pollution than in North America. Moreover, the smaller Scandinavian scientific community may have lessened the gap between their scientific disciplines.

It is difficult to discern any significant differences between the Canadian and American scientific approaches to the problem of long-range transport of air pollution. Scientists of both countries have a history of close relations which, in fact, have been institutionalized in the scientific boards of the International Joint Commission.[156] This consultative tradition has facilitated scientific study of the North American problem of long-range transport. Concerned scientists in both countries were equally well aware of the nature and scope of this type of air pollution by 1975. Given this equal understanding, it might have been expected that both countries would raise the issue to the policy level at approximately the same time, albeit in dissimilar ways. This was not the case. Canadians raised the issue to the policy level when scientific comprehension of the problem became clear in 1975. The problem emerged more slowly as a policy issue in the United States.

The Canadian problem was raised to a policy level within Environment Canada by the combined efforts of the Ontario Regional Office relating to the condition of lakes near Sudbury and of a Policy Planning Unit in Ottawa concerned about the issue of long-range transboundary air pollution. These policy initiatives found support among scientists from the Atmospheric Environment Service of the same department in a report entitled "A National Program for Research into Long-Range Transport of Air Pollution."[157] The program quickly became an interdepartmental and federal-provincial effort. The broad objectives of the policy were to encourage and coordinate necessary research and abate-

155. *See* SWEDEN CASE STUDY, *supra* note 131. Early North American symposia on the subject included that of the EPA at Rensselaerville, N.Y., in May 1975, and an International Symposium on Acid Precipitation held at Ohio State University later in the same year.

156. Within the IJC Framework, scientists and engineers are often asked to serve as experts without regard to nationality.

157. This document has not been publicly released.

ment measures. Developing the new program was difficult because the scientific problem crossed organizational lines and challenged the existing approach to air pollution control within Environment Canada. Yet a fast response to the potential danger resulting from the long-range transport of air pollutants was facilitated by the flexibility of the parliamentary system, the power of the central bureaucracy, and the relatively small size of Environment Canada.

The problem of long-range transport of air pollution in the United States became a policy issue through a slower, more circuitous process. Government-sponsored research was initially carried out by the Departments of Agriculture and Energy in 1975. Congress also sponsored research, albeit incidentally, as a part of the Ohio River Basin Energy Study. In 1978 the United States Government began active development of bureaucratic policies directed at the control of long-range air pollution. Two events were of particular importance. In December 1978 a major report to the Council on Environmental Quality aroused serious concern in government.[158] In that same year, a statement of the United States position was submitted to the Economic Commission for Europe as part of the negotiation of a convention on long-range transboundary air pollution. This emergence of long-range transport and acid rain as policy problems in the United States has been a multi-faceted phenomenon, partly because of the size of the Government and its Congressional structure.[159] Moreover, the damage caused by acidification was less extensive than in Canada. Finally, acid rain emerged as an environmental issue when there was a declining interest in the environment as a political issue.

The search for an appropriate policy to control long-range transboundary air pollution has absorbed senior pollution control officials of both nations since the mid-1970s. Canadian officials necessarily viewed the problem as immediate and politically charged.[160] While the Canadians might have taken a more imagi-

158. NATIONAL ATMOSPHERIC DEPOSITION PROGRAM, Council on Environmental Quality, A NATIONAL PROGRAM FOR ASSESSING THE PROBLEM OF ATMOSPHERIC DEPOSITION (Dec. 1978).

159. A recent illustration of the difficulty in gaining the attention of Congress was provided when Senator Daniel Moynihan admitted that he was not aware of the acid rain problem until it became the focus of public demonstrations during President Reagan's visit to Ottawa in March 1981. Ottawa Citizen, Mar. 13, 1981, at 14.

160. In 1976 Environment Canada identified the long-range transport of air

native initiative, the perspective they brought to the problem was not dissimilar to that of specialists in Europe and the United States. Officials in both countries initially believed that the most sensible and economical approach to the problem was to manage the emissions of transboundary air pollutants. In this context, management involves several steps, the first of which is the identification of the precise effects of specific air pollutants at a certain level of concentration in a given region. This matter could necessitate a formidable scientific research effort. The second step is the determination of the acceptable level of pollution in a given region, with due consideration to the harm feared and the contemplated costs. Finally, through dispersion or removal, emission controls must be applied to enough sources to reduce loadings in order to achieve the acceptable level of pollutants in the region.

