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A Canadian Perspective on the North American Acid Rain Problem

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A CANADIAN PERSPECTIVE ON THE NORTH AMERICAN ACID RAIN PROBLEM

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The North American acid rain problem has in recent years emerged as a major public policy issue in both the United States and Canada. In eastern Canada and the northeastern United States, particularly, there is deep and widespread concern over the adverse environmental and economic impacts associated with the elevated levels of precipitation acidity currently being experienced in much of eastern North America. This problem has been fairly described by Canada's Environment Minister John Roberts as "the most serious environmental threat to face the North American continent."[1] National responses to the problem, however, have differed markedly between the two countries. In the United States, acid rain, particularly in the context of the current congressional reauthorization of the Clean Air Act,[2] has become a focal point of much contention. The issue has touched off deep domestic controversy, pitting the industrialized states of the Midwest against those of the Northeast, and increasingly, important sectors of Congress against the Reagan administration. In Canada, by contrast, concern over the issue has produced more consensus than dissension, leading to several legislative and regulatory acid rain abatement decisions at both federal and provincial levels.

Recent Canadian efforts to ameliorate the acid rain problem have had an international as well as a domestic focus. Approximately fifty

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The opinions expressed in this article are entirely those of the author and do not reflect the position of any office or agency of the Canadian Government.

1. Speech by the Honourable John Roberts, Canadian Minister of the Environment, to the International Association on Water Pollution Research at 3 (June 25, 1980). Mr. Roberts compared the acid rain situation with the Great Lakes pollution problem. There, he points out, the problems were not faced until the damage had been done. In the case of acid rain, however, he notes that "[w]e cannot afford to take such a dangerous wait-and-see attitude. . . . We must begin now to deal with this menace. . . ." *Id.* at 4.

2. 42 U.S.C. § 7401 (Supp. IV 1980).

percent of the atmospheric acidity being deposited in sensitive eastern Canadian aquatic and terrestrial ecosystems originates in "imports" of United States-generated acid precursor pollutant gases.[3] While pressure from the scientific and political communities has precipitated a protracted Canada–United States diplomatic and scientific consultative process, it has so far failed to persuade the United States to embark upon the kind of parallel acid gas emission reductions essential to the environmental efficacy of present and planned Canadian acid rain abatement actions. From a Canadian perspective, the environmental, economic and diplomatic repercussions of this state of affairs are disturbing. The background and implications of the problem are worth exploring in some detail, if only to better assess the prospects of resolving what must rank as one of the most urgent, most serious and yet most intractable issues on the bilateral agenda.

CAUSES AND CONTRIBUTING FACTORS

Some appreciation of the nature of the environmental threat presented by acid rain is necessary for an understanding of the dimensions of the current bilateral problem.[4] Acid rain,[5] or more precisely acid deposition, is a short-hand term for a complex and still not fully understood form of environmental pollution. The term denotes a process involving the chemical conversion in the atmosphere of emissions of gaseous acid precursor pollutants (chiefly the oxides of sulphur and nitrogen) and the subsequent long-range transport, and eventual depo-

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3. BILATERAL RESEARCH CONSULTATION GROUP, THE LONG RANGE TRANSPORT OF AIR POLLUTANTS PROBLEM IN NORTH AMERICA: A PRELIMINARY OVERVIEW (1979). However, in the particularly acid-sensitive Muskoka-Haliburton recreational area north of Toronto, provincial precipitation monitoring programs over a three year period (August 1976-April 1979) showed that about 75% of precipitation events, and 80% of wet acidic deposition were associated with air masses arriving from the United States. Address by L. Shenfeld presented at the State of Wisconsin Legislative Council's Special Committee on Acid Rain, Meeting at Madison, Wisconsin, at 2 (July 8, 1982).

4. A recent and comprehensive discussion of the causes, effects and control implications of acid deposition in the North American context is contained in the reports of the work groups established by the 1980 Canada–United States Memorandum of Intent. *See* UNITED STATES–CANADA MEMORANDUM OF INTENT ON TRANSBOUNDARY AIR POLLUTION, IMPACT ASSESSMENT, ATMOSPHERIC MODELLING, EMISSIONS, COSTS AND ENGINEERING ASSESSMENTS AND CONTROL STRATEGIES, INTERIM REPORTS (Feb. 1981).

5. Precipitation acidity or alkalinity is measured in terms of pH units—the negative logarithm of the concentration of hydrogen ions in solution. Acid precipitation is defined as precipitation below the mildly acidic level of natural clean rainfall (pH 5.6). Because pH is a logarithmic scale, each unit change in pH represents a ten-fold change in acidity—pH 5 is ten times more acidic than pH 6, pH 4 is one hundred times more acidic than pH 6, etc. *See* OFFICE OF RESEARCH AND DEVELOPMENT, U.S. ENVIRONMENTAL PROTECTION AGENCY, RESEARCH SUMMARY ACID RAIN 3-4 (Oct. 1979).

sition, in either "wet" or "dry" form, of the resulting acids or acidic particles.[6]

In part because of the great difficulties in measuring dry deposition,[7] the more easily monitored wet deposition (*i.e.* acid rain and snow) has been the primary focus of concern in both Europe and North America. Data prepared for the National Commission on Air Quality indicate that much of the North American continent is now experiencing precipitation considerably more acidic than normal.[8] Rainfall over much of eastern Canada and the northeastern United States now averages between ten and forty times more acid than normal. Periodic rainfall episodes of much greater acidity have also been recorded: in Wheeling, West Virginia, rainfall has been recorded measuring 1.5 on the pH acidity scale; more acid than lemon juice.[9]

