Environmental Law Reporter

A Project of the Environmental Law Institute

ARTICLES & NOTES

Volume X, Number 2, February 1980 **10 ELR 50000**

Table of Contents

Air Pollution Control Laws in North America and The Problem of Acid Rain and Snow

by Gregory Wetstone

Recent scientific evidence has made it clear that air pollution emissions may have environmental effects in regions much more distant from the source than previously believed possible. Oxides of sulfur and nitrogen produced in the burning of fossil fuels and in smelting operations may be carried hundreds or even thousands of miles through the atmosphere, chemically transformed in the process, and eventually returned to earth as sulfuric and nitric acids, often in rain or snow. As a result, many areas of the United States and eastern Canada are now experiencing precipitation 25 to 40 times more acidic than "natural" rainfall.[1] Though the problem has been developing for decades, monitoring has been sporadic, and only in the past two or three years have scientists begun to focus study on the phenomenon and its associated environmental effects. It is now clear that in receiving areas, which are especially vulnerable because of soil naturally low in the capacity to neutralize acids, acid rain and snow can have devastating consequences.

The acid precipitation problem is particularly difficult to deal with through traditional approaches to air pollution control. Acid-forming compounds are emitted as conventional air pollutants, but they return to earth either in precipitation, where arguably they are not an *air* quality problem, or as chemically altered compounds (sulfates and nitrates) which are not yet the target of direct regulation. The pollution routinely crosses internal political boundaries (state and provincial borders) and international boundaries, making existing locally oriented approaches to control inappropriate. The difficulties are exacerbated by the fact that low levels of acid pollution deposited over many years can accumulate to cause serious environmental damage.

This article will focus on the acid precipitation problem in North America. It will examine the sufficiency of the abatement regimes of the United States and Canada, as well as the prospects for effective international action under existing doctrines of international law. Current efforts by the United States and Canada to forge an international agreement to remedy the problem will also be analyzed. Before these topics are discussed, it is necessary to first describe the acid precipitation problem in more detail.

The Problem

Acid rain was first brought to the world's attention in 1972 when Sweden raised the problem before the United Nations Conference on the Human Environment in Stockholm.[2] Scientific attention then focused upon assessing the phenomenon in North America. Old sampling records revealed that since the mid-1950s, when acid rain was confined almost entirely to the highly industrialized areas of the northeastern United States, the problem has intensified dramatically.[3] Acid rain and snow are now common in almost all of eastern North America and many areas of the West.[4] Rainfall in Georgia and Florida is now about as acidic as rainfall was in the most serious problem areas of the Northeast 25 years ago.[5] In parts of the Northeast, acid levels are now 20 times higher than they were in 1955.[6]

Scientists have related the rise in acid precipitation to increases in the emissions of sulfur and nitrogen compounds as air pollutants.[7] Rough estimates are that at present 60 to 70 percent of the problem is due to sulfuric acids (derived mainly from sulfur dioxide emissions), while nitric acids (derived mainly from emissions of nitrogen oxides) are responsible for the balance of the acidity.[8] However, these proportions are not fixed and most scientists believe that, because of the continuing increase in NO_x emission rates, nitric acids will constitute an increasingly larger part of the problem.

The largest sources of sulfur emissions are coal- and oil-fired electric power plants (especially plants using high sulfur coal) and smelting operations.[9] Nitrogen oxides are produced by almost all fossil fuels combustion processes, including the burning of gasoline in motor vehicles and the burning of oil and coal in power plants.

Acid precipitation begins with the "long-range transport" of these emissions. It has been demonstrated that air pollutants can be carried through the atmosphere for thousands of miles,[10] especially where tall stacks are

Gregory Wetstone (B.S. in Biology 1975, Florida State University; J.D. 1978, Duke University School of Law) is a staff attorney with the Environmental Law Institute specializing in air and water pollution control law and the law surrounding the control of toxic substances. The author would like to thank the German Marshall Fund of the United States for their generous funding in support of this research.

1. Rainfall is naturally slightly acidic from carbon dioxide in the air and from minerals released into the atmosphere in sea spray.

2. Bolin *et al.*, AIR POLLUTION ACROSS NATIONAL BOUNDARIES: THE IMPACT ON THE ENVIRONMENT OF SULFUR IN AIR AND PRECIPITATION (1972) (Sweden's case study for the U.N. Conference on the Human Environment in Stockholm).

3. Likens, *Acid Precipitation*, CHEM. & ENG. NEWS 20 (Nov. 22, 1976); Likens, Wright, Galloway & Butler, *Acid Rain,* 241 SCI. AM. 43 (Oct. 1979).

4. *Id.; see also,* Shaw, *Acid Precipitation in Atlantic Canada,* 13 ENVT'L SCI. & TECH. 406 (Apr. 1979); Lewis & Grant, *Acid Precipitation in the Western United States,* 207 SCIENCE 176 (Jan. 11, 1980).

5. Likens, *supra* note 3; Likens, Wright *et al., supra* note 3.

6. *Id.*

7. *Id.*

8. Glass, *Mounting Acid Rain,* 5 EPA J. 25 (July/August 1979).

9. In the United States about 70 percent of the annual emissions of sulfur oxides come from the combustion of fossil fuels in generating electricity. In Canada, where fossil fuels play a much less important role in generating electric power, about 60 percent of the SO_x emissions originate with non-ferrous metal smelters. Shaw, *supra* note 4 at 407; GREAT LAKES WATER QUALITY BOARD OF THE INTERNATIONAL JOINT COMMISSION, GREAT LAKES WATER QUALITY, 1978 ANNUAL REPORT at 82 (July 1979).

10. HIDY, MAHONEY & GOLDSMITH, INTERNATIONAL ASPECTS OF THE LONG RANGE TRANSPORT OF AIR POLLUTANTS prepared for the U.S. Dep't of State, Washington, D.C. (Doc. P-5252, Sept. 1978).

used to minimize local air quality effects. While in the atmosphere, the sulfur and nitrogen compounds are "oxidized" to form sulfates and nitrates,[11] the chemical particles most directly responsible for the problem. These particles can either drift down to earth independently (a phenomenon termed "dry deposition") or combine with water vapor in the air to form sulfuric and nitric acids in precipitation ("wet deposition"). Very little is known about dry deposition except that it almost surely presents as great an environmental threat as wet deposition[12] and is even more difficult to monitor.[13]

Although the parameters of the environmental effects of the deposition of acids from the atmosphere are not well understood, many serious consequences have already been identified. Acid rain and snow can promote the leaching from the soil of mineral nutrients, such as calcium, magnesium, potassium, and sodium, causing a reduction in forest and agricultural productivity.[14] Mountain and upstream lakes in areas that are low in acid-neutralizing minerals can be so acidified that fish species are no longer able to reproduce and are, along with other aquatic life-forms, eventually eliminated.[15] In contrast to the decline in fish population due to reproductive failure, which takes place over a period of years, dramatic large-scale fish kills may result from "acid stresses" which accompany the thawing of large amounts of acid-laden snow. If it occurs at spawning time, acid stress can prevent the development of a new generation of fish. Scientists have discovered that as a result gaps exist in the age structure of fish populations in affected areas.

In addition, metals present in the environment but chemically unavailable, such as aluminum, iron, mercury, and lead, can be "mobilized" by acid rain and snow in quantities sufficiently toxic to poison plants absorbing the metals through their roots, and affect fish as well. The ultimate consequences of the presence of these metals in the food chain are not yet understood. It is clear that the high level of metals in fish from acidified areas presents a health threat to those who consume fish, and eventually may doom the sport fishing industry in those acidified areas that still support aquatic life. A related problem is that drinking water from acidified sources may mobilize toxic metals present in the water pipes and thereby threaten human health.[16] Other effects that have been attributed to acid precipitation include damage to materials, such as the paint on automobiles and buildings, and severe corrosion of cement and marble structures, including our national monuments.

In many urban areas, the deposition of acids is but one more on a long list of serious air-quality-related problems.[17] However, in distant rural areas, some of which have been set aside to remain wilderness, acid precipitation presents a singular and immediate threat to the environment. Those areas that have only a limited capacity to neutralize acids in rain, snowfall, and dry deposition are particularly susceptible. Much of eastern Canada, northern New York State, the Appalachian and Rocky Mountains, and northern New England share the characteristics of soil low in natural buffers (such as calcium and limestone) with an underlying bedrock that is not conducive to the neutralization of acids. Once the "cumulative loading" of acids deposited in these areas through the years has exhausted the environment's limited neutralizing capacity, severe effects follow very quickly with the addition of small, previously inconsequential, quantities of acid.

This has already taken place in many of the "acid-sensitive" areas that lie north and east of the heavily industrialized region centering around the Ohio River Valley and in the vicinity of the huge nickel smelter at Sudbury, Ontario.[18] Over 100 of the high altitude lakes of the western Adirondack Mountains of New York, once a prime sport-fishing area, have already been so acidified that fish populations have been entirely eliminated.[19] In addition, fish have been eliminated in about 140 of Ontario's lakes, including many in the Killarney (wilderness) Park in the Sudbury region. Lakes in Ontario's popular Muskoka-Haliburton region are also endangered, and many have already lost much of their natural alkalinity.

In fact, Canada possesses acid-sensitive regions much more extensive than those in the United States and is therefore more threatened by the acid precipitation phenomenon. Nearly all of eastern Ontario, Quebec, and the Atlantic Provinces are especially vulnerable to acidity.[20] According to John Fraser, Canadian Minister of the Environment, 48,000 lakes in Ontario alone are threatened by acidification in the next 20 years if emission rates remain unchanged.[21]

Perhaps most disturbing is the likelihood that the ef-

11. Sulfates are compounds containing SO_4, while nitrates contain NO_4. Nitrogen and sulfur dioxide are NO_2 and SO_2, respectively.

12. *See*, BILATERAL RESEARCH CONSULTATION GROUP, THE LONG RANGE TRANSPORT OF AIR POLLUTANTS PROBLEM IN NORTH AMERICA: A PRELIMINARY OVERVIEW (Oct. 1979).

13. This article focuses on wet deposition. Any reduction in emissions to reduce the problem of wet deposition can be expected to have a roughly corresponding effect on dry deposition, however.

14. For a survey of the effects of acid precipitation see ENVIRONMENTAL PROTECTION AGENCY, ACID RAIN RESEARCH SUMMARY (EPA-600 18-79-028 Oct. 1979); Glass, *supra* note 8, at 26; GREAT LAKES SCIENCE ADVISORY BOARD, ANNUAL REPORT TO THE INTERNATIONAL JOINT COMMISSION 6-28 (July 1979).

15. *Id. See, e.g.*, Schofield, *Acid Precipitation: Effects on Fish*, 5 AMBIO 228-230 (1976); Harvey, *Fish Populations in Acid Stressed Lakes*, 19 VECH. INT'L LIMNOT. BD. 2406 (1975); Beamish, Van Loon & Harvey, *Long Term Acidification of a Lake and Resulting Effects on Fishes*, 4 AMBIO 98 (1975).

16. *See* ENVIRONMENTAL PROTECTION AGENCY, ACID RAIN RESEARCH SUMMARY (EPA-600 18-79-028 Oct. 1979); *Pipes Corroded From Acid Rain Could Contaminate Drinking Water*, 10 ENVIR. REP. CURR. DEV. 1168 (Sept. 14, 1979).

17. Perhaps as a result, the effect of acid precipitation on the urban environment has not been well studied.

18. The International Nickel Company smelter at Sudbury, which releases about 3,500 tons of sulfur dioxide into the atmosphere each day, is the largest single source of sulfur dioxide emissions in the Northern Hemisphere.

19. A. LA BASTILLE, ADIRONDACK PARK AGENCY REPORT ON ACID PRECIPITATION at 2 (July 1979).

20. *See* Shaw, *supra* note 4.

21. Statement of John Fraser, after meeting with U.S. Secretary of the Interior, Cecil Andrus, Washington, D.C. (Aug. 8, 1979).

fects of acid rain and snow on aquatic systems are irreversible.[22] No natural means is known by which an acidified lake might return to its original chemical and biological composition. Hence, unlike many other air and water pollution problems involving nontoxic materials, which remedy themselves once humans stop contributing pollution, remedial action would be necessary to return the lakes to their original state, if indeed that is possible.

Most researchers feel that efforts to add chemical buffers to affected waters to retard acidification offer at best only a partial and temporary solution. In Sweden, which suffers from a severe acid precipitation problem, lime has been tried to counter the effects of acidity deposited in lakes. But there has been little success in recreating the chemical balance necessary to support a normal spectrum of aquatic life. It is difficult to reestablish aquatic life after the introduction of large quantities of chemicals, especially since significant quantities of toxic metals are introduced into the water body through acid drainage and are not removed through the addition of buffers. In the words of Dr. Harold Harvey, a scientist who has been investigating the effects of acidification for several years,

> if you take an acid lake and you lime it, you do not now have a normal lake; you now have a limed, formerly very acid lake, with a very peculiar water chemistry and a very peculiar biota as a result.[23]

At any rate, the logistical difficulties of distributing the tremendous volume of chemicals that would be necessary to treat each of the endangered or acidified lakes could be insurmountable.

A final point concerns the possibility that some forms of aquatic life indigenous to acid-sensitive areas could face extinction. While the biological composition of the most affected areas is not extensively documented, there is already evidence that one species of brook trout may have become extinct due to acidification.[24] Animal species lost in this fashion can never be replaced, regardless of whether the proper chemical balance can be created again in acidified areas.

Current Domestic Pollution Control Efforts

The acid precipitation problem in North America has continued to worsen, despite efforts to control air pollution in both the United States and Canada. The following pages examine why existing pollution control programs have not successfully contained the problem.