This orthodox management approach involves a major technical and scientific effort. Its goal is to establish controls that will be economically appropriate to the contemplated harm. On the other hand, the process may involve undue delay, and it is available for abuse by those opposed to strict regulations or to any regulations at all. The emphasis on adjusting the degree of control on emission sources to the desired regional air quality and the costs of abatement can, and generally does, result in inadequate control standards. Because of these problems, the management approach has gradually lost favor among Canadian policymakers. Similar reservations are apparently entertained by many environmentalists in the United States, and the environmental sector of the federal bureaucracy is currently in disarray.

Many senior officials in both countries share the assumption that transboundary air pollution does not involve any serious legal problems. Many officials have taken the uncritical view that transboundary air pollution fits easily into the emerging framework of international legal principles of state responsibility. Under this approach, the chief requirement would be to fix responsibility on the polluter. Unfortunately, long-range transport of air pollution does not fit easily into this simple legal pattern. Attempts to utilize legal and scientific frameworks designed for other problems have complicated an already difficult situation.

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pollutants as a top priority environmental issue. In a June 1977 speech, Romeo LeBlanc, the Canadian federal Minister of the Environment, described the acid rain problem as an "environmental time bomb." Munton, *supra* note 3, at 7.

The legal and institutional aspects of this problem must be differentiated from other kinds of pollution issues.[161]

The first step toward a formal cooperative approach by the two governments was the establishment of a Bilateral Research Consultation Group on the Long-Range Transport of Air Pollutants in 1978.[162] The first meeting of this Research Consultation Group took place in July 1978. At the same time, powers inside the United States favored a formal air quality agreement with Canada, and in the fall of 1978 Congress responded by passing a resolution requiring the United States Department of State to initiate negotiations toward these ends.[163] This resolution was motivated not by national concern over the problem of acid precipitation, but by local concern in some border states about short-range pollution originating in specific projects located in southern Saskatchewan and northwestern Ontario.[164] After an Exchange of

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161. For a variety of views on the legal assumptions underlying efforts at environmental cooperation in North America, see *Rehabilitating Our Continental Neighborhood: Rivers, Lakes, Fisheries, and Pollution Zones,* AMERICAN SOCIETY OF INTERNATIONAL LAW, PROCEEDINGS OF THE 68TH ANNUAL MEETING 138-56 (1974). The comments of Professors Bilder, at 151-52, and McDougal, at 154-55, seem especially pertinent in the context of acid precipitation.

162. This initiative was agreed to by an exchange of notes in June 1978. Its purpose was simply to create a forum for the exchange of scientific information and the comparison of research activities, but in October 1979 the Consultation Group produced a preliminary study for public consumption. *See* PRELIMINARY OVERVIEW, *supra* note 2. This document played a major role in Canada toward converting what had been essentially a technical, bureaucratic concern into a popular, political issue. Munton, *supra* note 3, at 7.

163. This resolution, initially presented both in the United States and the House of Representatives, was later incorporated as an amendment to the Foreign Relations Authorization Act, Fiscal Year 1979, Pub. L. No. 95-426, § 612, 92 Stat. 990 (1978).

164. Two polluting projects were the Saskatchewan Power Corporation plant under construction on the East Poplar River and the Ontario Hydro facility under construction near Atikokan, north of the Boundary Waters Canoe Area in Minnesota. United States environmentalists feared that these plants would fail to meet either the national standards inherent in the "prevention of significant deterioration" criteria under the United States Clean Air Act, *see* note 78 *supra,* or the requirements for sulfur scrubber technology on new facilities, or both. On September 23, 1980, the United States and Canada issued a joint announcement that they had agreed on a cooperative monitoring arrangement for the Poplar River. DEP'T STATE BULL., Dec. 1980, at 34. In addition both sides of the border have evidenced a mounting concern on the part of environmentalists over the following transboundary issues: the risk of a blow-out in the Beaufort Sea; the prospect of a major oil spill on the West coast tanker route from Alaska; the

Notes dated November 16 and 17, 1978, exploratory meetings of United States and Canadian officials took place in December 1978 and June 1979, and on July 26, 1979, the two governments issued a Joint Statement on Transboundary Air Quality.[165]