Acidity of this degree and extent in precipitation is clearly not a natural phenomenon. While even unpolluted rain is slightly acidic, this is mainly due to the presence of carbonic acid associated with atmospheric carbon dioxide. In contrast, the principal constituents of contemporary acid rain are sulphuric and nitric, not carbonic, acids.[10] While there are natural sources of sulphur compounds (such as volcanoes and seaspray) and nitrogen oxides (such as lightning and organic soil material decay processes), most scientists agree that such sources contribute only minor amounts of acid precursors, probably less than ten percent of the overall acidic inputs on a continental basis.[11] Man-

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6. In wet deposition, sulphate and nitrate reaction products combine with atmospheric water vapour to produce mild sulphuric or nitric acids which precipitate directly in the form of acid rain or snow. In dry deposition, the damaging conversion to acids takes place after deposition of dry acid aerosols or particulate matter, on contact with surface or sub-surface water in aquatic or terrestrial ecosystems. *Id.* at 2-3.

7. According to Wetstone, "very little is known about dry deposition except that it almost surely presents as great an environmental threat as wet deposition and is even more difficult to monitor." Wetstone, *Air Pollution Control Laws in North America and the Problem of Acid Rain and Snow*, 10 ENVTL. L. REP. 50001-02 (1980).

8. EMBASSY OF CANADA, FACT SHEET ON ACID RAIN (1982). Substantial portions of the northeastern United States have reported rainfall with an average pH of 4.3, approximately 10 times the normal amount. Many parts of New York and New England have experienced rain that is 10 to 40 times as acidic as normal. Many parts of Canada have also observed comparable levels of acidity in precipitation. *Id.* at 2.

9. LaBastille, *Acid Rain How Great a Menace?*, 160 NAT'L GEOGRAPHIC 652, 669 (1981).

10. FACT SHEET, *supra* note 8, at 2.

11. COMPTROLLER GENERAL OF THE UNITED STATES, THE DEBATE OVER ACID PRECIPITATION: OPPOSING VIEWS—STATUS OF RESEARCH (Sept. 11, 1981). As the report notes, however, in the eastern United States, sulphur emissions are overwhelmingly man-made in origin with the total annual biogenic sulphur emissions averaging less than one percent of man-made sulphur emissions in the eastern United States north of the Gulf Coast. *Id.* at 25.

made emissions, especially from fossil fuel combustion, are responsible for the other ninety percent of the North American acid precursor pollutants, with the principal anthropogenic sources being electric-utility, industrial, commercial and residential boilers and heaters, motor vehicle exhaust and industrial processes such as metal smelting and chemical manufacture.[12]

Massive amounts of acid precursor pollutant gases are generated each year by both Canada and the United States. There are, however, significant differences both in terms of relative contributions and the importance of contributing sectors as between the two countries. For example, in 1980 United States sulphur dioxide emissions totalled approximately thirty million tons, two-thirds of which came from electrical generating plants. Canadian sulphur dioxide emissions for 1980 totalled 5.3 million tons, about one-half of which came from non-ferrous smelters (a much more significant source sector in Canada than coal-fired power plants). In 1980 United States nitrogen oxides emissions totalled 22.3 million tons, forty percent of which came from the transportation sector and thirty percent from electric utilities. Canadian nitrogen oxides emissions for 1980 totalled 2.2 million tons, with fifty percent having come from the transportation sector and only thirteen percent from utilities.[13]

While each country contributes to the other's acid rain problem, the net pollutant flux, on a continental basis, is south and north, with Canada "importing" about four times the acid precursor pollutants that it "exports."[14] These "imports" originate mainly from the heavily industrialized and coal-dependent states of the Midwest. A number of additional factors operate to exacerbate the adverse environmental impacts of these United States emissions. In the first place, the midwestern United States contains not only the greatest concentration of old power plants (burning large amounts of high sulphur coal subject to little containment at source),[15] but also the highest density of United

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12. THE INTERAGENCY TASK FORCE ON ACID PRECIPITATION, NATIONAL ACID PRECIPITATION ASSESSMENT PLAN 34 (June 1982). Sulfur dioxide (SO_2), oxides of nitrogen (NO_x), sulphates, chlorides, volatile organic compounds (VOC) and fine particulate matter have been identified as playing important roles in forming acid precipitation. *Id.*

13. UNITED STATES–CANADA MEMORANDUM OF INTENT, STRATEGIES DEVELOPMENT AND IMPLEMENTATION, INTERIM REPORT, *supra* note 4, at 25-26.

14. HOUSE OF COMMONS SUBCOMMITTEE ON ACID RAIN OF THE STANDING COMMITTEE ON FISHERIES AND FORESTRY, STILL WATERS: THE CHILLING REALITY OF ACID RAIN 12 (Ottawa, 1981).