The United States

Air pollution in the United States is controlled through a complex array of programs established under the Clean Air Act.[25] The provisions for federal establishment of uniform national ambient air quality standards (NAAQS) are the foundation of the Act's regulatory programs. States must develop control programs that will reduce emissions sufficiently to permit attainment and maintenance of these air quality goals. More stringent technology-related controls are required for major new sources through new source performance standards (NSPS), which apply to certain categories of new or modified stationary sources that contribute significantly to air pollution. In addition, the federal prevention of significant deterioration (PSD) program is intended to limit degradation of air quality in the nation's clean air regions. Other relevant Clean Air Act programs concern the protection of visibility in pristine areas, and the regulation of motor vehicle emissions. The Environmental Protection Agency's (EPA's) policy regarding the use of tall smokestacks by major pollution sources is also pertinent.

While the Clean Air Act is the statute most central to the control of acid-forming air pollutants, regulation under other environmental laws, most notably the Federal Water Pollution Control Act (FWPCA) and the Endangered Species Act, is also potentially relevant in light of the extensive environmental effects associated with acid rain, snow, and dry deposition.[26] These statutes will also be briefly discussed.

---

22. The Great Lakes Water Quality Board of the International Joint Commission has concluded that "unless emissions are reduced, widespread irreversible harm to ecosystems susceptible to acid precipitation will occur within 10 years to 15 years." GREAT LAKES WATER QUALITY BOARD, *supra* note 9, at 83.

23. STANDING RESOURCES DEVELOPMENT COMMITTEE OF ONTARIO, INTERIM REPORT ON ACIDIC PRECIPITATION, ABATEMENT OF EMISSIONS FROM THE INTERNATIONAL NICKEL COMPANY OPERATIONS AT SUDBURY, AND POLLUTION CONTROL IN THE PULP AND PAPER INDUSTRY 19 (June 1979).

24. ONTARIO MINISTRY OF THE ENVIRONMENT, NORTHEAST REGION, LIMNOLOGICAL OBSERVATIONS ON THE AURORA TROUT LAKES (1978).

25. 42 U.S.C. §§7401-7642, ELR STAT. & REG. 42201.

26. Although outside of the federal statutory system, another relevant source of law is the emerging federal common law of nuisance, which has been used, with mixed success, to address interstate pollution problems. This doctrine is based on two Supreme Court decisions in the early 1900s. In fact, the seminal case of Georgia v. Tennessee Copper Co., 206 U.S. 230 (1907), concerned the emission of acid gases by a copper smelter. The Court enjoined further discharges holding that:

> It is a fair and reasonable demand on the part of a sovereign that the air over its territory should not be polluted on a great scale by sulphurous acid gas, that the forests on its mountains, be they better or worse, and whatever domestic destruction they have suffered, should not be further destroyed or threatened by the act of persons beyond its control, that the crops and orchards on its hills should not be endangered from the same source.

206 U.S. at 238. The other early case, Missouri v. Illinois, 200 U.S. 496 (1906), concerned the City of Chicago's discharge of sewage into the Illinois River.

Sixty five years later the Tenth Circuit Court of Appeals held in a landmark decision that these cases provided for the creation of a federal common law action to seek redress for interstate pollution, Texas v. Pankey, 441 F.2d 236, 1 ELR 20089 (10th Cir. 1971) (Texas sought injunctive relief for contamination of water supplies by pesticide runoff from New Mexico ranches). This view was adopted a year later by the Supreme Court in Illinois v. City of Milwaukee, 406 U.S. 91, 2 ELR 20201 (1972). Justice Douglas, writing for the Court, declared: "[W]hen we deal with air or water in their ambient interstate aspects, there is a federal common law," 406 U.S. at 103, 2 ELR at 20204. While the *Illinois* case solidified the validity of the common law nuisance action, it left the parameters undefined. One major issue on which post-*Illinois* courts have failed to agree is whether the doctrine allows for suits by parties other than states. *Compare* Committee for the Consideration of the Jones Falls Sewage System v. Train, 539 F.2d 1006, 6 ELR 20703 (4th Cir. 1976) (private parties may not sue under federal common law of nuisance) *with* Stream Pollution Control Bd. v. United States Steel Corp., 512 F.2d 1036, 5 ELR 20261 (7th

National Ambient Air Quality Standards

The national ambient air quality standards[27] are the foundation of the Clean Air Act programs for the control of air pollution from stationary sources. The ambient standards are numerical translations of the Act's objectives that air pollution not endanger the public health or welfare.[28] Before promulgating an ambient standard, EPA must develop a "criteria document," providing scientific support for the Agency's conclusions concerning the health and welfare effects of exposure to that air pollutant.[29] Two standards are then promulgated to assure that neither the public health (primary standard), nor the public welfare (secondary standard) is threatened.[30]

Responsibility for achieving these standards rests primarily with the states, which are required to devise state implementation plans (SIPs) designating specific emission limitations for sources which ensure that ambient levels are not exceeded.[31] States are allowed three years after promulgation of the SIP to attain health-related primary standards, while a "reasonable time" is given to achieve secondary standards.[32] If a state's SIP is not adequate to achieve ambient standards within the required period, EPA has authority either to withhold federal funds or to intercede and promulgate an implementation plan of its own.

Present ambient standards do not effectively address the long-range transport of acid-forming compounds. As explained below, many of the problems surrounding the ambient standards are attributable to weaknesses in the state implementation plans designed to assure their attainment. However, there are some problems with the air quality standards themselves.

At present, ambient standards are in place for seven "criteria" pollutants or pollutant mixtures, including sulfur dioxide and nitrogen dioxide, the pollutant gases that create the acid precipitation problem.[33] But, the compounds most directly responsible for acid deposition, sulfates and nitrates, are not directly regulated.[34] As a result, the dry deposition of sulfates and nitrates, a phenomenon which contributes significantly to the acid problem in many areas, cannot be viewed as a violation of existing air quality standards.

The primary ambient standards for SO_2 and NO_2 have been attained in most of the nation's air quality control regions.[35] The problem is that most geographical regions can comply with the ambient standards and still allow substantial emissions of these pollutants. In fact, many states are able to achieve present NO_2 standards by relying solely on federal motor vehicle emission controls, with no requirements in their state implementation plans for NO_2 controls on existing stationary sources.[36] Sulfur dioxide control requirements, while much more stringent than those for NO_2, are nonetheless far below our present

Cir. 1975) (suit by private party under federal common law not "wholly insubstantial and frivolous"); Township of Long Beach v. City of New York, 445 F. Supp. 1203, 8 ELR 20453 (D.N.J. 1978) (municipality entitled to invoke doctrine).

However, a recent Seventh Circuit decision has enhanced the viability of the common law of nuisance doctrine as a means for plaintiffs without statutory recourse to secure relief for pollution-related damages. In City of Evansville v. Kentucky Liquid Recycling, Inc., ____F.2d____, 9 ELR 20679 (7th Cir. 1979), the court of appeals reversed the trial court's dismissal of a nuisance action on the ground that the doctrine could be applied only in litigation brought by sovereign states and ruled that two municipal corporations had properly stated a claim for damages arising from defendant's pollution of the Ohio River with toxic chemicals. The decision did not resolve whether private as well as municipal parties can bring common law nuisance actions in the federal courts. However, it does seem that states, municipalities, or even the federal government can now bring a nuisance action in federal court to force abatement of interstate pollution causing damage in neighboring states. *See* United States v. United States Steel Corp., 356 F. Supp. 556, 3 ELR 20204 (N.D. Ill. 1973).

The nuisance action might therefore provide a means to seek abatement of interstate pollution causing acid rain and snow. The most serious obstacle to success in such a suit would probably be evidentiary. It would be difficult to demonstrate to the court's satisfaction that emissions from particular sources are responsible for acid-related damage in distant areas given the uncertainty of present air quality modeling techniques.

For a discussion of the federal common law of nuisance, see generally Comment, *Seventh Circuit Interprets Federal Common Law of Nuisance to Authorize Municipalities to Sue for Damages,* 9 ELR 10168 (1979).

27. Clean Air Act §109, 42 U.S.C. §7409, ELR STAT. & REG. 42211.

28. Clean Air Act §109(b), 42 U.S.C. §7409(b), ELR STAT. & REG. 42212.

29. Clean Air Act §108(a)(2), 42 U.S.C. §7408(a)(2), ELR STAT. & REG. 42210.

30. Clean Air Act §109(b), 42 U.S.C. §7409(b), ELR STAT. & REG. 42212.

31. Clean Air Act §110, 42 U.S.C. §7410, ELR STAT. & REG. 42212.

32. Clean Air Act §110(a)(2)(A), 42 U.S.C. §7410(a)(2)(A), ELR STAT. & REG. 42212.

33. Other substances for which National Ambient Air Quality Standards currently exist include lead, ozone, total suspended particulates, hydrocarbons, and carbon monoxide. For an assessment of the progress made in achieving ambient air quality standards, see COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY 1978, 4–33 (1978).

34. Sulfates and nitrates are important components of the criteria pollutant mixture "total suspended particulates" (TSP). However, because they are primarily emitted as gases and because of their fine particulate size, these compounds are not controlled to a meaningful extent under TSP regulations.

35. Some areas of Ohio, Michigan, and southeastern Arizona have failed to attain the primary ambient standard for SO_2. The NO_2 standard is exceeded only in southern California. *See* COUNCIL ON ENVIRONMENTAL QUALITY, *supra* note 33, at 65, 66.

36. Examples include Illinois, Indiana, Kentucky, Michigan, Missouri, New Jersey, Oregon, Texas, and West Virginia. *See* ENVIRONMENTAL PROTECTION AGENCY, AIR POLLUTION REGULATIONS IN STATE IMPLEMENTATION PLANS: INDIANA (EPA-450 3-78-064 Aug. 1978); ENVIRONMENTAL PROTECTION AGENCY, AIR POLLUTION REGULATIONS IN STATE IMPLEMENTATION PLANS: KENTUCKY (EPA-450 3-78-067 Aug. 1978); ENVIRONMENTAL PROTECTION AGENCY, AIR POLLUTION REGULATIONS IN STATE IMPLEMENTATION PLANS: MICHIGAN (EPA-450 3-78-072 Aug. 1978); ENVIRONMENTAL PROTECTION AGENCY, AIR POLLUTION REGULATIONS IN STATE IMPLEMENTATION PLANS: MISSOURI (EPA-450 3-78-075 Aug. 1978); ENVIRONMENTAL PROTECTION AGENCY, AIR POLLUTION REGULATIONS IN STATE IMPLEMENTATION PLANS: OREGON (EPA-450 3-78-087 Aug. 1978); ENVIRONMENTAL PROTECTION AGENCY, AIR POLLUTION REGULATIONS IN STATE IMPLEMENTATION PLANS: TEXAS (EPA-450 3-78-093 Aug. 1978); Environmental Protection Agency Review of Proposed Changes to Illinois State Implementation Plan, 44 Fed. Reg. 38587 (July 2, 1979).

technological capability.[37] Moreover, the standards are especially ineffective in addressing long-range transport because concern for compliance focuses on ground level concentrations, not on higher altitudes more relevant to the transport process.

It would not be entirely fair, however, to fault EPA for setting standards that do not address long-range transport and therefore acid precipitation. The laxity of present standards is largely due to poor documentation of the health effects associated with exposure to low levels of the pollutants. Developed in 1969 and revised in 1973, the criteria document for SO_2 was based primarily on evidence concerning health and welfare effects resulting from short-term exposure to relatively high concentrations of sulfur oxides in combination with suspended particulates.[38] Data concerning the effects of exposure to low levels of the pollutant were not, in EPA's opinion, sufficient to support a more stringent SO_2 standard. Similarly, the NO_x criteria document was developed in 1971 and does not provide information on the effects of human exposure to low levels of that pollutant sufficient to support a stringent primary standard.[39]

EPA has examined the possibility of altering the focus of ambient regulation. In 1975 the Agency investigated the feasibility of promulgating an ambient sulfate standard and concluded that adequate scientific data did not yet exist to support such a regulatory program.[40] EPA's current plans are to address the acid deposition problem in the criteria document reviews for SO_2 and particulates due to be completed in 1980.[41] Following revision of the criteria documents, a revised secondary standard for these substances may be promulgated to accommodate acid precipitation concerns, although this will probably not occur before 1982.

It is, however, unlikely that promulgation of more stringent secondary standards for SO_2, NO_x, or particulates would have any real effect in light of the Clean Air Act's lax requirements for attainment of secondary standards. The Act mandates attainment of the health-related primary standards within three years of state implementation plan promulgation.[42] But no firm deadline for attainment of secondary standards is established by the Act or EPA regulations. States are required only to pursue attainment within a "reasonable time."[43]

Unfortunately, no vehicle presently exists under the Clean Air Act or current regulations for imposing a rigorous requirement for expeditious secondary standard attainment in cases of especially widespread and serious environmental effects, such as those associated with the deposition of acids. It is therefore difficult for EPA to require prompt action through alteration of ambient standards without a health-based rationale. While there are, at present, indications of serious health effects associated with the acid deposition phenomenon,[44] EPA's position is that they have not been sufficiently documented to support promulgation of more stringent primary standards.

The ambient standard approach was devised to address the problems associated with high air pollutant concentrations relatively near to the pollution sources. Acid precipitation is, however, not just a local problem. Nor is the ambient pollutant concentration in the locality where long-range emissions originate directly relevant. The most serious environmental damages presently believed to be associated with acid precipitation are a consequence of the cumulative regional loading of emissions released into the atmosphere over many years of sustained polluting activity. They can only be addressed through a reduction in the total regional pollution load.

State Implementation Plans

Under the Clean Air Act the basic tool for attaining and maintaining air quality standards is the state implementation plan. The Act requires each state to develop control plans sufficient to attain and maintain ambient air quality standards.[45] EPA is empowered to impose sanctions and to step in to develop and implement its own plan if a state's is not adequate.

State implementation plan development starts with air quality monitoring and modeling to determine baseline air quality. The state is divided into "Air Quality Control Regions" that are either "attainment" or "non-attainment" for each pollutant for which an ambient standard has been promulgated. In every non-attainment area the state must develop an inventory of all significant sources of emissions. Control programs must then be devised that will bring about achievement of the standards. Attainment measures can include a wide variety of techniques to reduce pollutant concentrations, although the Clean Air Act emphasizes emission limitations.