The Joint Statement placed special emphasis on the problem of long-range transport of air pollutants and the phenomenon of acid rain. It was affirmed that both governments "share a growing concern about the actual and potential effects of transboundary air pollution and are prepared to initiate co-operative efforts to address transboundary air pollution problems." The Joint Statement identified "a substantial basis of obligation, commitment and co-operative practice in existing environmental relations" between the two countries.[166] Recognizing the importance of the immediate problem, the governments pledged to move their discussions beyond the informal stage to develop a formal bilateral agreement on transboundary air quality which would be based on the following principles and practices:

1. Prevention and reduction of transboundary air pollution which results in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems and impair or interfere with amenities and other legitimate uses of the environment.
2. Control strategies aimed at preventing and reducing transboundary air pollution including the limitation of emissions by the use of control technologies for new, substantially modified and, as appropriate, existing facilities.
3. Expanded notification and consultation on matters involving a risk or potential risk of transboundary air pollution.
4. Expanded exchanges of scientific information and increased co-operation in research and developments concerning transboundary air pollution processes, effects and emission control technologies.
5. Expanded monitoring and evaluation efforts aimed at understanding of the full scope of the transboundary air pollution

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Ross Dam case; the Sage Creek coal mining issue; the well-publicized Garrison Diversion project; air quality concerns in the Windsor-Detroit area; fears of downstream flooding in the Champlain-Richelieu district; water quality problems on the Saint John and St. Croix rivers; and the prospect that a controversial oil refinery complex might be located close to the Canadian border at Eastport, Maine.

165. DEP'T STATE BULL., Nov. 1979, at 26-27.

166. *Id.* References were made to the Boundary Waters Treaty of 1909, *see* note 118 *supra*, to Principle 21 of the 1972 Stockholm Declaration on the Human Environment, *see* note 111 *supra*, and to the 1978 Great Lakes Water Quality Agreement, *see* note 127 *supra*. *Id.*

phenomenon.

6. Cooperative assessment of long-term environmental trends and of the implications of these trends for transboundary air pollution problems.

7. Consideration of such matters as institutional arrangements, equal access, non-discrimination and liability and compensation, as relevant to an agreement.

8. Consideration of measures to implement an agreement.[167]

While not departing from the management approach, the Joint Statement did declare unequivocally that a serious environmental problem existed. Given the scientific difficulty which can arise in simply identifying the existence of such a problem, this first step was extremely significant. The next diplomatic milestone, the ECE Convention on Long-Range Transboundary Air Pollution, consequently may be seen as a step backward. Unlike the United States-Canadian Joint Statement, the ECE Convention hedged on the all-important question of whether an actual problem existed. It recognized the possibility of adverse effects and expressed concern that "a rise in . . . emissions . . . may increase such adverse effects."[168] This had the effect of once again requiring the parties to establish a connection between the environmental harm and certain emissions. Both Canada and the United States acceded to the Convention, though their reasons for doing so probably are not connected with pollution control.[169]

Concerned officials in both countries found the situation in late 1979 to be dismal. The Joint Statement had not been followed by a bilateral agreement. The ECE Convention promised few advances, and it could be viewed as a step backwards. Energy and economic conditions in both countries were worsening, and an unpromising political climate was developing. The need for a new approach to long-range air pollution was becoming manifest to some officials. These difficult circumstances did, however, provide a stimulus for the negotiation of the Memorandum of Intent between the Government of Canada and the Government of the

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167. *Id.* at 27.

168. Long Range Convention, *supra* note 132, at 1442-43.

169. Since there is no economic commission for North America in the United Nations, the United States and Canada are members of both the ECE and its counterpart for Latin America (ECLA). In both forums, these two nations must be careful not to pursue a critical, oppositionist type of diplomacy in regions to which they do not belong.

United States concerning transboundary air pollution.[170] Signed on August 5, 1980, this Memorandum is a significant diplomatic initiative which provides a formal framework for new approaches to the problem of air pollution control and reaffirms that a significant environmental problem exists and will grow more serious.[171] Most importantly, the parties express the conviction that "the best means to protect the environment from the effects of transboundary air pollution is through the achievement of necessary reductions in pollutant loadings."[172]

The first section of the Memorandum sets out the mechanism for treaty development. A Canadian-United States coordinating committee is established to undertake preparatory work in science, engineering, economics, and law.[173] The second section obligates both governments to develop domestic policies and strategies designed to address transboundary pollution problems and, where necessary, provide legislative support for them. In addition, both states must promote vigorous enforcement of existing laws and regulations requiring "limitation of emissions from new, substantially modified and existing facilities in a way which is responsive to the problems of transboundary air pollution." These

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170. DEP'T STATE BULL., Oct. 1980, at 21. No. 2043, (text reproduced in U.S. DEP'T OF STATE, PRESS RELEASE 209A (obtainable from the Office of Press Relations, Department of State, Washington, D.C. 20520)) [hereinafter cited as Memorandum].