15. Wetstone, *supra* note 7, at 50006. Older coal-fired power plants emit an average of eighty-three pounds of sulfur dioxide per ton of coal burned, whereas plants subject to the much more stringent new source performance standards (NSPS) emit an average only of twelve pounds of sulfur dioxide per ton of coal burned. *Id.*

States sulphur emissions: six midwestern states (Ohio, Indiana, West Virginia, Illinois, Michigan and Kentucky) emit a total of 8.4 million tons of sulphur dioxide annually; forty-two percent of the sulphur dioxide output of the eastern United States.[16] Secondly, those areas of North America situated directly downwind of the Ohio Valley, the poorly buffered low-alkaline soils and waters of eastern Canada and the northeastern states, are the areas of the continent not only receiving the heaviest acid "loadings," but least able to absorb and neutralize such acidic inputs.[17]

Of equal importance, much midwestern coal is burned under a regulatory regime which, by focusing on reducing local ambient air pollution problems, has substantially worsened long-range impacts, particularly those associated with acid deposition. For example, one of the consequences of the orientation of our clean air laws towards minimizing ambient concentrations near sources has been the promotion of control strategies designed to achieve compliance with air quality standards, not just by greater containment at the source, but also by dispersing more widely—often over the nearest state, provincial, or international boundary—large volumes of acid precursor pollutants.[18]

The most notorious manifestation of this "out of state, out of mind" regulatory philosophy has been the proliferation of tall smokestacks, particularly at coal-fired power plants.[19] Tall stacks have significantly aggravated the acid rain problem by facilitating wider pollutant dispersion. They allow a greater volume of acid precursor pollutants to be emitted without exceeding ambient standards near the source. By injecting these emissions at a higher altitude where winds are stronger and more constant, tall stacks enhance pollutant atmospheric residence time, thereby magnifying opportunities for the production of more

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16. Kamlet, Bakalian, Einbender & Wall, *Acid Rain: An Environmentalist's Perspective*, 14 A.B.A. NAT. RESOURCES L. NEWSLETTER 4, 7 (1982).

17. *See infra* note 21 and accompanying text.

18. Wetstone, *supra* note 7, at 50007. As Wetstone observes:

> 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.

Id.

19. Since 1970, 175 stacks higher than 500 feet have been built; all but eight of these stacks are at powerplants that emit sulphur and nitrogen pollution, which can contribute to visibility deterioration and acid deposition in distant areas. NATIONAL COMMISSION ON AIR QUALITY, TO BREATHE CLEAN AIR 238 (1981).

sulphate and nitrate, the effects of which are felt over greater distances.[20]

THE EFFECTS OF ACID RAIN

Recent scientific research in both Europe and North America has linked a wide range of adverse impacts on both rural and urban environments with acid deposition. In large part because of its greater visibility, the best known and documented area of environmental impact is freshwater acidification damage. The aquatic ecosystems at greatest risk are those low in natural alkalinity, or buffering capacity, such as those commonly found in the glaciated areas of North America and northern Europe. They are covered by thin soils and underlain by granitic or other non-calcareous bedrock.[21] Surface water acidification in these areas, while influenced by factors such as lake size and drainage basin geochemistry, seems largely related to the length and level of acid loading. Over time, acidic inputs steadily and inexorably deplete limited natural buffering capacity to the progressive detriment of aquatic biological communities. Fish and fish food organisms are particularly vulnerable to acid-induced changes in surface water chemistry with decreases in species richness, changes in species dominance and ultimately the disappearance of entire species of freshwater life.[22] In "acidified" bodies of water (those below a pH of 4.5) most fish populations will have ceased to exist,[23] and the body of water will have be-

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20. From June 28 to 30, 1982, the Government of Sweden hosted ministers of 22 countries at a discussion of acid rain and its effects. This Stockholm Conference on Acidification of the Environment resulted in numerous recommendations. Among those proposed were continued research of the problem and development of the best technology available. The ministers also specifically recognized that the use of tall stacks is nothing more than "an obsolete abatement mechanism" and not a substitute for new and improved emission controls. Stockholm Conference on the Acidification of the Environment, 6 U.N. IRPTC Bulletin (No. 1) at 14 (Sept. 1983).

21. Particularly acid-sensitive terrain covers much of Ontario and Quebec and parts of the Atlantic Provinces. The four most susceptible regions of the United States, based on bedrock geology, are the Northeast, the Appalachian Mountains, the Minnesota-Wisconsin-Michigan highlands and the western mountain regions of Colorado, Oregon, Idaho, Washington and California. UNITED STATES–CANADA MEMORANDUM OF INTENT, IMPACT ASSESSMENT, INTERIM REPORT, *supra* note 4, at 3-4.

22. To date acidification has been implicated in the extinction of one species of brook trout, the Aurora trout. ONTARIO MINISTRY OF THE ENVIRONMENT, NORTHEAST REGION, LIMNOLOGICAL OBSERVATIONS ON THE AURORA TROUT LAKES 36 (1978).

23. ONTARIO MINISTRY OF THE ENVIRONMENT, A SUBMISSION TO THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY OPPOSING RELAXATION OF SO_2 EMISSION LIMITS IN STATE IMPLEMENTATION PLANS AND URGING ENFORCEMENT 64-65 (expanded ed. March 27, 1981).

> When excessive acid loadings from the atmosphere are applied to sensitive areas, the pH of the runoff may be reduced to values well below 6.0 for a few weeks

come, for all practical purposes, biologically—and permanently—dead.[24]

The toll of aquatic acidification damage in eastern North America has recently attained disturbing dimensions.[25] Hundreds of lakes and rivers in eastern Canada and the northeastern United States have become acidified to the point where they are entirely fishless. This has resulted in significant economic repercussions: in northern Ontario, for example, where sport fishing is a significant component of a tourist industry valued at $1 billion annually, the total annual tourist industry losses attributable to acid rain have been estimated to reach as high as $230 million;[26] in Nova Scotia, the total annual loss to the provincial economy associated with the acidification of nine rivers formerly supporting an Atlantic salmon fishery has been estimated at in excess of

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time during the spring snow melt or for a few hours or days during heavy summer and autumn rains. In addition to these short term effects, the soil alkalinity or buffering capacity can be slowly used up. . . .