To gain EPA approval of its SIP, the state must present monitoring and modeling data indicating that its control programs will bring about attainment of the standards. The models used are sometimes simple "rollback" models that assume, for example, that a region with SO_2 levels twice the standard will attain the standard if total

37. *See* note 52 *infra,* and accompanying text.

38. Department of Health, Education and Welfare, Air Quality Criteria for Sulfur Oxide (Jan. 1969); Environmental Protection Agency, Air Quality Criteria for Sulfur Oxide (June 1973). For a summary, see Envir. Rep. 31:2208 (1976).

39. Environmental Protection Agency, Air Quality Criteria for Nitrogen Oxides (1971). It is expected, however, that the present NO_2 standard of 100 micrograms per cubic meter will be strengthened by the addition of a new standard with a much shorter averaging period (less than three hours as opposed to the annual average of the present standard). The 1977 Clean Air Act amendments require promulgation of such a standard if determined by the EPA to be necessary. Clean Air Act §109(c), 42 U.S.C. §7409(c), ELR Stat. & Reg. 42212. It now appears likely that a short-term standard will be proposed in the spring of 1980. *See* Environmental Protection Agency Development Plan for Nitrogen Dioxide Ambient Air Quality Standards, *reprinted in* 10 Envir. Rep. Curr. Dev. 711 (July 13, 1979).

40. Environmental Protection Agency, Position Paper on Regulation of Atmospheric Sulfates (1975).

41. Section 109 of the Clean Air Act was altered in 1977 to require EPA to review existing air quality criteria and standards before 1981 (and every five years thereafter) and to revise the standards as necessary. 42 U.S.C. §7409(d), ELR Stat. & Reg. 42212.

42. Clean Air Act §110(a)(2)(A), 42 U.S.C. §7410(a)(2)(A), ELR Stat. & Reg. 42212.

43. *Id.*

44. *See* note 16 *supra.*

45. Clean Air Act §110, 42 U.S.C. §7410, ELR Stat. & Reg. 42212.

SO_2 emissions in the region are cut in half. Also used are more sophisticated computer models that take into account meteorological conditions, topographical considerations, and source operating characteristics.

Some EPA scientists feel that present models are inadequate because they address only local air quality effects and are not able to account for the deterioration in air quality which occurs 20 to 30 miles from the source.[46] The cumulative effect of the small degradations in air quality from numerous distant sources can be great, in some instances approaching the maximum permitted ambient level.[47]

In some cases state implementation plans are not even adequate to achieve NAAQS locally. Perhaps the most visible example is the State of Ohio, the most significant producer of SO_2 pollution in the eastern United States.[48] There have been long and vigorous disputes between Ohio and EPA over the adequacy of that state's SIP provisions concerning SO_2.[49] EPA is handicapped in responding to inadequate SIPs because the Agency must step in to promulgate and implement an alternative if it finds the state's version unsatisfactory. EPA took these steps in Ohio and found them to be both taxing of the Agency's resources and extremely difficult. The Agency lacks the resources and the political clout for this level of intervention. Under the 1977 amendments to the Clean Air Act, EPA also has the option of cutting off various federal funds, but this too is a politically unwieldy measure.

The SIP approach gives exclusive consideration to control of in-state sources to attain ambient standards in-state. It is not an effective vehicle for controlling air pollutants imported from or exported to other states.[50] Hence, pollutants transported beyond state borders often escape regulation. Sections 126 and 110(a)(2)(E) of the Clean Air Act were intended to insure that emissions permitted under one state's SIP do not contribute to pollution levels in excess of ambient standards in another state.[51] But these provisions have been without significant effect, largely because of uncertainties surrounding the diffusion models used to relate air quality problems in one state to distant emissions from another. Not surprisingly, this system, which is poorly attuned to take account of the flow of conventional pollutants across state boundaries, cannot cope with the more complex situation in which the receiving state gets not air pollution but acid deposition.

Significantly, present SIPs frequently require much less pollution abatement than current technology is capable of achieving. Under current standards, existing coal-fired power plants in compliance with applicable SIPs emit on the average seven times the amount of sulfur dioxide permissible under the technology-based performance standards for new power plants.[52] Many sources, even in the pollution-laden Ohio River Valley, are currently burning large quantities of high sulfur coal without removing sulfur from the flue gases.[53] Nor is it

46. *See* Carter, *Uncontrolled SO_2 Emissions Bring Acid Rain,* 204 SCIENCE 1179, 1182 (June 15, 1979).

47. *Id.*

48. According to Harry Hovey, Director of the New York State Department of Conservation's Division of Air, Ohio produces twice as much sulfur dioxide pollution as New York, New Jersey, and all of New England combined. *Can U.S. Canada Reach Agreement on "Acid Rain"?,* Wall St. J., Sept. 21, 1979, at 18, Col. 3.

49. *See* EPA Enforcement, Two Years of Progress, Dec. 1972-Nov. 1974; EPA Enforcement, A Progress Report, Dec. 1974-Dec. 1975; *Ohio EPA Head Declares War on EPA,* Wheeling, West Virginia Intelligencer, Sept. 22, 1979, at 1, Col. 1. EPA Region V Administrator John McGuire recently commented that: "The state [Ohio] has never supported environmental objectives." AIR/WATER POLLUT. REP. 418 (Oct. 15, 1979).

50. Pennsylvania has sought judicial assistance to force consideration of the interstate impacts of alterations in state air pollution control requirements. In January 1979, the state petitioned the United States Court of Appeals for the Third Circuit to review EPA's approval of relaxations in the West Virginia state implementation plan. Pennsylvania maintains that EPA cannot approve SIP revisions without consideration of the effects on the interstate transport of air pollution and without an examination of the effects of the prevention of significant deterioration program. *See* note 77 *infra* and accompanying text. Pennsylvania v. Environmental Protection Agency, No. 79-1025 (3d Cir. 1979). The Pennsylvania Department of Environmental Resources has also given notice that it intends to sue Ohio over that state's enforcement of existing emission standards. Pennsylvania and New York have strongly objected to recent plans to relax emission standards for certain Ohio power plants. *Pennsylvania Warns of Intention to Sue on Rules for Cleveland Plants,* 10 ENVIR. REP. CURR. DEV. 1544 (Nov. 23, 1979).

51. Section 110(a)(2)(E) provides that a state implementation plan may be approved by the EPA only if

> it contains adequate provisions (i) prohibiting any stationary source within the State from emitting any air pollutant in amounts which will (I) prevent attainment or maintenance by any other State of any such national primary or secondary ambient air quality standard, or (II) interfere with measures required to be included in the applicable implementation plan for any other State . . . to prevent significant deterioration of air quality or to protect visibility, and (ii) insuring compliance with the requirements of section 7426 of this title, relating to interstate pollution abatement;

42 U.S.C. §7410(a)(2)(E), ELR STAT. & REG. 42212. Section 126 provides in part that

> Any State or political subdivision may petition the Administrator for a finding that any major source emits or would emit any air pollutant in violation of the prohibition of section 110(a)(2)(E)(i). Within 60 days after receipt of any petition under this subsection and after public hearing, the Administrator shall make such a finding or deny the petition . . . . [I]t shall be a violation of the applicable implementation plan in such State—(1) for any such major proposed new (or modified) source . . . to be constructed or to operate in violation of the prohibition of section 110(a)(2)(E)(i) or (2) for any major existing source to operate more than three months after such finding has been made with respect to it.

42 U.S.C. §7426, ELR STAT. & REG. 42229.

52. The Ohio Edison Company's plant on the Ohio-West Virginia border emits up to 12 pounds of SO_2 per million BTUs, or 10 times the amount permissible under new source performance standards. Carter, *Uncontrolled SO_2 Emissions Brings Acid Rain,* 204 SCIENCE 1179 (June 15, 1979). According to EPA Administrator Douglas Costle, old plants emit an average of 83 pounds of SO_2 per ton of coal burned. This is seven times the amount that new plants are expected to emit. Costle, *New Source Performance Standards for Coal-Fired Power Plants,* 29 J. AIR POLLUT. CONT. ASS'N 690 (July 1979).

53. *See* Carter, *supra* note 52.

common under current standards for sources to "wash" coal before burning. Washing is a relatively inexpensive process which, if utilized, could yield a 20 to 30 percent reduction in SO_2 emissions from sources using eastern coal high in sulfur-containing pyrite.[54]

SIPs are generally designed to minimize the local ground level effects of emissions. As a result, controls that disperse pollution upward or outward and thus contribute to long-range transport and acid rain are encouraged. Only legal action by environmental groups[55] and the 1977 amendments to the Clean Air Act, which limited the use of tall stacks to attain NAAQS in the vicinity of polluting facilities,[56] have checked this trend. Hence, in many areas the effect of the present system has been to encourage wider dispersion of pollution to avoid locally high concentrations, rather than to reduce the total quantity of regional emissions. With the use of dispersion techniques, tremendous quantities of pollution can be emitted on a regional scale, carried through the atmosphere, and visited on distant areas, even while ambient standards are fully met according to conventional ground level monitoring techniques.

New Source Performance Standards

In place of the SIP emission limitations established pursuant to the ambient standards, most major new sources are required to comply with stringent, technology-based new source performance standards.[57] More stringent requirements are imposed on new sources because engineering considerations are believed to permit the achievement of lower emission levels than on existing operations by incorporating pollution control considerations into the design and construction of the facility.[58] The nationally uniform standards serve to eliminate the possibility that states might compete for new industry through relaxations of control requirements as well as to encourage and demonstrate developments in pollution control technology.

EPA's recently promulgated NSPS for coal-fired power plants[59] are particularly relevant to the acid precipitation problem, since EPA scientists estimate that roughly three quarters of the sulfur oxide emissions in the eastern United States come from power plants. It is expected that 350 new power plants will be built between now and 1995,[60] and the new rules will govern emissions of sulfur dioxide and nitrogen dioxide from all of them. EPA's original 1971 standards for new coal-fired power plants limited SO_2 emissions to 1.2 pounds per million British Thermal Units (BTUs). Under the new regulations all plants must reduce uncontrolled SO_2 emissions from 70 to 90 percent, depending upon the sulfur content of the coal used.[61] In effect, these rules require all new plants to use "scrubbers" to desulfurize flue gases. EPA has determined this to be the "best system of emissions control (taking costs into account) which has been adequately demonstrated."[62] It should be noted, however, that these standards theoretically do not preclude the use of emerging technologies that might also effectively control sulfur emissions.

According to EPA Administrator Douglas Costle, today's power plants emit an average 83 pounds of SO_2 for each ton of coal burned, as opposed to the 12 pounds of SO_2 per coal ton that new sources will average.[63] This startling discrepancy is more a testament to the laissez-faire policy toward existing sources of pollution than a tribute to the stringency of new technologically based limitations. In fact, environmentalists have attacked the NSPS standard for SO_2 as too lenient in light of greater reductions that have been demonstrated elsewhere, primarily in Japan.[64]

While the NSPS will help ameliorate the environmental effects of future growth, there are several considerations that suggest that they will not yield a significant reduction in overall emissions in the near future. According to EPA scientists, most power plants in this country are relatively young, with an average of 20 useful years left, compared with an estimated 35-year life for most new plants. Utilities are currently free to use the older plants, which may be cheaper to operate, since most have little or no environmental controls, for the heavier base load generation, while using newer, more tightly controlled units only for

54. For industry's perspective on the promise of coal washing, see *More Coal Per Ton,* 4 ELEC. POWER RESEARCH INST. 69 (June 1979).

55. NRDC v. EPA, 489 F.2d 390, 4 ELR 20204 (5th Cir. 1974), *reversed on other grounds sub nom.* Train v. NRDC, 421 U.S. 60, 5 ELR 20264 (1975).

56. Clean Air Act §123, 42 U.S.C. §7423, ELR STAT. & REG. 42228.

57. New or modified stationary sources in certain industrial categories determined by EPA to contribute significantly to air pollution problems are required by §111 of the Clean Air Act to comply with a technology-based "standard of performance." This standard is required to specify a quantitative emission limit for each listed pollutant which reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of achieving such reduction) the Administrator determines to have been adequately demonstrated. 42 U.S.C. §7411, ELR STAT. & REG. 42216.

58. Some commentators have suggested that the sharp differences in the requirements for new and existing sources are not warranted by engineering concerns and represent instead a political trade-off in which tight controls on existing sources were sacrificed for the emphasis on new plants. *See, e.g.,* Carter, *supra* note 52.

59. 44 Fed. Reg. 33580 (June 11, 1979).

60. *See* Costle, *New Source Performance Standards for Coal-Fired Power Plants,* 29 J. AIR POLLUT. CONT. ASS'N 690 (July 1979).

61. The 90 percent requirement applies to all facilities where uncontrolled emissions exceed 16 pounds of SO_2 per million BTUs. A sliding scale is required for coal containing less sulfur, but in all cases at least a 70 percent reduction is required. 44 Fed. Reg. 33580 (June 11, 1979).

62. As required by §111, 42 U.S.C. §7411, ELR STAT. & REG. 42216.

63. *See* Costle, *supra* note 52, at 690.

64. *See* MAXWELL, ELDER & MORASKY, SULFUR OXIDES CONTROL TECHNOLOGY IN JAPAN (Interagency Task Force Report prepared for the Senate Committee on Energy and Natural Resources, 1978). The Natural Resources Defense Council has argued that Japan has demonstrated that a greater than 93 percent reduction in SO_2 emissions is achievable. Letter from Richard Ayres, Senior Staff Attorney, NRDC, to Douglas M. Costle, Administrator, Environmental Protection Agency (Aug. 15, 1978).

marginal power needs.[65] EPA scientists have suggested that if new plants were used to capacity, significantly greater emission reductions would result. Also, some utilities may squeeze all the use they can from old plants, thereby delaying their dependence on new, more tightly controlled units.