171. The preamble to the Canadian-United States Memorandum of Intent, in marked contrast with the ECE Convention, refers to "actual and potential damage resulting from transboundary air pollution" and "the already serious problem of acid rain." *Id.* It makes note of scientific findings which "indicate that continued pollutant loadings will result in extensive acidification in geologically sensitive areas during the coming years, and that increased pollutant loadings will accelerate this process." *Id.*

172. *Id.* ¶ 9.

173. *Id.* A work group structure for negotiation of a transboundary air pollution agreement is described in the Annex to the Memorandum. This structure consists of the following: an impact assessment work group; an atmospheric modelling work group; a strategies development and implementation work group; an emissions, costs, and engineering assessment sub-group; and a legal institutional arrangement and drafting work group. *Id.* All of these intergovernmental groups have been active since the signing, and some have already produced interim reports. *See, e.g.,* STRATEGIES, Interim Report, *supra* note 6. In addition, both of the parties to the Memorandum have set up fairly elaborate interagency LRTAP committee structures at the national level. See, for example, LRTAP NEWSLETTER 1-5 (Dec. 1980), for a description of the Canadian committee structure.

activities are to be done in consultation with the other state. The third section requires that notification and consultation be undertaken between both states on proposed industrial development and proposed changes of policy which "may significantly affect transboundary air pollution." The last section provides for the exchange of scientific and technical information.

The most significant aspect of the Memorandum is that it explicitly notes that a transboundary air pollution problem exists and is already serious. It sets out a mechanism to directly address that issue within a short period of time. Formal negotiations under the Memorandum were scheduled to begin no later than June 1, 1981.[174] While the Memorandum of Intent provides the basis for effective negotiations on transboundary air pollution, the changed political situation in the United States has aroused Canadian concern regarding the prospects for an agreement. The new United States administration was elected on a platform unsympathetic to pollution control. Moreover, its declared intention has been to reduce the regulatory burden on United States industry. President Reagan's recent visit to Ottawa provided a convenient vehicle to transmit Canadian concerns, yet the President remained uncommitted.[175]

V. Conclusion: A Proposal for Negotiation

Formal negotiations of a Canadian-United States transboundary air pollution agreement are scheduled to begin in the fall of 1981. It may be timely, therefore, to conclude this study with a few suggestions on the general purposes and salient features of such an instrument.

A. *Scope of the Agreement*

It should be accepted that the North American problem of acid precipitation due to long-range transport of atmospheric pollutants would be dealt with best by a general transboundary air pollution agreement. Such an instrument would contain provisions on the problem of single-source, short-range, transboundary air pollution. Since Canada is a net importer and the United States a net exporter of atmospheric pollutants, an exclusively long-range air pollution agreement between the parties would be

174. This initial date has been pushed back to the fall of 1981.
175. Dep't State Bull., Apr. 1981, at 7.

somewhat asymmetrical and might be expected to run into ratification difficulties in the United States Senate in light of the recent history of Canadian-United States treaty-making.[176] A general agreement covering both long-range and short-range problems would reflect a variety of concerns that are likely to be shared more equally by the two neighboring countries.

B. *Objectives*

The long-range goal of the agreement should be to minimize the acidification of fresh water and other detrimental effects on terrestrial ecosystems attributable to the long-range transboundary transmission of sulfur dioxide and nitrous compounds. Negotiations should attempt to reach agreement on bold, specific, and verifiable objectives, such as the ninety-seven to ninety-eight percent elimination of sulfur dioxide emissions from designated categories of industrial sources over a twenty-five year period. Unverifiable and ambiguous objectives will simply contribute to resentment, cynicism, and disillusionment on both sides of the border. The major emphasis of any short-range solution should be to develop new or improved procedures for intergovernmental notification and consultation. Furthermore, reciprocal and more expeditious resort to national and international tribunals must be established for the settlement of relevant disputes between the two contracting states.