Therefore, the ultimate result of deposition of acids in sensitive areas is acidification of the surface water with virtually complete destruction of aquatic life. . . .

Id.

24. STILL WATERS, *supra* note 14, at 57. While repeated applications of limestone can be effective in temporarily restoring pH levels of an acidified or acid-stressed body of water, lake liming cannot return an affected body of water to its natural state, nor is it a viable remedial strategy for the vast majority of affected North American lakes and rivers, which are commonly located in remote areas far from any road access. In the view of the House of Commons Acid Rain Subcommittee, liming should be "considered by governments only for selected waterbodies . . . and must not be regarded as a substitute for the control of acid rain-causing emissions at source." *Id.* at 59.

25. Ontario government scientists have determined that 140 provincial lakes have acidified to the point where they no longer support any fish life. ONTARIO MINISTRY OF THE ENVIRONMENT, THE CASE AGAINST THE RAIN: A REPORT ON ACIDIC PRECIPITATION AND THE ONTARIO PROGRAMS FOR REMEDIAL ACTION 1 (1980). If 1980 levels of acid loading remain constant, most of the aquatic life in 48,000 additional Ontario lakes will disappear within 10-20 years. *Id.* at 2.

In New York's Adirondack Park, 264 lakes and ponds totalling some 11,000 acres have a pH of less than 5, and are incapable of supporting any viable sport fish, with an additional 256 lakes totalling some 63,000 acres in danger of reaching critical levels of acidity. Ember, *Acid Pollutants: Hitchhikers Ride the Wind,* 59 CHEMICAL AND ENGINEERING NEWS No. 34, Sept. 14, 1981 at 22.

Nova Scotia has already suffered extensive acid rain damage to its salmon fishery: nine provincial rivers have a pH of 4.7 and no longer support salmon or trout reproduction; eleven additional rivers are in a pH range of 4.7-5.0, where some juvenile salmon mortality is probably occurring, with seven more in a pH range of 5.1-5.3, considered borderline for Atlantic salmon. UNITED STATES–CANADIAN MEMORANDUM OF INTENT, STRATEGIES DEVELOPMENT AND IMPLEMENTATION, INTERIM REPORT, *supra* note 4, at 16.

26. STILL WATERS, *supra* note 14, at 110.

$300,000.[27] Unless midwestern United States gas emissions are significantly reduced, future economic losses in both eastern Canada and the northeastern United States will dwarf present costs, for with continued acid loadings at current levels, the irreversible acidification of hundreds of thousands of low-alkaline eastern North American lakes and rivers is simply a matter of time.

While much less is known about the terrestrial impacts of acid rain, present scientific evidence suggests that acid deposition may have potentially significant adverse impacts on forests, soils and certain agricultural crops. Extensive and irreversible degradation of the thin, acid-sensitive soils covering much of eastern North America is one of the areas of greatest concern. Acid rain is believed to impair soil fertility and productivity by leaching out vital plant nutrients, by inhibiting the action of terrestrial decomposer micro-organisms essential to the forest floor nutrient recycling processes and by interfering with plant and tree root nutrient and moisture uptake.[28] Current research, while still not conclusive, suggests such effects may be responsible for declines in forest productivity,[29] an economic impact of potentially great concern to Canada, where eastern forests alone yield approximately $4 billion annually in export earnings and provide employment for an estimated 193,000 Canadians.[30]

Indirect agricultural impacts through reduced soil fertility are generally considered to be less severe, largely because agricultural soils are regularly limed and fertilized. Direct impact on certain important agricultural crops, however, may be much more significant. In controlled laboratory experiments simulated acid rainfalls have been shown to change protective plant surfaces, disturb plant metabolism, disrupt growth and reproductive processes and increase susceptibility to drought and other environmental stresses.[31] Field data confirming such observations are generally lacking, and it is also difficult to isolate the adverse impacts on crops of acid rain from the effects of other air pollutants known to be damaging, such as oxidants. The current toll of oxidant damage, primarily from ozone, estimated at between $1.7 and

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27. *Id. See supra* note 25.

28. Ember, *supra* note 25, at 23-24.

29. THE CASE AGAINST THE RAIN, *supra* note 25, at 21.

30. *Acid Rain: Hearings on H.R. 91 Before the Subcommittee on Natural Resources, Agriculture Research and Environment of the Committee on Science and Technology*, 97th Cong., 1st Sess. 402 (1982) (statement of J.P. Bruce, Asst. Deputy Minister in charge of Atmospheric Environment Service, Environment Canada).

31. G. WETSTONE & A. ROSENCRANZ, ACID RAIN IN EUROPE AND NORTH AMERICA: NATIONAL RESPONSES TO AN INTERNATIONAL PROBLEM 34 (1982).

3.6 billion annually in the United States,[32] however, provides an additional compelling reason for the curtailment of acid precursor pollutants, since ozone is a pollutant by-product of the same nitrogen oxides which can result in damaging nitric acid compounds.

Aquatic and terrestrial impacts, while of greatest current concern are by no means the only areas of damage associated with the deposition of acidic particles and pollutants. Sulphur oxides, for example, are known to be particularly damaging to stone, paint, metals, buildings and other man-made structures, including unique historical monuments. While it is difficult to separate the extent of material damage attributable to acid precursor pollutant sulphur dioxide, such impacts are very likely to form a significant portion of the estimated $2-4 billion,[33] and $285 million,[34] in annual air pollution damage to buildings and materials in the United States and Canada respectively.