In any case, it is clear that old plants will not be replaced rapidly enough for the NSPS to offer a short-range solution to the acid precipitation problem. According to reliable estimates, we should not expect to see the NSPS yield a decrease in SO_2 emissions in this country until about the year 2000.[66] This estimate is valid, however, only if power plants converting to coal from other fuels are required to install stringent SO_2 controls.

Even if there is an eventual reduction in SO_2 emissions, the acid precipitation problem may persist. Emissions of NO_x are presently increasing at a significant rate and most experts feel that by the year 2000, nitric acids rather than sulfuric acids will be primarily responsible for acid precipitation and deposition.[67]

Present new source performance standards for NO_2 are not stringent, primarily because an affordable control technology has not been developed.[68] Technical capabilities in this area are increasing rapidly and, according to EPA officials, more stringent NO_x regulations can be expected when the standards for new coal-fired power plants are revised in 1984. However, because motor vehicles are responsible for much of the nation's NO_x pollution,[69] new source performance standards can only be expected to do part of the job.

Motor Vehicle Controls

Mobile sources presently contribute about half of the nation's NO_x emissions.[70] The Clean Air Act adopted two approaches to the control of mobile source pollution. Transportation control plans are authorized to promote increased use of mass transportation.[71] In addition, emissions per vehicle mile are regulated through a requirement that all new automobiles sold in the United States be certified to be in compliance with EPA emission limits.[72] Originally the legislative goal was to reduce emissions of NO_x (along with hydrocarbons and carbon monoxide) to 10 percent of the uncontrolled levels.[73] However, as a result of economic and technological pressures, the standards were loosened in the 1977 amendments. New autos are presently allowed to emit up to two grams of NO_x per vehicle mile, and in 1981 the standard will be tightened to one gram.[74] The original statutory goal of 0.4 grams per mile was reduced to a research objective.[75] Automobile emissions are expected to contribute to an estimated 50 percent increase in national NO_x emissions by the year 2000.[76]

Prevention of Significant Deterioration

In the 1977 Clean Air Act amendments, Congress outlined a program to protect air quality in the nation's clean air regions.[77] The prevention of significant deterioration program is designed to provide special protection to areas with air quality that is better than ambient standards require. Since acid precipitation is a severe problem in many pristine areas, it is precisely the type of concern that one might expect the PSD program to address. In fact, however, PSD regulation has only a small and incidental effect on the emission of pollutants which cause acidity to be deposited in clean air regions.

Under the PSD program, the states are directed to adjust their implementation plans to assure that concentrations of sulfur dioxide and particulates do not increase beyond statutorily specified "increments" in clean air

65. *See* Carter, *supra* note 52.

66. EPA estimates that sulfur oxide emissions will increase from the 1975 level of 18.6 million tons to 20.5 million tons by 1995, about a 10 percent increase. Without the NSPS the projected emissions for 1995 would be 23.8 million tons, a 28 percent increase. Costle, *EPA Announces Final NSPS for Coal-Fired Electric Power Plants,* 29 J. AIR POLLUT. CONT. ASS'N 552 (July 1978).

67. *See, e.g.,* Testimony of Stephen Gage, Assistant EPA Administrator for Research and Development, before the National Commission on Air Quality, Washington, D.C., Oct. 5, 1979.

68. Coal-fired power plants, for example, are required by the recent NSPS to reduce uncontrolled NO_2 emissions by 20 percent. 44 Fed. Reg. 33580 (June 11, 1979). EPA sources report that a breakthrough in nitrogen oxide control technology may permit more stringent NO_x control requirements in the near future, however. *Nitrogen Oxide Control Technology 'Breakthrough' at Hand, EPA Says,* 10 ENVIR. REP. CURR. DEV. 1448 (Oct. 26, 1979).

69. COUNCIL ON ENVIRONMENTAL QUALITY, ENVIRONMENTAL QUALITY 1978, at 27 (1978).

70. *Id.*

71. Clean Air Act §110(a)(2)(B), 42 U.S.C. §7410(a)(2)(B), ELR STAT. & REG. 42212.

72. Clean Air Act §206 *et seq.,* 42 U.S.C. §7525 *et seq.,* ELR STAT. & REG. 42245.

73. H.R. REP. No. 294, 95th Cong., 1st Sess. 232 (1977).

74. Clean Air Act §202, 42 U.S.C. §7521, ELR STAT. & REG. 42240. EPA's regulations may be found at 40 C.F.R. 86.081. EPA has granted a two-year delay to the American Motors Corp. on the application of the 1.0 gram per mile NO_x standard under §202(b)(1)(B) which allows small manufacturers lacking the financial and technological resources to design their own pollution control equipment additional lead time to develop experience with pollution control systems purchased from other manufacturers. 40 C.F.R. pt. 86, 44 Fed. Reg. 47880 (Aug. 15, 1979).

75. Clean Air Act §202(b)(7), 42 U.S.C. §7521(b)(7), ELR STAT. & REG. 42242.

76. *See* MITRE CORP. *et al.,* National Environmental Impact Projection No. 1. (Dep't of Energy Report No. MTR 7905; Dec. 1979.) VAN HORN, FERRELL, BRANDI & CHAPMAN, REVIEW OF NEW SOURCE PERFORMANCE STANDARDS FOR COAL-FIRED UTILITY BOILERS (Report to EPA by Teknekron Research Inc., June 1979).

77. Clean Air Act §§160-169, 42 U.S.C. §§7470-7479, ELR STAT. & REG. 42233. The actual effect of the amendments was to provide express statutory authority for and alter several elements of a similarly directed EPA program which had been in place since 1974. This earlier program was implicitly authorized by the stated purpose of the 1970 Clean Air Act "to protect and enhance the quality of the nation's air resources," Clean Air Act §101(b)(1), 42 U.S.C. §7401(b)(1), ELR STAT. & REG. 42205. EPA adopted the program only after being forced to do so through litigation. Sierra Club v. Ruckelshaus, 334 F. Supp. 253, 2 ELR 20262 (D.D.C. 1972), *aff'd per curiam,* 2 ELR 20656 (D.C. Cir. 1972), *aff'd by an equally divided court sub nom.* Fri v. Sierra Club, 412 U.S. 541, 3 ELR 20684 (1973). EPA's regulations, 39 Fed. Reg. 42509 (1974), were upheld against a number of legal challenges. Sierra Club v. EPA, 540 F.2d 1114, 6 ELR 20669 (D.C. Cir. 1976) *cert. denied* 430 U.S. 959 (1977).

regions.[78] The nation's clean air regions are divided into three classes. National and international parks, wilderness areas, and the like are all designated as Class I, the most stringent category in terms of permissible air quality degradation.[79] All other areas were initially designated as Class II regions but can in most cases be redesignated as Class III, the most lenient classification.[80] For each class, the 1977 amendments set forth maximum permissible increases for sulfur dioxide and particulates over the area's "baseline concentration."[81] EPA is currently developing additional increments for the other criteria pollutants, including nitrogen dioxide.[82]

The principal mechanism for preventing the violation of PSD increments is a preconstruction review program for major sources which propose new construction or modification of existing facilities.[83] An applicant is required to demonstrate that emissions from the proposed source will not contribute to pollution in excess of the applicable PSD increments, national ambient air quality standards, or other Clean Air Act requirements.[84] Most major newly constructed or modified sources are also required to install the "best available control technology" for each emitted pollutant.[85]

While air quality benefits will in the long run be realized because of the controls required on some new sources in PSD areas, the major effect of the stringent PSD standards has been an alteration in the siting of new sources rather than a reduction in overall emissions.[86] The adjustments in plant siting may serve the legislative goal by keeping major sources away from clean air areas, but they are of no help to the larger problems surrounding long-range transport.

The Clean Air Act's articulation of the PSD policy authorizes and directs the states (and where appropriate, EPA) to issue "emissions limitations and [take] other measures as may be necessary . . . to prevent significant deterioration of air quality."[87] However, the air quality concerns addressed by the PSD program do not encompass all forms of air quality deterioration. They involve only SO_2 and particulates, not sulfates and nitrates, the secondary products being deposited as acids. Even after the program is expanded to cover the other "criteria" pollutants, the presence of sulfuric or nitric acids in PSD areas will be a violation of the spirit, but not the letter, of the PSD requirements.

The PSD program has not been used to regulate distant pollution sources contributing to air quality degradation in clean air regions.[88] Yet, one stated purpose of PSD regulation is "to insure that emissions from any source in any state will not interfere with any portion of the applicable implementation plan to prevent significant deterioration of air quality for any other state . . . ."[89] In a recent decision, however, the Court of Appeals for the District of Columbia Circuit held that the permitting and preconstruction review requirements of the PSD program do not apply to major polluting sources located in nonattainment areas that have a "substantial impact" on a clean air area of another state.[90] At any rate, modeling limitations have confined consideration of air pollutant transport across state lines to the most flagrant situations where sources are close to the receiving areas and the impact is manifest.

Visibility

The sulfate and nitrate particles responsible for acid deposition contribute significantly to pollution-related reductions in visibility in many parts of the country.[91] Congress addressed this concern in the 1977 Clean Air Act amendments by establishing as a national goal the reduction and prevention of any visibility impairment in

78. Clean Air Act §163, 42 U.S.C. §7473, ELR STAT. & REG. 42233.

79. Clean Air Act §162(a), 42 U.S.C. §7472(a), ELR STAT. & REG. 42233.

80. Clean Air Act §162(b), 42 U.S.C. §7472(b), ELR STAT. & REG. 42233. The Act includes criteria for redesignation but prohibits the reclassification of some areas. Clean Air Act §164, 42 U.S.C. §7474, ELR STAT. & REG. 42234.

81. Clean Air Act §163(b), 42 U.S.C. §7473(b), ELR STAT. & REG. 42233. The term "baseline concentration" is defined in §169(4), 42 U.S.C. §7479(4), ELR Stat. & Reg. 42236.

82. Section 166 establishes deadlines for the promulgation of PSD regulations for other criteria pollutants. They were due in August 1979. Clean Air Act §166, 42 U.S.C. §7476, ELR STAT. & REG. 42235.

83. The review is required for sources in 28 different industrial categories which "have the potential" to emit 100 tons per year or more of any pollutant, and for all industrial sources emitting over 250 tons per year. Clean Air Act §169, 42 U.S.C. §7479, ELR STAT. & REG. 42236. *But see* Alabama Power Co. v. Costle, ____F.2d____, 10 ELR 20001 (D.C. Cir. Dec. 14, 1979) (potential emissions means emissions as reduced by pollution controls incorporated in the plant's design).

84. Clean Air Act §165(a)(3), 42 U.S.C. §7475(a)(3), ELR STAT. & REG. 42234.

85. Clean Air Act §165(a)(4), 42 U.S.C. §7475(a)(4), ELR STAT. & REG. 42234. Best available control technology (BACT) is defined as "the maximum degree of reduction of each pollutant" determined on a case-by-case basis, using §111 or §112 standards as the ceiling and taking into account energy, environmental, and economic costs. Clean Air Act §169(3), 42 U.S.C. §7479(3), ELR STAT. & REG. 42236.

86. *See* J. QUARLES, FEDERAL REGULATION OF NEW INDUSTRIAL PLANTS (Jan. 1979).

87. Clean Air Act §161, 42 U.S.C. §7471, ELR STAT. & REG. 42233. Although the congressional statement of the purpose of the PSD provisions includes a reference to the problems associated with air pollutants that have been incorporated into other media, §160(1), 42 U.S.C. §7470(1), ELR STAT. & REG. 42233, this intent is nowhere translated into concrete authority to allow states to act to prevent the significant deterioration caused by air pollutants in rainwater or snow.

88. One state has sued to force greater consideration of interstate pollution effects and the effect on the prevention of significant deterioration program. *See* note 50 *supra*.

89. Clean Air Act §160, 42 U.S.C. §7470, ELR STAT. & REG. 42233.

90. Alabama Power Co. v. Costle, ____F.2d____, 10 ELR 20001 (D.C. Cir. Dec. 14, 1979). The court emphasized that despite this limitation on the reach of §165, §§110(a)(2)(E) and 126 provide EPA with the means to address this problem of interstate pollution, 42 U.S.C. §§7410(a)(2)(E) and 7426, ELR STAT. & REG. 42212, 42229. *See* note 51 *supra*.

91. *See* COUNCIL ON ENVIRONMENTAL QUALITY, *supra* note 33, at 79; Bachman, *Regulatory Strategies for Sulfates and Inhaled Particles* (Prepared for the Mass. Air Pollution Control Assoc. Technical Conference on Sulfates, Philadelphia, Pa., Apr. 13–14, 1978), *reprinted in* ENVIRONMENTAL LAW INSTITUTE, AIR AND WATER POLLUTION CONTROL: PROGRESS AND PROBLEMS 408 (1978).

federal areas where visibility is determined to be an important value.[92] EPA, after consultation with the Department of the Interior, has already determined that visibility is important in 156 out of 158 Class I PSD areas.[93] EPA is presently developing regulations requiring SIP revisions to contain emission limits, schedules of compliance, and other measures to insure reasonable progress towards achieving visibility goals. Major sources which have been operating for less than 15 years and which are likely to impair visibility will be required to apply "best available retrofit technology" for controlling emissions.[94]

Because fine particulates, including sulfates and nitrates, contribute to visibility impairment, it can be expected that implementation of the visibility protection program will serve to help reduce the load of pollutants which contribute to acid precipitation. However, present technology does not effectively capture fine particulates, and any visibility regulations are therefore likely to be both expensive and controversial.[95] Hence, it may be several years before emissions are actually reduced through implementation of the visibility protection program.