C. *Approaches*

The agreement must be based on a firm rejection of the dispersion techniques traditionally applied to sulfur dioxide and nitrous compounds under air quality management approaches. With regard to acid precipitation, the agreement should represent a continental abatement strategy delineating the development and implementation of mutually acceptable emission standards. A boldly innovative effort to achieve the reduction and removal of emissions is needed to impose uniform and effective pollution controls in a manner which reduces the competitive disadvantage to any industry. The agreement should envisage national legislation con-

176. On the recent withdrawal of the East Coast Fisheries Agreement from the United States Senate, see Johnston, *The Ratification Crisis,* NEW DIRECTIONS (Newsletter of Dalhousie University Ocean Studies Programme), *reprinted in* OCEAN LAW, May 1981, at 1-2.

sisting of specific and enforceable control measures that would not be stultified by evidentiary challenges in law or science. In short, the agreement should reflect a regulatory rather than management approach to the control of acid precipitation. This approach would reject the concept of liability embodied in the "allocation of entitlements" approach, which seems wholly inappropriate to this type of air pollution problem.

On the short-range side of the agreement, the negotiators should attempt to develop existing principles and procedures under the evolving doctrine of state responsibility, which would represent a bilateral contribution to the furtherance of international environmental law. The agreement should specifically formulate the following principles of environmental responsibility which would be applied to local transboundary air pollution between the two countries: exchange of information, prior notification and consultation, nondiscrimination and equal access for pollution victims, and liability and compensation rules to be applied to claimants. The establishment of a special transboundary claims tribunal might be considered under the agreement in order to provide claimants with an alternative to a foreign court of law.

D. *Acid Precipitation Control Measures*

The detailed control measures applied to the acid precipitation problem should be consistent with three standards applied to different kinds of industrial sources. First, new plants should be required to install the best available control technology at the time of construction regardless of cost. Second, large-scale existing plants should be required, regardless of cost, to phase in the best available retrofit technology as expeditiously as possible within a ten-year period. And last, all other small-scale existing plants should be required to phase in appropriate retrofit technology as expeditiously as seems reasonable within a twenty-five year period, taking into account the need to balance the economic costs of installation and operation against the economic and social costs of such pollution.

A transboundary air pollution agreement designed along these lines would not be easy to negotiate, ratify, or implement. Such an undertaking by Canada and the United States would be complex, expensive, and politically controversial. But it is hard to envisage any effective approach that could be simple, inexpensive, and popular. Only a radical and innovative effort can eliminate

the problem of acid precipitation in North America.

Perhaps society is not ready to pay this price, even to offset the risk of the irreversible pollution of our water and soil; yet a treaty of this kind is possible as well as necessary. Many of the environmental policies of the future will be expensive. Seventeen Mediterranean states have already accepted a very costly agreement for the long-term elimination of land-based pollution of their common waters.[177] In attempting to combat the atmospheric pollution of their water and soil, the two neighboring states of North America begin with fewer disadvantages. Diplomacy between them has not always been easy or successful, and in recent years their relationship has sometimes been strained,[178] but they have a general reputation for neighborly accord. Now, however, they must pass the acid test!

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177. Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources (1979), *reprinted in* 19 INT'L LEGAL MATERIALS 869 (1979).

178. Strains between the two countries have been aggravated recently by the decision of the United States Government to relax, rather than tighten, the present controls under the Clean Air Act. Exploratory talks between the two countries in June 1981 failed to provide any solid basis for negotiation of a transboundary air pollution agreement. A Canadian diplomatic note expressing concern that the proposed revisions "do not impede ongoing Canada-United States efforts to address transboundary air pollution" failed to deflect the United States Government's policy of leniency in air pollution control. Toronto Star, June 24, 1981, at A-18.

Canadian Environmental Minister John Roberts has described the acid rain problem as the most serious issue between Canada and the United States: "We do not need further studies. What we need are general reductions in emissions and we need them now." In the fall of 1981, he is scheduled to meet with United States senators and congressmen in the hope of persuading them that the revamped United States Clean Air Act should include tougher controls on the fallout from electric generating plants burning coal. Halifax, N.S., Mail Star, Sept. 15, 1981, at 13.