Finally, there is some indication that acid rain and its precursors could have direct and indirect adverse impacts on human health. Acid deposition, for example, can contaminate water supplies by leaching out heavy metals from soil, bedrock and lead or copper plumbing. The consumption of contaminated drinking water or the ingestion of fish which have bio-accumulated significant concentrations of heavy metals presents obvious human health risks. The extent of direct health impacts is more speculative, although there is evidence suggesting that respiratory problems can be significantly exacerbated by the inhalation of the fine sulphate and nitrate particles which make up the dry form of acid deposition.[35]

GOVERNMENTAL RESPONSES

While Canada and the United States have a long tradition of generally successful resolution of transboundary environmental disputes, both within the framework of the International Joint Commission and on a government-to-government basis, transboundary air quality (apart from several notable short-range problems)[36] has only recently emerged

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32. *Id.* at 35.

33. *Id.* at 36.

34. STILL WATERS, *supra* note 14, at 110.

35. BRIDGE & FAIRCHILD, NORTHEAST DAMAGE REPORT OF THE LONG RANGE TRANSPORT AND DEPOSITION OF AIR POLLUTANTS 55-58 (N.E. Reg. Task Force on Atmospheric Deposition, April, 1981).

36. In the 1920's and 1930's, short-range pollution emanating from the smelter of Consolidated Mining and Smelting Company of Canada at Trail, British Columbia, became the focus of considerable bilateral attention until its final resolution by an international arbitral tribunal in 1941. *See* 3 R. Int'l. Arb. Awards 1905. Air pollution in the Detroit-Windsor area has been a continuing concern since the 1960's, particularly within

as an important focus of bilateral attention. Long-range air pollution was not generally perceived as a potentially important concern until the late 1970's. At that time both the International Joint Commission, through its Great Lakes Water Quality Board,[37] and the Bilateral Research Consultation Group[38] (set up by the two governments in 1978) drew attention to the seriousness of long-range air pollution problems, notably acid rain.

Bilateral consultation over the acid rain issue, however, effectively dates from a 1978 resolution of the United States Congress, which called upon the President to "make every effort to negotiate a cooperative agreement with the Government of Canada aimed at preserving the mutual airshed of the United States and Canada."[39] In part because the problems which led to this resolution (two small Canadian coal-fired power plants in Saskatchewan and Ontario)[40] were even then

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the International Joint Commission context. In its 1982 report, the Commission noted a general lack of improvement in air quality with respect to particulate and ozone levels, and recommended that governments:

> Consider amending the current reference to the Commission to allow for a modern and more relevant air quality activity which includes a consideration of the previously described emerging problems [the long-range movement of air pollutants and toxic and hazardous air pollutants] as well as a re-examination of the structure of the current air quality monitoring network.

INTERNATIONAL JOINT COMMISSION, ANNUAL REPORT ON MICHIGAN–ONTARIO AIR POLLUTION 13 (1982).

37. In 1978 the Commission's Great Lakes Water Quality Board, in discussing the effects of airborne pollutants on waters within the Great Lakes basin, concluded that "[a]ll parts of the Great Lakes watershed are now receiving precipitation containing 5 to 40 times more acid than would occur in the absence of atmospheric emissions. Many inland lake ecosystems in the most susceptible parts of the Basin may be irreversibly harmed within 10-15 years." INTERNATIONAL JOINT COMMISSION, SEVENTH ANNUAL REPORT: GREAT LAKES WATER QUALITY 50 (1979).

38. UNITED STATES–CANADA RESEARCH CONSULTATION GROUP, THE LONG RANGE TRANSPORT OF AIR POLLUTANTS PROBLEM IN NORTH AMERICA: A PRELIMINARY OVERVIEW (Oct. 1979). SECOND REPORT OF THE UNITED STATES–CANADA RESEARCH CONSULTATION GROUP ON THE LONG RANGE TRANSPORT OF AIR POLLUTANTS (Nov. 1980). The Bilateral Research Consultation Group reports were extremely important in early bilateral acid rain consultation and provided the scientific foundation for the 1980 Memorandum of Intent.

39. 42 U.S.C.A. § 7415 note (1978). The resolution went on to state that:

> it is further the sense of the Congress that the President, through the Secretary of State working in concert with interested Federal agencies and the affected states, should take whatever diplomatic actions appear necessary to reduce or eliminate any undesirable impact upon the United States and Canada resulting from air pollution from any source.

Id.

40. Project design modifications and the establishment in September 1980 of a comprehensive bilateral monitoring arrangement have largely served to defuse United States

well underway toward a mutually satisfactory resolution, and in part because of Canadian concern over the emerging evidence of the seriousness of long-range air pollution problems, government representatives agreed in late 1978 to shift the focus of the proposed agreement to long-range air pollution problems, with a specific emphasis on the most pressing of those problems, acid rain.