EPA's Tall Stack Policy

The use of tall smokestacks as a means of minimizing the local air quality effects of emissions promotes the long-range transport of air pollutants both by releasing the pollutants higher in the atmosphere, where they are more likely to be carried long distances, and by increasing the total loading of pollutants which can be emitted within ambient air quality constraints.[96] In theory, one of the strong points of the Clean Air Act's approach to air pollution control is the reliance on emission limitations, rather than dispersion techniques such as tall stacks, as the central vehicle for attainment of ambient standards.[97] However, EPA has historically been unwilling to deny tall stacks a major role in the nation's air pollution control strategy.[98]

A recent EPA study reports that since enactment of the 1970 Clean Air Act amendments more than 175 smokestacks over 500 feet high have been constructed.[99] Of these, 75 are taller than 700 feet and 35 are taller than 800 feet.[100] All but eight of these sources are power plants,[101] which emit sulfur and nitrogen pollution that can contribute to acid deposition in distant areas. According to EPA scientists, the technology for building tall stacks on this scale was not developed until the late 1960s. Also, there was little incentive for the building of such structures before initial passage of the Clean Air Act in 1968 made it important for sources to minimize local ground level pollutant concentrations. Hence, it seems that long-range air pollution transport has been promoted, rather than reduced, by ambient regulation under the Clean Air Act. At the least it is clear that tall smokestacks have become taller and more prevalent since the Act's passage.

In the 1977 Clean Air Act amendments Congress required EPA to tighten its policy concerning the use of tall stacks. Section 123 was amended to provide that in calculating emissions limitations no credit would be allowed for the greater pollutant dispersion (and lesser local air quality effect) resulting from the use of tall stacks.[102] Credit would be given only for the dispersion associated with stack heights that do not exceed "good engineering practice."[103] In January 1979 EPA proposed regulations to implement §123.[104] Because the regulations would allow some sources with less than maximum height smokestacks to increase stack height and raise emission levels, the net effect of their implementation would be only a slight decrease in total emissions.[105] The Natural Resources Defense Council, Inc., which has successfully sued EPA in the past over its tall stack policy,[106] has commented that the proposed regulations are more lenient than Congress intended and engineering considerations necessitate.[107] EPA is expected to repropose or supplement the regulations before 1981.

92. Clean Air Act §169A(a), 42 U.S.C. §7491(a), ELR STAT. & REG. 42237.

93. 44 Fed. Reg. 69122 (Nov. 30, 1979).

94. Clean Air Act §169A(b), 42 U.S.C. §7491(b), ELR STAT. & REG. 42237.

95. Section 169A(a)(4) gives the EPA Administrator 24 months after the statute's enactment (until August 7, 1979) to promulgate regulations to assure "reasonable progress" toward visibility goals, 42 U.S.C. §7491(a)(4), ELR STAT. & REG. 42237. EPA has already missed this deadline, and the difficulties it faces in developing these regulations make significant further delays likely.

96. Atmospheric loading is increased because a greater total quantity of pollutants can be emitted without exceeding ambient air quality standards at ground level.

97. Section 110 of the Act requires each state implementation plan to include emission limitations as necessary to insure attainment of ambient standards. 42 U.S.C. §7410(a)(2)(B), ELR STAT. & REG. 42212.

98. In 1974, EPA's approval of Georgia's state implementation plan, which relied on the use of tall stacks rather than emission limitations, was successfully challenged in court. NRDC v. EPA, 489 F.2d 390, 4 ELR 20204 (5th Cir. 1974), *reversed on other grounds sub nom.* Train v. NRDC, 421 U.S. 60, 5 ELR 20264 (1975). The Fifth Circuit eventually had to hold the EPA Administrator in contempt of court in order to compel the Agency's compliance with the court decision. 529 F.2d 755, 6 ELR 20413 (5th Cir. 1976).

99. ENVIRONMENTAL PROTECTION AGENCY, IDENTIFYING AND ASSESSING TECHNICAL BASES FOR STACK HEIGHT FOR THE EPA REGULATORY ANALYSIS at 13 (Preliminary Report No. 69-02-3323 Sept. 1979).

100. *Id.*

101. *Id.*

102. 42 U.S.C. §7423, ELR STAT. & REG. 42228.

103. The degree of emission limitation required for control of any air pollutant under an applicable implementation plan under this title shall not be affected in any manner by:

> (1) so much of the stack height of any source as exceeds good engineering practice (as determined under regulations promulgated by the Administrator), or
> (2) any other dispersion technique.

42 U.S.C. §7423(2), ELR STAT. & REG. 42228.

104. 44 Fed. Reg. 2608 (Jan. 12, 1979).

105. EPA predicts net reduction in emissions of about a half million tons annually. 42 Fed. Reg. 2613.

106. *See* note 98 *supra.*

107. R. Ayres, *Comments of the Natural Resources Defense Council on Proposed Regulatory Revisions: 1977 Clean Air Act Amendments for Stack Heights* (Apr. 2, 1979).

Other Statutes Relevant to Acid Precipitation

The deterioration of water quality in acid sensitive areas and the eventual elimination of aquatic life in acid lakes, as observed in the Adirondacks, is in direct conflict with the stated purpose of the Federal Water Pollution Control Act.[108] That statute was intended to protect inland and coastal waters and their aquatic inhabitants from the effects of pollution.[109] However, the regulatory structure of the FWPCA is focused on the elimination or reduction of direct discharges into waterways. The Act contains no authority for dealing with the deposition of pollutants from the atmosphere, a phenomenon which has only recently been recognized as important.[110]

The Endangered Species Act,[111] intended to protect threatened fish and wildlife from extinction, is also potentially relevant. While the precise composition of aquatic life in the areas most seriously threatened by acid precipitation is not well documented, the extinction of one rare species of brook trout due to acidity has already been reported.[112] Scientists fear that the widespread acidification of lakes in sensitive areas, and the accompanying deterioration of the regional ecosystem, may threaten the existence of other aquatic species.

If it were to be demonstrated that an endangered species faced elimination as a result of acidification, legal action might be possible under §7 of the Endangered Species Act.[113] That section requires that federal agencies insure that no action which they fund or authorize "jeopardizes the continued existence of any endangered species, or threatened species, or results in the destruction or adverse modification of [the] habitat of such species . . . ."[114] On this basis EPA approval of state implementation plans which arguably authorize emissions contributing to acid precipitation (and the threat to endangered fish or wildlife) could be challenged. Conceivably, the Agency might be required to demand a more stringent state implementation plan that specifically addressed long-range transport concerns.

Even if legal recourse is not available through these statutes, the violation of their objectives should not be overlooked. The role of airborne acidity in preventing achievement of the objectives of several of Congress' most important statements of environmental policy, the Federal Water Pollution Control Act, the Endangered Species Act, and, of course, the Clean Air Act, evidences the seriousness of the threat to national environmental goals presented by the acid rain phenomenon.

An Overall Assessment

The causes of acidity in rain and snow are largely unaddressed by the complex regime of air pollution control requirements in the United States. The major pollution control programs for existing sources were not designed to reduce the total atmospheric loading of pollutants and have not had that effect. Yet a reduction in the aggregate loading of sulfur dioxide and nitrogen dioxide air pollution is necessary to reduce the acidity of precipitation.

Regulation by states pursuant to the national ambient air quality standards, the central means of controlling emissions from existing sources, focuses on local ground level pollutant concentrations. As a result, major sources of sulfur dioxide (mostly power plants) have utilized tall smokestacks, which promote the long-range transport of air pollutants, rather than emission controls to achieve ambient standards for SO_2. Pollutants transported beyond state boundaries are in most cases not addressed. Ambient standards for NO_2 are so lax that many states have instituted no control program and are nevertheless in attainment.

The prevention of significant deterioration program, intended to protect air quality in clean air regions, does not in its present form provide a vehicle for the control of distant sources contributing to acid precipitation in pristine areas. The PSD program focuses on the ambient concentrations of criteria pollutants and not on the total loadings of sulfates, nitrates, or acids. Moreover, because of legal and modeling constraints, the PSD program has not been used for the control of pollution transported over long distances.

The new source performance standards do promise an eventual reduction in aggregate SO_2 emissions, though not until about the turn of the century. This projection will hold, however, only if future increases in the use of coal are accompanied by stringent pollution controls. But even with a reduction in SO_2 emissions, the acid problem may persist because of increasing NO_x emission rates. Present NSPS for NO_x are not stringent, due largely to technological constraints. Total motor vehicle emissions, which presently are responsible for about 40 percent of the nation's NO_x emissions, are expected to remain constant through the next 20 years, despite stricter federal emission limits for new automobiles.

Canada

Canada's air pollution control regime, like the one in the United States, involves a mix of federal and provin-

108. 33 U.S.C. §§1251-1376, ELR STAT. & REG. 42101.

109. "The objective of this chapter is to restore and maintain the chemical, physical and biological integrity of the nation's waters . . . ." 33 U.S.C. §1251(a), ELR STAT. & REG. 42105.

110. GREAT LAKES WATER QUALITY BOARD, REPORT TO THE INTERNATIONAL JOINT COMMISSION at 61 (1976). *See also* INTERNATIONAL JOINT COMMISSION, WATER QUALITY OF THE UPPER GREAT LAKES at 55, 56 (1979):

> . . . air pollution has a significant effect on the water quality in the Upper [Great] Lakes. The atmosphere is a major pathway of deleterious inputs.
>
> . . . .
>
> The atmosphere is a major contributor of phosphorous, heavy metals, persistent synthetic organics, and acid to the waters of the Upper Lakes . . . . [N]ot only local but also distant emissions affect water quality; transport distances can be thousands of kilometers.

111. 16 U.S.C. §§1531-1543, ELR STAT. & REG. 41825.

112. ONTARIO MINISTRY OF THE ENVIRONMENT, *supra* note 24.

113. 16 U.S.C. §1536, ELR STAT. & REG. 41830.

114.

> Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency (hereinafter in this section referred to as an "agency action") does not jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with the affected States, to be critical, unless such agency has been granted an exemption for such action by the Committee pursuant to subsection (h) of this section.

16 U.S.C. §1536(a), ELR STAT. & REG. 41830.

cial responsibilities. However, in contrast to the United States, where the federal government mandates and oversees state action, in Canada the federal role is one of guidance and demonstration to the more autonomous provinces. Provincial control programs tend to be undertaken flexibly, with a minimum use of formal legal measures and an emphasis on government/industry cooperation in the development of control requirements.

The key program for the control of nontoxic air pollutants in Canada involves the promulgation by the federal government of advisory "national ambient air quality objectives" for specific pollutants.[115] Other relevant federal initiatives include non-binding "national emissions guidelines" for selected categories of new sources,[116] motor vehicle emissions limits for new cars,[117] and mandatory "national emission standards" for control of air pollution endangering the public health or causing violation of a Canadian international obligation.[118] In addition, the provinces have independently enacted legislation authorizing the control of air pollution through a variety of approaches for the protection of the public health.[119]

As described below, the Canadian approach to air pollution control differs in many fundamental respects from the system in the United States and is, generally speaking, less stringent. It should be kept in mind, however, that the Canadian system was developed in response to very different needs and pressures. The continuing desire to encourage greater development of the nation's not fully realized industrial potential has had an important influence on Canadian pollution control decisions. Also, the public perception of the environment in Canada as largely pristine, given the immense Canadian wilderness areas, contributes to a political climate that has not been conducive to the adoption of stringent air pollution control requirements.[120]

Canada is a geographically large nation with comparatively limited areas of industrial development. It releases into the atmosphere about one-fifth as much SO_2 and one tenth as much NO_x as the United States.[121] Nevertheless, there are some extremely large Canadian sources that may contribute significantly to deposition of acids in Canada and in parts of the United States as well. Most notable are the Nanticoke coal-fired power plant on Lake Erie, the largest coal-fired power plant in the free world, and the International Nickel Company (INCO) smelter in Sudbury, Ontario, the largest source of SO_2 pollution in the Northern Hemisphere. In fact, nonferrous smelting currently accounts for about 45 percent of Canada's sulfur emissions.[122] But recent estimates are that future increases in the emission of both sulfur dioxide and nitrogen dioxide in Canada may be attributable primarily to electric power plants.[123]

It should be noted that Canadian pollution control requirements were developed without the influence of the review and prodding by environmentalists that has played a central role in environmental decision making in the United States. Interested individuals or organizations are not given the opportunity to participate in, or comment formally on, provincial regulatory decisions.[124] Nor is judicial recourse available to environmentally concerned parties wishing to challenge the effectiveness of federal or provincial implementation of environmental laws.[125]

National Ambient Air Quality Objectives

Under its Clean Air Act, the Canadian federal government is empowered to set three ranges of air quality objectives: desirable, acceptable, and tolerable.[126] The

115. Clean Air Act, Can. Stat. c. 47 §4 (1970-71-72), *reprinted in* INT'L ENVIR. REP. 51:1901 (1978).

116. The Governor in Council may publish or cause to be published national emission guidelines indicating quantities and concentrations in which any contaminant should not be emitted into the ambient air from sources of any class, whether stationary or otherwise. Clean Air Act, Can. Stat. c. 47 §8 (1970-71-72), *reprinted in* INT'L ENVIR. REP. 51:1902 (1978).

117. Motor Vehicle Safety Act, Can. Stat. c. 26 §1102 (1969-70), *reprinted in* INT'L ENVIR. REP. 51:2301 (1978).

118. Clean Air Act, Can. Stat. c. 47 §7 (1970-71-72), *reprinted in* INT'L ENVIR. REP. 51:1902 (1978).

119. *See, e.g.,* Prince Edward Island Public Health Act, Quebec Environmental Quality Act, Newfoundland Department of Consumer Affairs and Environmental Act, New Brunswick Clean Environment Act, and Nova Scotia Environmental Protection Act. All are reprinted in INT'L ENVIR. REP. 51:8001; 51:8351; 51:6321; 51:6001; 51:6801 (1978).

120. For one view of the climate for environmental regulation in Canada, see Carroll, *Differences in the Environmental Regulatory Climate of Canada and the United States,* 14 CAN. WATER RESOURCES J.____ (Fall 1979).

121. UNITED STATES-CANADA RESEARCH CONSULTATION GROUP, THE LRTAP PROBLEM IN NORTH AMERICA: A PRELIMINARY OVERVIEW 5 (Oct. 1979) (hereinafter cited as RESEARCH CONSULTATION GROUP PRELIMINARY REPORT).