Momentum towards formalizing a coordinated bilateral response began shortly thereafter with the signing of the 1979 Joint Statement[41] and the 1980 Memorandum of Intent (MOI).[42] In the first document, Canada and the United States set out the common principles and practices both countries have traditionally sought to apply in resolving bilateral environmental problems, and expressed a shared "determination to reduce or prevent transboundary air pollution."[43] In the Memorandum of Intent, Canada and the United States explicitly recognized the seriousness of transboundary air pollution, especially acid rain, and formally committed themselves to negotiating a proposed bilateral air quality agreement in order to resolve such problems. More specifically, and to support the negotiation of such an agreement, both governments agreed to establish five bilateral working groups composed of experts from both countries, to develop the best current scientific and technical assessments of environmental acidification and how to control it most effectively. In addition, in the period pending conclusion of the agreements, both Canada and the United States pledged their intention to take appropriate interim actions to deal with transboundary air pollution, and to "promote the vigorous enforcement of existing laws and regulations as they require limitation of emissions from new, substantially modified, and existing facilities in a way which is responsive to the problems of transboundary air pollution."[44]

The 1981-1982 period subsequent to the signing of the MOI, while

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concerns over the Poplar River project's potential adverse transboundary impacts. Continuing uncertainty over Ontario Hydro's plans regarding construction of the Atikokan plant has given this issue in recent years a much lower bilateral profile than it originally had. Even if completed, however, Atikokan's emissions would only have a minimal transboundary impact, and would be insignificant compared to the volume of United States-generated pollutants currently impacting the acid-sensitive Boundary Waters Canoe Area.

41. EXTERNAL AFFAIRS CANADA, COMMUNIQUE, JOINT STATEMENT ON TRANSBOUNDARY AIR QUALITY BY THE GOVERNMENT OF CANADA AND THE GOVERNMENT OF THE UNITED STATES OF AMERICA (July 26, 1979), *reprinted in* DEP'T ST. BULL., Nov. 1979, at 26-27.

42. Memorandum of Intent Between the Government of the United States and the Government of Canada Concerning Transboundary Air Pollution, Aug. 5, 1980, 20 I.L.M. 690.

43. *See supra* note 41.

44. MOI, *supra* note 42, at 691-92.

characterized by extensive scientific-level consultations and intensive diplomatic-level negotiations, was not, unfortunately, highlighted by any measure of bilateral consensus on acid rain abatement action. Indeed, rather than serving as a means of dispute resolution, the MOI consultative process began to degenerate into a forum of increasingly divisive bilateral dispute. This state of affairs reflected, more than anything else, a substantially altered bilateral negotiating climate attendant on the change of United States administrations that occurred relatively early in the career of the MOI. The change of government in January 1981, ushered in an Administration that, despite its stated intention of honoring the MOI, did not share the viewpoint on the extent of the need for scientific understanding and the urgency of abatement actions, which had animated the original signatories of the Memorandum. This fundamental divergence in perspective between the parties had unfortunate consequences for all of the vital elements of the MOI: instead of promoting diplomatic accord and scientific consensus, the process engendered diplomatic impasse and scientific conflict; instead of stimulating parallel interim abatement actions, the MOI did not prevent a divergence in domestic air pollution control policies that has had the effect of worsening the transboundary problem during the very period both countries were ostensibly seeking ways to alleviate it.

Nowhere was the failure of the MOI process more evident than at the negotiating table. The focal point of division in the four negotiating sessions held in 1981 and 1982 was the issue of the sufficiency of the acid rain scientific data-base. From the onset of the negotiations, Canadian representatives, while acknowledging the need for more research, repeatedly urged that more than enough was then known to warrant significant cutbacks in North American acid precursor pollutant emissions.[45] Accordingly, at the third round of negotiations in February 1982, Canada proposed that both countries embark on a joint program of phased emission reductions, tabling a draft agreement involving a fifty percent reduction by 1990 in eastern Canadian and

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45. In the words of Roger Simmons, M.P. (and Parliamentary Secretary to the Minister of Environment):

> [T]he official position of the Government of Canada is that we cannot wait for a perfect understanding of the acid rain phenomenon before moving to control it. If we had waited back in 1972 for a complete understanding of the effects of phosphorus in the Great Lakes before starting our joint clean-up program, we would still be waiting and Lake Erie would be irreversibly dead. We know that we have been badly abusing some of our most precious natural resources and that the abuse must be stopped. How many more lakes have to die before we get the message?

Simmons, *How Many More Lakes Have to Die?*, CANADA TODAY, Feb. 1981, at 11.

United States emissions of sulphur dioxide.[46]. United States opposition to such proposals was, however, unwavering. Administration spokesmen, emphasizing the alleged gaps in scientific understanding of transport, transformation and the deposition processes, continued to insist that much more research was necessary before any emission reductions could even be contemplated.[47] As a result of this policy, Canada's fifty percent reduction proposal was rejected by the United States negotiators at the fourth round of negotiations held in Ottawa in June of 1982. In the wake of the June meeting, matters reached the point where then Environment Minister Roberts publicly questioned the usefulness of continuing the negotiations:

> It was the lack of progress in our negotiations of a transboundary air pollution agreement that led me to the decision earlier this year to undertake a reappraisal of the usefulness of continuing the negotiation. This reappraisal is still going on.[48]

A second source of bilateral friction within the MOI framework during 1981 and 1982 related to the impact of United States administration policies on the activities of the bilateral work groups. In the early period of their activity, the work groups generated a valuable series of reports on the various scientific and technical matters subsumed under the MOI rubric (e.g., environmental impacts, including especially atmospheric modelling and emission control techniques). Earlier work group reporting activities served to intensify the concern over the

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46. The Canadian negotiators proposal to reduce sulphur dioxide emissions by fifty percent was based on the findings of the scientists in the bilateral work groups established under the August 1980 Memorandum of Intent. This figure represents the reduction necessary to bring down eastern North American acidic sulphate loadings to the 20 kg/hectare/year level that Canadian experts consider necessary to protect "moderately sensitive" aquatic eco-systems. Address by Edward D. Lee, then Assistant Under-Secretary for United States Affairs for the Canadian Department of External Affairs, Symposium on Acidic Precipitation and Atmospheric Deposition: A Western Perspective (June 25, 1982).