122. Air Pollution Control Directorate, Environment Canada, 1979: A Nation-Wide Inventory of Air Contaminant Emissions—1974 (Rep. EPA 3-AP-78-2, Dec. 1978). RESEARCH CONSULTATION GROUP PRELIMINARY REPORT, *supra* note 121, at 6.

123. RESEARCH CONSULTATION GROUP PRELIMINARY REPORT, *supra* note 121, at 7.

124. *See* ESTRIN & SWAIGEN, ENVIRONMENT ON TRIAL Ch. 21 (Toronto, 1978); ELDER, ENVIRONMENTAL MANAGEMENT AND PUBLIC PARTICIPATION (Toronto, 1975).

125. *Id. See, e.g.,* Green v. Province of Ontario and Lake Ontario Cement Ltd., 12 Ont. 2d 396 (1973), where the Ontario Supreme Court denied standing to plaintiff Green in his effort to represent the public interest in a suit against the Ontario government for a breach of public trust. (Green was also assessed approximately $4,000 in costs.) Ontario had leased provincial land, purchased with the intention of expanding an adjacent park, to a cement company. *See also* Rosenberg v. Grand River Conservation Authority, 12 Ont. 2d 496 (1976).

126. Section 4(1) of the Clean Air Act provides:

> The Minister may formulate, with respect to any air contaminant, ambient air quality objectives reflecting three ranges of quality of the ambient air in relation to that contaminant and in relation to that contaminant in combination with any one or more other air contaminants that, for either short term conditions or long term conditions or both represent
>
> (a) The tolerable range of concentrations of that contaminant either alone or in combination with those one or more other air contaminants;
>
> (b) the acceptable range of concentrations of that contaminant either alone or in combination with those one or more other air contaminants; and
>
> (c) the desirable range of concentration of that contaminant, if any, either alone or in combination with those one or more other air contaminants.

Can. Stat. c. 47 (1970-71-72).

TABLE I[131]
AMBIENT STANDARDS AND OBJECTIVES IN CANADA AND THE UNITED STATES

		Permissible Pollutant Concentration (micrograms per cubic meter)							
		Canadian Ambient Objectives			Representative Provincial Standards			U.S. Ambient Standards	
Pollutant	**Averaging Time**	**Desirable**	**Acceptable**	**Tolerable**	**Ontario**	**Alberta**	**Saskatchewan**	**Primary**	**Secondary**
SO_2	Annual	30	60		55	30	30	80	60
	24 hour	150	300	800	275	150	150	365	260
	3 hour								1300
	1 hour	450	900		690	450	450		
NO_2	Annual	60	100			60	100	100	100
	24 hour		200		200	200	200		
	1 hour		400	1000	400	400	400		

tolerable range is the equivalent of the United States' primary standard and indicates the level at which there is a danger to public health. The acceptable range is comparable to the secondary standard in the United States and is intended to reflect the level at which "welfare" effects to vegetation, soil, water, or the general public comfort may occur. The desirable range represents a long-range pollution control goal. These objectives are only advisory, however, and have no legal effect unless they are incorporated into provincial or municipal legislation. Alberta, Manitoba, New Brunswick, Ontario, and Saskatchewan have all adopted ambient standards keyed to these objectives, while Labrador, Newfoundland, Nova Scotia, Prince Edward Island, and Quebec, in general the less important polluters, have not.[127] British Columbia has established a permitting system for air pollution emissions which is similar in effect to the ambient standard approach.[128]

Ambient objectives are in effect for five pollutants or pollutant mixtures, including sulfur dioxide and nitrogen dioxide.[129] Sulfates and nitrates are not directly addressed through ambient regulation. Hence, as in the United States, the deposition of these substances, an important part of the acid precipitation problem, cannot be viewed as a violation of air quality objectives.

While all of the provinces have legislation empowering provincial or municipal authorities to control air pollution as necessary to protect the public health,[130] regulation of nontoxic air pollutants is most seriously pursued in those provinces that have adopted ambient standards. The standards adopted by those provinces for sulfur dioxide and nitrogen dioxide fall at the low end of the acceptable range of the ambient objectives. The provincial standards are slightly more stringent than the comparable United States secondary standards and are far more stringent than the comparable primary standards, which are the real focus of ambient regulation in the United States. (See table above.)

Provincial regulation of emissions from stationary sources pursuant to the ambient objectives is far more informal than the analogous SIP process in the United States. Provincial legislation allows wide discretion in the development of abatement requirements.[132] This flexibility is intended to minimize economic disruption and assure cost-effective control requirements. Critics argue, however, that industry can successfully oppose stringent controls under this approach because pollution control decisions are reached through private negotiations between government and industry from which public interest representatives are excluded.[133] While agreements calling for strict emission control requirements have emerged from this process,[134] there is evidence that some sources are indeed able to resist provincial control efforts successfully.[135] The extent of the influence of industrial

127. *See* Int'l Envir. Rep. 51:5101; 51:5601; 51:6001; 51:6301; 51:6701; 51:7001; 51:8001; 51:8301; 51:9001 (1978).

128. *See* Int'l Envir. Rep. 51:5401 (1978).

129. Clean Air Act, Can. Stat. c. 47 §4(2) (1970-71-72) *reprinted in* Int'l Envir. Rep. 51:1901 (1978). Objectives have also been promulgated for suspended particulates, carbon monoxide, and oxidants. Stat. O. & R. 74-325 (May 14, 1974) *reprinted in* Int'l Envir. Rep. 51:1941; Stat. O. & R. 75-32 (Jan. 16, 1975) *reprinted in* Int'l Envir. Rep. 51:1961; and Stat. O. & R. 78-74 (Jan. 19, 1978), *reprinted in* Int'l Envir. Rep. 51:1965.

130. *See, e.g.,* Ont. Rev. Stat. c. 16 (1970); Ontario Environmental Protection Act, Ont. Rev. Stat. c. 86 (1971), *reprinted in* Int'l Envir. Rep. 51:7101 (1978); Quebec Environmental Quality Act, Que. Stat. c. 49 (1972), *reprinted in* Int'l Envir. Rep. 51:8351 (1978); Manitoba Clean Environment Act, Man. Stat. c. 76 (1972, amended), *reprinted in* Int'l Envir. Rep. 51:5801 (1978); Saskatchewan Air Pollution Control Act, Sask. Rev. Stat. c. 267 (1965, amended), *reprinted in* Int'l Envir. Rep. 51:9151 (1978). Alberta Clean Air Act, Alta. Rev. Stat. c. 16 (1971), *reprinted in* Int'l Envir. Rep. 51:5161 (1978); Newfoundland Department of Health Act, Nfld. Rev. Stat. c. 83 (1970); British Columbia Health Act, B.C. Rev. Stat. c. 170 (1960).

131. Int'l Envir. Rep. 51:1941, 51:1961, 51:1965, 51:5181, 51:7351, 51:9174 (1978); 40 C.F.R. §§50.5, 50.11 (1978).

132. *See generally* Estrin & Swaigen, *supra* note 124, at 459. In Ontario, for example, government authority to issue a control order in the face of pollution demonstrated to be of an immediate danger to human life is entirely discretionary.

> When the Director is of the opinion, based upon reasonable and probable grounds, that it is necessary or advisable for the protection or conservation of the natural environment, the prevention or control of an immediate danger to human life, the health of any persons or to property, the Director *may* issue a stop order or a control order directed to the person responsible.

(Emphasis added.) Section 12, Ontario Environmental Protection Act, Ont. Rev. Stat. c. 86 (1971) *reprinted in* Int'l Envir. Rep. 51:7101 (1978).

133. *See* Estrin & Swaigen, *supra* note 124.

134. For example, two new smelters in Ontario, one for copper and one for zinc, will have sulfur containment of over 95 percent. Letter from W.A. Lemmon, Chief, Mining, Mineral and Metallurgical Division, Air Pollution Control Directorate, Environment Canada to George Rejon, Environmental Counsel, Canadian Embassy, Washington, D.C. (Dec. 17, 1979).

135. In 1970 the Ontario Ministry of the Environment ordered the International Nickel Company (INCO) to reduce emissions from 5,100 tons per day of sulfur dioxide to 700 tons per day by

interests on the formulation of control requirements in Canada raises serious questions about the likelihood that provincial governments would impose expensive emission limitations. Such requirements will almost surely be necessary to reduce emissions sufficiently to address the acid rain and snow problem.

Cost effectiveness is a major consideration in the development of most provincial pollution control programs. Less costly measures, such as the use of low-sulfur fuels (Canada has no major domestic high-sulfur coal industry, like that in the eastern United States) and the use of dispersion techniques (tall stacks and plant siting in clean air regions) are the major means of avoiding excessively high ambient concentrations. Stringent, more technologically oriented, abatement requirements for nontoxic pollutants are not common in Canada. For example, although they are used on many types of sources to reduce sulfur emissions in the United States, flue gas desulfurization "scrubbers" are not now used in Canada.[136]

One consequence of the Canadian emphasis on cost effectiveness is that, to an extent even greater than in most areas of the United States, pollutants are dispersed, rather than controlled at the source, in order to attain ambient standards. There are no federal or provincial laws that limit the use of tall smokestacks in Canada. As in the United States, emphasis is placed on controlling pollutant concentrations at ground level and not at the higher altitudes more relevant to long-range transport and the acid precipitation problem. Because Canada's industrial development is, in general, less concentrated than that of the United States, dispersion is a more effective approach to the achievement of that nation's ambient goals. Canadian environmental officials are aware, however, that greater containment at the source will be needed to reduce the acidity of rain and snowfall.

Other Air Pollution Control Programs

The Canadian Clean Air Act also empowers the federal government to set "national emissions guidelines."[137] These are non-mandatory standards intended to promote uniform air pollution regulation by provincial and municipal governments across Canada. Guidelines are issued only for new facilities, leaving the provinces with the responsibility for development of any standards to be applied to existing sources. To date, guidelines for six industrial categories have been issued under this program,[138] but these do not include sulfide-ore smelters or coal-fired power plants, the source categories most relevant to the acid precipitation problem in Canada.

Another federal program concerns control of automotive emissions,[139] which are presently responsible for roughly 60 percent of Canada's NO_x pollution.[140] The federal government has set emission standards for all new automobiles sold in Canada. The standards apply to nitrogen oxides, as well as hydrocarbons and carbon monoxide. Presently, new cars are allowed to emit 3.1 grams of NO_x per vehicle mile.[141] This standard is expected to remain unchanged until the middle 1980s.[142] It is anticipated that the contribution of automotive emissions to the growing nitrogen oxides pollution problem in Canada will not be reduced by the 3.1 gram per mile emission limit.

The Canadian Department of the Environment is also authorized to set mandatory emission standards for classes of stationary sources which present a significant danger to health or which may affect Canada's compliance with an international air pollution agreement.[143]

1978. Since then INCO has extended the smokestack on its Sudbury smelter to 1,250 feet (estimated to be the tallest in North America) and reduced emissions to about 3,000 tons per day. However, in 1978, supposedly based on reworked dispersion data, the Ministry issued new control orders allowing continued emissions at the 3,600 tons per day rate. *See Ontario Eases INCO's Sulfur Controls Inciting Environmentalists' Protests,* INT'L ENVIR. REP. CURR. DEV. 241 (Aug. 10, 1978); STANDING RESOURCES DEVELOPMENT COMMITTEE, *supra* note 23, at 40-62.

136. The Canadian objections to scrubbers concern both the expense of their installation and maintenance and the problems in disposing of the huge quantities of sludge produced in the removal of sulfur from the flue gases. The sludge problem can be overcome, however. Instead of sludge, Japanese scrubbers produce saleable materials such as gypsum, elemental sulfur, sulfuric acid, and sodium sulfite. Interestingly, much of the scrubber technology used in Japan is based on processes developed in the United States. MAXWELL, ELDER & MORASKY, SULFUR OXIDES CONTROL TECHNOLOGY IN JAPAN (Interagency Task Force Report prepared for the Senate Committee on Energy and Natural Resources, 1978).

137. The Governor in Council may publish or cause to be published national emission guidelines indicating quantities and concentrations in which any air contaminant should not be emitted into the ambient air from sources of any class, whether stationary or otherwise. Clean Air Act, Can. Stat. c. 47 §8 (1970-71-72), *reprinted in* INT'L ENVIR. REP. 51:1902 (1978).

138. Packaged Incinerators National Emissions Guidelines, *reprinted in* INT'L ENVIR. REP. 51:1971; Cement Industry Emission Guidelines, *reprinted in* INT'L ENVIR. REP. 51:1975; Metallurgical Coke Industry Emission Guidelines, *reprinted in* INT'L ENVIR. REP. 51:1983; Arctic Mining Industry Emission Guidelines, *reprinted in* INT'L ENVIR. REP. 51:1987; Asphalt Paving Industry National Emission Guidelines, *reprinted in* INT'L ENVIR. REP. 51:1979; Pulp and Paper Industry Emission Guidelines, Canada Gazette, pt. I, 5940 (Sept. 22, 1979).

139. Motor Vehicle Safety Act, Can. Stat. c. 26 §1102, *reprinted in* INT'L ENVIR. REP. 51:2301 (1978). The provinces are responsible for assuring that automobile emissions control devices are properly operated and maintained. *See* Gullon, *Canada's Mobile Sources Air Pollution Control Program,* 29 J. AIR POLLUT. CONT. ASS'N 592 (June 1979).

140. RESEARCH CONSULTATION GROUP PRELIMINARY REPORT, *supra* note 121, at 7.

141. *See* Gullon, *supra* note 139.

142. *Id.*

143.

> Where the emission into the ambient air of an air contaminant in the quantities and concentrations in which it is consumed or produced in the operation of stationary sources of a particular class or classes specified by the Governor in Council would
>
> (a) constitute a significant danger to the health of persons, or
>
> (b) be 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, the Governor in Council may prescribe national emission standards establishing the maximum quantities, if any, and concentrations of such air contaminant that may be emitted in the ambient air by stationary sources of such class or classes.