47. In the view of then Environmental Protection Agency Administrator Anne M. Gorsuch, "the best option with respect to the acid rain issue appears to be to accelerate EPA's current 10-year research project . . . and defer regulation until the sources and extent of the problem can be better identified." *Quoted in* Ember, *supra* note 25, at 30. More recently, Mrs. Gorsuch has explained that while acid deposition presents two elements of concern (sulphur and nitrous oxides), "[w]e don't know what happens when these elements go up, how they are transformed, how far they are transported, and what their effects are. . . . We at EPA have a duty to first understand a problem before we can remedy it." Text of remarks by the Administrator before the Commonwealth Club, San Francisco, California, July 30, 1982, *reprinted in The Commonwealth*, Aug. 9, 1982, at 213, col. 2.

48. 5 INT'L ENV'T REP.: CURRENT REP. (BNA) 312, 313 (Aug. 11, 1982).

environmental impacts of acid rain and thereby helped fuel the momentum for abatement actions. In 1981 and 1982, however, Reagan administration policies and practices began to adversely affect scientific-level dialogue and to raise questions about the continuing objectivity and eventual credibility of the work group process. In 1982, for example, the Administration replaced a number of key United States work group scientists with others who appeared collectively to have less detailed knowledge and experience than their predecessors in the subjects under review. In addition there were accusations of increasing pressure on such scientists from policy-level bureaucrats (described at the time as "non-participating observers").[49] Moreover, the Administration insisted on conducting a unilateral "peer review" of the final work group reports, by a panel of scientists (selected by the White House Office of Science and Technology Policy) who collectively seemed less familiar with the science of acid rain than the experts whose work they were to review. Canadian suggestions that such a review—if deemed necessary—be carried out by a body with a recognized expertise and impartiality, such as the National Academy of Sciences (NAS) or by a joint NAS/Canadian Royal Society body were rejected by Administration policy-makers.[50] Decisions such as these both raised doubts about Administration motivations and marked a disturbing departure from the tradition of collegial impartiality that has in the past been characteristic of Canada–United States scientific consultation.

Perhaps the most significant area of tension during 1981 and 1982, however, related to the different treatment that the interim actions commitment of the MOI received in the two countries. In order to meet this commitment, the two Canadian provincial governments most directly concerned took steps to curtail significantly their major emission sources. For example, Quebec announced that it would require the Noranda smelter to reduce its sulphur dioxide emissions forty percent by 1985.[51] At the same time Ontario moved to require Ontario Hydro

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49. Letter from Representative Toby Moffett (D-Conn.) to Alexander Haig, Secretary of State (June 18, 1982). The letter was strongly critical of "[p]olitical interference by U.S. agency personnel in the scientific pursuits of the working groups, including the replacement of qualified scientists with others who share less independent viewpoints on the acid rain issue." *Id.*

50. State Department officials reportedly stated at the time that peer review need not be done jointly because such a review was not contemplated by the Memorandum of Intent. However, as one Canadian Embassy official notes, "[i]t's hard to arrive at a common solution to common problems unless you proceed jointly." Sullivan, *Canada: U.S. Spurns Joint Acid Rain Panel,* Jackson Clarion-Ledger Daily News, June 12, 1982, at 9A, col. 1.

51. Address by K.J. Merklinger, then Director United States Transboundary Relations, Department of External Affairs, at Dalhousie University, Halifax, Nova Scotia (Mar. 9, 1982).

to reduce the sulphur dioxide emissions from its Sudbury operations to a level of 1950 tons per day, amounting to about a seventy percent containment, and to ensure that Ontario Hydro cuts its acid gas emissions forty-three percent below 1980 levels by 1990.[52] The Canadian Federal Government, for its part, to ensure the effective implementation of a bilateral air quality agreement, amended the Canadian Clean Air Act in December 1980, to enhance and clarify the authority for the control of transboundary air pollution originating in Canada.[53]

By late 1982, the United States administration, in contrast, had moved neither to reduce current acid gas emissions, nor to improve existing institutional control mechanisms. Notwithstanding the clear import of the MOI, apart from an acceleration in acid rain research,[54] the only actions taken by the Administration responsive to the problems of transboundary air pollution were a series of administrative level actions which responded to the problem only by making it substantially worse. In 1981 alone, for example, the United States Environmental Protection Agency (EPA) approved requests for relaxation of emission limits in a number of State Implementation Plans resulting in increasing permissible sulphur dioxide emission levels by over one million tons per year.[55] As Canadian officials noted at the time, two-thirds of the approved emission increases affected major sources within EPA Region V, which encompasses the greatest current problem source area, the Ohio Valley.[56] In addition, the EPA revised its stack height regulations in such a manner as to ensure increased regulatory reliance on the tall stacks which have so significantly exacerbated the

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52. ONTARIO HYDRO, BACKGROUNDER FOR THE MEDIA (Jan. 26, 1981). On January 12, 1981, in a direct response to concerns regarding acid rain raised by the Ministry of the Environment, Ontario Hydro's board of directors approved a ten year, $500 million program to reduce acid gas emissions from 1981 levels of 560,000-609,000 metric tons to 450,000 metric tons by 1985 and 300,000 metric tons by 1990. These reductions will be achieved through a combination of measures including the installation of sulphur scrubbers, increased use of low sulphur coal and increased reliance on nuclear power plants. *Id.* Ontario Hydro reductions were the result of a provincial regulation, Ontario Environmental Protection Act, S.O. 1971, ch. 86 (Mar. 4, 1980).