While several standards have been set pursuant to the protection of health, all have concerned toxic emissions demonstrated to have serious public health consequences, such as mercury, vinyl chloride, and lead.[144] None are directly relevant to acid precipitation.

Nor has there been federal regulation of sulfur dioxide or nitrogen dioxide emissions pursuant to any international air pollution covenant, since none presently exists. Of course, if a bilateral agreement between Canada and the United States concerning transboundary air pollution were to be reached, then federal regulatory jurisdiction could be extended under this provision to permit direct federal control. However, such an expansion of federal regulatory authority might be resisted by the provinces. A more politically acceptable approach would most likely be used to secure abatement from stationary sources pursuant to any new agreement.[145]

As mentioned above, the provinces that have not chosen to follow federal ambient objectives have approached air pollution control primarily from a public health viewpoint.[146] A minister or lieutenant governor-in-council (which effectively means the provincial cabinet) is charged with the responsibility of regulating pollution as necessary to protect the public health. Also, on the local level municipalities are authorized to issue specific directives in the interest of health protection. These may include regulation of emissions (Nova Scotia), control of the siting, construction, and operation of industries that might cause air pollution (Quebec), or regulation of the composition of fuels (New Brunswick).[147] These independent provincial initiatives are related to the avoidance of excessive concentrations of dangerous pollutants at ground level. It is unlikely that they appreciably reduce the total load of acid-forming pollutants. Also, for the most part, these provinces are not major polluters at the present time.

An Overall Assessment

The presence of large undeveloped areas makes Canada seem more suitable for the use of dispersion-oriented pollution controls than the United States. But this approach is only useful in the avoidance of high ambient concentrations in the locality surrounding the emission source. To reduce the deposition of acids in distant areas, the total quantity of emissions released into the atmosphere must be controlled. The air pollution programs presently in effect in Canada, which rely primarily on cost-effective measures to the exclusion of technological means of control such as scrubbers, do not reduce the total load of pollution entering the atmosphere sufficiently to prevent Canada from contributing significantly to the acid deposition problem in North America. In fact, as in the United States, the pervasive use of tall stacks to minimize local air quality effects promotes the long-range transport of acid-forming chemicals. And, because there is no program analogous to the new source performance standards in the United States, long-term improvement in the emissions picture in Canada for either sulfur dioxide or nitrogen oxides is not assured.

International Law

Given the great distances which acid-forming pollutants can travel through the atmosphere, and the role of both the United States and Canada in contributing to the deposition of acids across their common border,[148] it is clear that acid rain and snow in North America are international as well as domestic problems. There is presently no agreement between Canada and the United States concerning transfrontier air pollution. Hence, international environmental principles offer the central guidance concerning the nations' responsibilities, if any, to ameliorate the problem.

While a relatively undeveloped field, international environmental law is likely to be of increasing importance, at least in the context of air pollution, as scientific understanding of the long-range transport of air pollution improves, and the extraterritorial consequences of domestic pollution control decisions become more evident. As used here, international environmental law refers not only to legally binding treaties and decisions by international tribunals but also to the declarations of international organizations which reflect customary rules of conduct among nations.

The first formal recognition of the atmosphere as a resource requiring international protection was the 1962 Treaty Banning Nuclear Weapons Tests, which prohibited nuclear testing "if such explosion causes radioactive debris to be present outside the territorial limits" of the state conducting the explosion.[149] Since then a broad range of programs involving research, monitoring, and the tentative development of international air pollution guidelines have been undertaken to promote international protection of the atmosphere. In particular, the European Economic Community, the United Nations, and the Organization for Economic Cooperation and Development have been active in this regard.[150]

Clean Air Act, Can. Stat. c. 47 §7(1) (1970–71–72), *reprinted in* INT'L ENVIR. REP. 51:1901 (1978).

144. Secondary Lead Smelter National Emission Standards Regulations, STAT. O. & R. 76-464, July 9, 1976, *as amended* Nov. 17, 1977; Asbestos Mining and Milling National Emission Standards Regulations, STAT. O. & R. 77-514, June 23, 1977; Chlor-Alkali Mercury National Emission Standards Regulations, STAT. O. & R. 77-548, June 30, 1977; Vinyl Chloride National Emission Standards Regulations, STAT. O. & R. 79-299, Mar. 30, 1979. *Reprinted in* INT'L ENVIR. REP. 51:2001; 51:2041; 51:2061; 51:2091 (1978).

145. *See* text at notes 169–178 *infra*.

146. *See generally* Prince Edward Island Public Health Act, Quebec Environmental Quality Act, Newfoundland Department of Consumer Affairs and Environmental Act, New Brunswick Clean Environment Act, Nova Scotia Environmental Protection Act. All are reprinted in INT'L ENVIR. REP. 51:8001; 51:8351; 51:6321; 51:6001; 51:6801 (1978).

147. *Id.*

148. While estimates vary, a recent report by the United States-Canada Research Consultation Group concluded that Ontario and Quebec contributed 38,000 tons of sulfur emissions to the United States in January, and 21,000 tons in August. In contrast, the United States contributed about 50,000 tons and 68,000 tons of sulfur emissions to eastern Canada in January and August, respectively. RESEARCH CONSULTATION GROUP PRELIMINARY REPORT, *supra* note 121.

149. 5 August 1963, 2 U.S.T. 1313, T.I.A.S. No. 5433, 480 U.N.T.S. 43.

150. *See* LEVIN, PROTECTING THE HUMAN ENVIRONMENT, PROCEDURES AND PRINCIPLES FOR PREVENTING AND RESOLVING INTERNATIONAL CONTROVERSIES (United Nations Institute for

In the fall of 1979, members of the Economic Commission for Europe (ECE), a United Nations organization with 34 member states including Canada and the United States as well as eastern and western European countries, signed a "Convention on Transboundary Air Pollution."[151] It is the first international accord to directly address this problem. The significance of the ECE convention lies largely in its recognition of the international nature of the long-range air pollution transport problem. The agreement establishes avenues of international cooperation in monitoring and research activities and in the joint development of air pollution control strategies. Signatory states pledge to make efforts "to limit and, as far as possible, gradually reduce and prevent air pollution." However, the agreement does not compel abatement action. It includes no mechanism for enforcement of its terms. Nor does it delineate the responsibility of member states to abate pollution causing damage in another state or to award compensation for such damage.

Several international organizations have attempted to formulate general principles concerning the responsibility of states for the extraterritorial damages caused by pollution. Probably the most influential of international statements on this subject is the 1972 Declaration of the United Nations Conference on the Human Environment in Stockholm, which provides that:

> **Principle 21**
>
> States have, in accordance with the Charter of the United Nations and the principles 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 cooperate to develop further the international law regarding liability and compensation for the victims of pollution and other environmental damage caused by activities within the jurisdiction or control of such States to areas beyond their jurisdiction.[152]

Also pertinent is an earlier application of this doctrine in the course of resolving a United States/Canada air pollution dispute during the 1920s and 1930s. Fumes from a smelter at Trail, British Columbia were causing damage in adjacent areas of the State of Washington. As part of an extended United States/Canada dialogue on the dispute, a tribunal was created to rule on several of the key issues. In a widely quoted dictum the tribunal stated that:

> No state has a 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 persons or property therein, when the case is of serious consequence and the injury is established by clear and convincing evidence.[153]

Significantly, the tribunal required both payment of damages and the establishment of a regime to abate and monitor pollution from the smelter.

Analogous principles may be found in the more developed area of international water pollution. The Helsinki Rules, promulgated at the 1966 conference of the International Law Association in Finland, are regarded as a comprehensive expression of the international law of rivers.[154] The Helsinki Rules adhere to the proposition that states do not have the right to pollute so as to cause "substantial injury" to another state.[155] The Rules provide for abatement of the offending pollution and compensation for extraterritorial damages.[156] These views are consistent both with the tone of numerous international water pollution accords[157] and with the predominant scholarly interpretation of accepted norms of conduct by states.[158]

However, for several reasons accepted notions of international law cannot alone compel major modifications in

Training and Research, 1977); Hardy, *The United Nations Environment Program,* in TECLAFF & UTTON, INTERNATIONAL ENVIRONMENTAL LAW 57 (1975).

151. U.N./ECE/GE. 79-42960.

152. U.N. Doc. A/Conf. 84/4, *reprinted in* 11 INTERNATIONAL LEGAL MATERIALS (1972). While the Stockholm declaration does not explicitly mention air pollution, Principle 6 provides that:

> The discharge of toxic substances 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.

153. 3 R. INT'L ARB. AWARDS 1905. *See* BURROS & JOHNSTON, THE INTERNATIONAL LAW OF POLLUTION (1974). *See also* the *Corfu Channel* case in which the International Court of Justice held Albania responsible for damage to a British ship in light of Albania's obligation "not to knowingly allow its territory to be used contrary to the rights of other states." [1949] I.C.J. 4.

154. Helsinki Rules on the Uses of the Waters of International Rivers, International Law Association (London, 1967) (hereinafter cited as Helsinki Rules), *reprinted in* BURROS & JOHNSTON, *supra* note 153.

155.

> [C]onsistent with the principle of equitable utilization of the waters of an international drainage basin, a State
>
> (a) must prevent any new form of water pollution or any increase in the degree of existing water pollution in an international drainage basin which would cause substantial injury in the territory of a co-basin State, and
>
> (b) should take all reasonable measures to abate existing water pollution in an international drainage basin to such an extent that no substantial damage is caused in the territory of a co-basin State.

Helsinki Rules, art. X.

156. "In the case of a violation of the rule stated in paragraph 1(a) of Article X of this Chapter, the State responsible shall be required to cease the wrongful conduct and compensate the injured co-basin State for the injury that has been caused to it." Helsinki Rules, art. XI.

157. *See* Utton, *International Water Quality Law* in TELCLAFF & UTTON, INTERNATIONAL ENVIRONMENTAL LAW 154 (1974). For example, a 1922 agreement between Denmark and Germany prohibited pollution of border waters and provides for liability for pollution-related damage. Agreement Between Denmark and Germany Relating to Water Sources and Dykes on the German-Danish Frontier, art. 29, ratified at Berlin, June 7, 1922, 10 L.N.T.S. 187. The 1957 Yugoslav-Hungarian Agreement on Fisheries in Frontier Waters prohibits the discharging of waste water and matter noxious to fish population and requires payment of damages for a breach of the duty. Dec. 27, 1957, U.N. Doc. ST/LEG./SER.B/12 at 837.

158. For a comprehensive discussion of international water quality law, see UTTON, *supra* note 157.

the pollution control policies of industrialized nations. As commentators have noted, general statements concerning the duty of states to avoid actions adversely affecting the environment of other nations are not responsive to the difficult questions concerning precisely what types of conduct are unacceptable.[159] A certain amount of pollution invariably accompanies industrialization, and it is generally accepted that there is no international right to a completely pollution-free environment.[160] Present international legal doctrines do not offer a means of defining the point at which a nation's interest in industrial development is outweighed by concerns surrounding the environmental effects of transfrontier pollution.[161]

Further, there is presently no mechanism for enforcement of international legal doctrines. No international agency is empowered to give force to international environmental principles not incorporated into binding agreements. The most respected of international adjudicatory bodies, the International Court of Justice, may rule on a case only after the involved nations have consented to a reference,[162] a rare occurrence.

Another problem is that in the few existing applications of international environmental law where the nations involved have consented to be bound by the decision of a neutral tribunal, claimants have been required to demonstrate that specific identifiable sources have caused environmental injury. The *Trail Smelter* decision, for example, refers to a state's obligation not to allow its air pollution to affect another state "where injury is established by clear and convincing evidence."[163] Unfortunately, because of the incomplete scientific understanding of the intricacies of the long-range transport phenomenon, it is difficult to assign the responsibility for acidity in distant areas to individual sources. Yet if action were to be suspended until a clear link was established between emissions and distant environmental effects, or until the exact nature of the environmental damage caused by acidity was comprehended, irreversible damage would almost certainly take place in acid-sensitive areas.

Also, past international environmental controversies have, in general, focused on individual pollution sources or sources contributing to pollution in a clearly defined watershed. To address acid deposition it will be necessary to broaden the international focus from examination of specific pollution sources to consideration of the national contribution to the total regional atmospheric pollution load. The incorporation of international considerations on such a fundamental level in the molding of national pollution control strategies would be a significant step forward. Such a development would be consistent with the increasingly accepted realization that the earth's atmosphere is a vulnerable closed system, in which the offenses of one nation may contribute to serious problems that affect others.[164]

Numerous vehicles exist to promote international consultation and cooperation in research, monitoring, and assessment of the environmental impacts of new developments.[165] However, the present international legal framework does not effectively foster preventive action, although several international organizations clearly subscribe to the notion that prevention is the best means of avoiding environmental harm.[166] While general principles concerning the responsibility of nations to provide compensation for the damages caused by transboundary pollution are useful in allocating expense and may have some deterrent value, they are of only limited utility in avoiding permanent environmental damage, like that which can be expected from acid deposition in sensitive areas.

Nor, for that matter, can we rely on the compensation approach to deal with the growing number of other potentially irreversible international pollution problems, such as the depletion of the ozone layer due to the emission of chloro-fluorocarbons[167] or the warming of the earth from the buildup of carbon dioxide emissions.[168] As these and other global atmospheric pollution problems become more pressing, it will become increasingly necessary to consider the international consequences of domestic pollution control decisions before permanent global environmental damage becomes apparent, despite an unavoidable level of scientific uncertainty.

The comparatively limited context of the atmospheric transport of acid-forming compounds in North America seems a singularly suitable arena in which to evolve an approach to domestic pollution control more cognizant of international considerations. Significant movement toward this objective could be made through an agreement between Canada and the United States governing transboundary air pollution.

A Bilateral Agreement

Ample precedent exists in the United States/Canada relationship for the resolution of a transboundary pollution problem, such as acid deposition, through negotiation of an agreement requiring abatement on both sides of the border. The two countries have a history of cooperation which includes major advances in the control of international water pollution.

159. *See, e.g.,* LEVIN, *supra* note 150, at 40.

160. *Id.*

161. However, some international accords have built on these doctrines through the formulation of more specific guidelines, such as water quality standards. One example is the 1972 Great Lakes Water Quality Agreement between the United States and Canada, 23 U.S.T. 2813, *reprinted in* BURROS & JOHNSTON, THE INTERNATIONAL LAW OF POLLUTION 127 (1974).

162. *See* Statute of the International Court of Justice, arts. 36, 37.

163. 3 R. INT'L ARB. AWARDS 1905 (1949).

164. *See, e.g.,* SCHNEIDER, WORLD PUBLIC ORDER OF THE ENVIRONMENT (Toronto, 1979); HARGROVE, LAW, INSTITUTIONS AND THE GLOBAL ENVIRONMENT (1972).

165. *See* LEVIN, *supra* note 150.

166. The Stockholm Action Plan of 1972 and the Declaration of the Council of European Communities in its "Principles of an Environmental Policy" adhere to this policy. *See* KISS, SURVEY OF CURRENT DEVELOPMENTS IN INTERNATIONAL ENVIRONMENTAL LAW 56 (Morges, Switzerland 1976).

167. *See generally* Fluorocarbons and the Environment (Report of the Federal Task Force on Introductant Modification of the Stratosphere for the Council on Environmental Quality and the Federal Council on Science and Technology, 1975).

168. For a good discussion of the carbon dioxide problem, see HIDY, MAHONEY & GOLDSMITH, INTERNATIONAL ASPECTS OF THE LONG RANGE TRANSPORT OF AIR POLLUTANTS ch. 3 (Dep't of State, Doc. P5252, 1978).

Seventy years ago in the Boundary Waters Treaty of 1909, the two governments agreed to insure that:

> . . . boundary waters and waters flowing across the boundary shall not be polluted on either side to the injury of health or property . . . .[169]

The treaty also provided for creation of the International Joint Commission (IJC), an impartial body to monitor progress toward achieving the goals of the agreement and to assist in resolving disputes. This approach has since been adopted by many other nations in bilateral water pollution agreements.[170]

The commitment of both nations to control water pollution was further defined in the Great Lakes Water Quality Agreement of 1972, one of the first international accords to set water quality standards for boundary waters.[171] On the basis of reports by the IJC on the nature and effects of pollution in the Great Lakes basin ecosystem, this agreement was replaced in 1978 with a new accord outlining with much greater specificity the steps to be taken to achieve water quality objectives.[172] While many problem areas remain, movement is being made toward the attainment of these water quality goals, according to the latest report of the Great Lakes Water Quality Board to the IJC.[173]

The two governments also have a record of cooperative action in the resolution of transboundary air pollution problems. The most notable example is the historic *Trail Smelter* controversy,[174] in which Canada ultimately agreed to compensate the United States for damages caused by fumes from a Canadian smelter and to impose an abatement and monitoring regime at the smelter. That dispute was the first in which both governments evidenced a willingness to apply doctrines and mechanisms developed primarily to deal with transboundary water pollution problems to the air pollution area. More recently, the two governments have engaged the International Joint Commission in the air pollution area through references under the Boundary Waters Treaty and the Great Lakes Water Quality Agreement of 1978. In particular, the IJC has become involved in the transboundary air pollution problem in the Detroit/Winsor area.[175]

Transboundary air pollution has also been peripherally dealt with in the course of recent efforts to address water pollution concerns. Recent reports of the IJC have emphasized the impact of air pollution on the water quality of the Great Lakes. The most recent report of the Great Lakes Water Quality Board concluded that:

> The atmosphere provides an important source for a variety of pollutants [in the Great Lakes] including phosphorous, nitrogen, lead, copper, other heavy metals, sulphates, PCBs, polycyclic aromatic hydrocarbons and other substances.[176]

The importance of pollutants deposited from the atmosphere was also recognized in the 1978 Great Lakes Water Quality Agreement itself. In article VI the two governments agreed to develop and implement:

> [P]rograms to identify pollutant sources and relative source contribution, including the more accurate definition of wet and dry deposition rates, for those substances which may have significant adverse effects on environmental quality including the indirect effects of impairment of tributary water quality through atmospheric deposition in drainage basins. In cases where significant contributions to Great Lakes pollution from atmospheric sources are identified, the Parties agree to consult on appropriate remedial programs.[177]

As the governments of the United States and Canada have come to understand the severity of the transboundary air pollution problem, cooperative activity in the area has increased. In 1978 the two governments established a "Bilateral Research Consultation Group on the Long Range Transport of Air Pollutants" to coordinate research efforts. The recently released preliminary report of this group offers the most comprehensive assessment of the problem available to date.[178] Informal discussions on transboundary air pollution between the Canadian Department of External Affairs and the United States Department of State were initiated in December 1978. There have been several meetings since that time and discussion papers have been exchanged. It now appears likely that formal negotiations will begin in the near future.

Efforts to forge an effective accord, one that will significantly reduce the transboundary flow of acid-forming air pollution, are complicated by a number of considerations. One of the most important is overcoming the natural unwillingness of both nations to yield some degree of national sovereignty over domestic pollution control decisions. Others are: developing an abatement agreement compatible with the fundamentally different pollution control approaches of the two countries; developing a concrete abatement program despite the scientific uncertainty which surrounds many aspects of the acid deposition problem; securing the approval of the Canadian provinces necessary before Canada could implement any agreement; and developing the political will in both nations to support potentially expensive abatement requirements.

The success of past efforts to formulate a cooperative strategy to improve and maintain water quality in the Great Lakes suggests that these problems, which were also factors in that case, can be overcome. For example, scientific uncertainty was dealt with in the water quality

169. Art. IV, Boundary Water Treaty of 1909, U.S.T. 548, *reprinted in* INT'L ENVIR. REP. 31:0401.

170. *See* KISS, SURVEY OF CURRENT DEVELOPMENTS IN INTERNATIONAL ENVIRONMENTAL LAW 75 (Morges, Switzerland 1976).

171. *Id.* 1972 Agreement Between Canada and the United States on Great Lakes Water Quality, 23 U.S.T. 2813, *reprinted in* BURROS & JOHNSTON, *supra* note 161, at 127.

172. 1978 Agreement Between the United States and Canada on Great Lakes Water Quality, *reprinted in* INT'L ENVIR. REP. 31:0601 (Jan. 1979).

173. GREAT LAKES WATER QUALITY BOARD, 1978 ANNUAL REPORT TO THE INTERNATIONAL JOINT COMMISSION (July 1979).

174. 3 R. INT'L ARB. AWARDS 1905 (1949).

175. *See generally* MICHIGAN/ONTARIO AIR POLLUTION BOARD, ANNUAL REPORT TO THE IJC (Oct. 1979).

176. GREAT LAKES WATER QUALITY BOARD, 1978 ANNUAL REPORT, *supra* note 173, at 79.

177. Art. VI, 1978 Agreement Between the United States and Canada on Great Lakes Water Quality, *reprinted in* INT'L ENVIR. REP. 31:0604.

178. RESEARCH CONSULTATION GROUP PRELIMINARY REPORT, *supra* note 121.

arena through the formulation of successive agreements. The 1978 accord was a more specific extension of the principles established in the 1972 agreement based, in part, on new scientific data developed through cooperative United States/Canada research efforts. A similar scenario could be productively utilized in efforts to address transboundary air pollution. An initial accord might, for example, focus on the control of sulfur oxide pollution, while control of nitrogen oxides, which is presently not as well understood, might be left for a later agreement.

In negotiating the water quality agreements, concerns of national sovereignty and the desire to retain the integrity of domestic pollution control strategies were placated through the use of water quality objectives to be achieved through the independent actions of both nations. A similar tack could be adopted in the transboundary air pollution context. Both nations could, for example, agree to reduce aggregate sulfur dioxide emissions by 50 percent through whatever control regimes they choose.

The key factor is likely to be the expense. Neither nation will agree to require costly abatement steps unless the public supports such an action. In Canada economic constraints are most likely to be imposed through the provinces, which would be burdened with the lion's share of the responsibility for implementation of any agreement and which are more susceptible than the federal government to the political influence of affected industries. In order to assure provincial support of any final agreement, provincial representatives are likely to be directly involved in the negotiation of any air quality pact, just as Ontario, the only affected province, took part in the formulation of the Great Lakes Water Quality Agreements. While states would not be directly involved in the negotiations, the position of the United States will nevertheless be influenced to roughly the same extent by the political support for increased abatement and the opposition of affected industries. Hence, in the absence of the rapid development of inexpensive control technologies, the success of efforts to force an effective agreement will depend largely on whether both nations develop the political will to undertake expensive abatement measures.

Conclusion

Present legal and institutional means of controlling air pollution in Canada and the United States do not adequately address the acid precipitation problem and may in fact worsen the situation through the emphasis on local effects and the consequent promotion of the use of dispersion techniques, most notably tall smokestacks. Nor is there an adequate international legal framework capable of requiring action to abate the transboundary flow of acid-forming air pollutants.

Officials of the United States and Canada are currently involved in efforts to forge a bilateral agreement to address the transboundary aspect of the acid precipitation problem in North America. However, because of several considerations, including the expense of increased abatement and the scientific uncertainty surrounding the problem, an effective accord is not likely to be reached quickly.

While a great deal remains to be learned about the acid precipitation phenomenon, it is clear that the acids falling from the atmosphere originate as sulfur and nitrogen pollutants released in the burning of fossil fuels and in smelting operations. Further, it is apparent that the only means of eliminating the threat to health and the environment presented by acids in rain, snow, and dry particles is to reduce the emission of acid-forming pollutants. Such a step in either country would address transboundary as well as domestic concerns.

Utilities are expected to contribute significantly to increases in emissions of SO_2 and NO_x in the next 20 years in both Canada and the United States.[179] In the United States emissions of SO_2 from coal-fired power plants not subject to new source performance standards must be reduced, especially in states, such as Ohio, that have failed to achieve ambient standards. In Canada there is a need to tighten SO_2 control requirements for smelters as well as power plants. Also, the technology must be developed to support more stringent controls for the release of NO_x from stationary sources and motor vehicles in both countries.[180] In the absence of new controls for NO_x, increasing deposition of nitric acids will mask any improvement that might otherwise follow from a reduction in the emissions of sulfur compounds. Most importantly, both nations must cease relying on dispersion techniques, such as the use of tall smokestacks, to avoid locally high ambient concentrations.

While the precise means of emissions reduction might include less expensive techniques, such as coal-washing, energy conservation, and greater use of cleaner fuels, more costly measures, such as the use of flue gas desulfurization scrubbers or fluidized-bed combustion, will surely have to play a major part. Hence, any significant emissions cutback will be expensive. A recent report to the IJC estimated that a 50 percent reduction in SO_2 emissions from eastern Canada would cost about $350 million per year, while a similar decrease in the eastern United States might cost $5 billion to $7 billion annually.[181]

Costs of this magnitude can be seen in perspective only when compared with the damages associated with failure to take abatement action. Without abatement, the acidity of rain and snowfall in eastern North America will continue to increase, and serious adverse health and environmental effects can be expected to result. The ecological effects of which we are presently aware, such as the acidification of aquatic systems, may in fact be only symptomatic of larger environmental harms. Direct economic losses could include an appreciable reduction in the productivity of agricultural and forest lands,[182] loss of the tourist and fishing industries in acidified areas, and

179. *Id.*

180. Both nations are presently researching the fluidized-bed combustion process, which permits coal to be burned more efficiently with lower emissions of SO_2 and NO_x. *See generally* General Accounting Office, How to Burn Coal Efficiently and Economically, and Meet Air Pollution Requirements—The Fluidized-Bed Combustion Process (Nov. 1979).

181. Great Lakes Water Quality Board, 1978 Annual Report to the IJC 83 (July 1979).

182. Bolin, *et al.*, Air Pollution Across National Boundaries: The Impact on the Environment of Sulfur in Air and Precipitation (1971) (Sweden's case study for the U.N. Conference on the Human Environment, Stockholm). The authors concluded that acid precipitation had caused a 15 percent reduction in agricultural productivity.

damage to building materials throughout North America from acid corrosion. Environmental effects, which are less easily quantified, could include the permanent loss of fish and other aquatic life forms in many thousands of North American lakes, the loss of some wildlife dependent on aquatic life, and the deterioration of the terrestrial ecosystem in ways not yet understood. Although the parameters of the health effects of acid rain are not yet established, certain toxic metals chemically mobilized in acid conditions, such as aluminum, mercury, and lead, pose clear risks to human health, as do respirable acid particles.

A direct comparison between the costs of control measures and the costs of a failure to abate is not possible. Because the range of effects associated with acid deposition includes forms of damage that are diffuse, difficult to measure, or speculative, it is difficult to attach a dollar figure to the benefits of reducing acid-forming emissions. In contrast, as is commonly the case where environmental controls are concerned, the costs of abatement are clearly demonstrable. Without a clear economic justification for the expense of more stringent controls, any new air pollution control measures will face strong political opposition. Such opposition can be countered only by broad public concern over the dangers of acid rain and snow.

Present approaches to air pollution control in both Canada and the United States represent difficult compromises between economic concerns and the need for environmental protection. The revelation that conventional (nontoxic) pollutants are transported great distances and deposited as environmentally damaging acids signals the need to redraw this delicate balance between environmental and economic considerations. We now know that the emphasis on new sources and locally oriented controls in the United States does not assure attainment of Clean Air Act or Clean Water Act goals and offers little protection for the acid-sensitive areas of North America. Similarly, it is now apparent that the extensive wilderness areas in eastern Canada cannot be protected from the pollution products of Canadian industrial development through the control approach currently utilized in that country.

With political support from a concerned public, the air pollution control regimes of both countries can be altered to reflect our recently expanded understanding of the long-range transport phenomenon. Only through a continued willingness to modify air pollution control measures to accommodate our developing understanding of the effects of pollution can we hope to keep pace with emerging environmental problems such as acid precipitation. If we wait until impending environmental dangers are manifest, we risk permanent environmental damage of an unknown scope.