53. Canadian Clean Air Act, CAN. STAT., ch. 47 § 4(1).

54. In fiscal year 1980 the various federal agencies comprising The Interagency Task Force On Acid Precipitation spent or obligated about $11 million on research programs relating to acid rain; approximately $13 million was spent or obligated in 1981, with over $17 million spent for 1982 activities. President Reagan's 1983 request to Congress proposed a $22 million level for acid rain research. NATIONAL ACID PRECIPITATION ASSESSMENT PLAN, *supra* note 12, at 4; INTERAGENCY TASK FORCE ON ACID PRECIPITATION, 1982 ANNUAL REPORT 53.

55. Moffett letter, *supra* note 49.

56. Merklinger address, *supra* note 51.

acid rain problem by exempting from further sulphur dioxide emission reductions 160 of the 167 tall stacks built at United States coal-fired power plants since 1970.[57] Actions such as these maintained and increased the transboundary flow of acid precursor pollutants into Canada, thereby diluting the effective environmental benefit of the acid gas emission reduction programs begun at considerable expense by Canadian jurisdictions.

At no time in 1981-1982 did the United States formally repudiate the MOI. Nevertheless, the collective impact of Administration policies was such that Canadian officials increasingly came to the conclusion that the MOI did not appear to be a productive avenue for negotiation. Accordingly, Canada increasingly sought to exert what leverage it could command in other potentially more receptive United States fora.[58] In particular, Canadian diplomatic efforts were asserted in the then current congressional reauthorization of the Clean Air Act, where acid rain control was a particularly contentious issue.

THE CLEAN AIR ACT REAUTHORIZATION

As of the date of this writing, the reauthorization process had become the focus of an important national debate, engaging a wide array of the many state, regional and national interests affected by the environmental, economic and political impacts of Clean Air Act regulatory programs. Congress had in effect become a battleground for the forces of industry and environmentalists, with the latter fighting a determined rearguard action against the combined forces of industry and the Administration as they attempted to persuade Congress to adopt highly controversial revisions to the Act, contained in bill H.R. 5252.[59]

This legislation was designed to ease substantially the perceived

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57. Moffett letter, *supra* note 49.

58. Ontario for its part has begun to intervene formally in EPA administrative proceedings in active opposition to the relaxation of emission limitations for midwestern power plants. *See* MULVANEY, A SUBMISSION TO THE U.S. EPA OPPOSING RELAXATION OF SO_2 EMISSION LIMITS IN STATE IMPLEMENTATION PLANS AND URGING ENFORCEMENT (Ontario Ministry of the Environment, 1981). *See also* Ohio v. EPA, No. 81-1310 (D.C. Cir. 1981).

59. *A bill to Amend the Clean Air Act, 1981: Hearings on H.R. 5252 Before the Subcomm. on Health and the Environment of the House Comm. on Energy and Commerce*, 97th Cong., 2d Sess. 157 (1982). This bill was introduced December 16, 1981 by Rep. T. Luken (D-Ohio), and co-sponsored by Energy and Commerce Committee Chairman John Dingell (D-Mich.), Ranking Minority Member James Broyhill (R-N.C.) as well as Rep. E. Madigan (R-Ill.), Rep. E. Hillis (R-Ind.) and Rep. B. Trayler (D.-Mich.). For a section by section analysis, see *Dingell Co-sponsors New Bill: House Air Act Proposal Keeps Much In Tact, Proposes Some Major Changes*, Inside EPA Weekly Report, Special Issue, Dec. 18, 1981, at 1.

burden on industry of present Clean Air Act regulations by loosening statutory standards, rolling back compliance deadlines and streamlining existing permitting procedures. Much less radical proposals emerged from the Senate, where the Environment and Public Works Committee showed greater sensitivity to environmental concerns. The Senate Committee sought generally to effect only minor modifications to existing air pollution control programs. As of this writing, reconciliation of these very disparate bills (neither of which has yet received House or Senate floor consideration) has not yet been attempted, nor is it presently clear when resolution of the Clean Air Act debate will be accomplished.

In late 1982 acid rain control was among a number of unresolved Clean Air Act issues hanging in the congressional balance. Two major policy options had emerged from the respective House and Senate Committees with Clean Air Act jurisdiction. From the House Energy and Commerce Committee, where industrial and midwestern interests held sway, proposals emerged which would have done nothing more than mandate accelerated acid rain research, while allowing for substantial future increases in United States acid precursor pollutant emissions.[60] In the Senate by contrast, a much more action-oriented proposal, originally offered in 1981 by Senator Mitchell of Maine, came to attract an impressive measure of bipartisan support.[61] In the summer of 1982 in the course of marking up its Clean Air Act revisions, the Senate Environment and Public Works Committee adopted by a margin of 15-1 a modified version of the Mitchell bill, which, if enacted, would have had the effect of mandating not only increased acid rain

60. The acid rain amendment approved by the Energy and Commerce Committee in April, 1982 was originally introduced by Rep. Edward Madigan (R-Ill.). Following its adoption, the Madigan amendment was modified to include a provision purportedly capping sulphur dioxide emissions at 1982 levels. However, as the Natural Resources Defense Council pointed out, this proposal, in fact, "would permit emissions from existing facilities to rise from their actual levels to what would be allowed if the facilities were running 100% of the time." The nation's largest 200 coal-fired power plants emitting in 1982 15 million tons of sulfur dioxide per year could under the new proposal "emit over 29 million tons of sulfur dioxide per year, almost double and considerably more than all present utility emissions." NATURAL RESOURCES DEFENSE COUNCIL, FACT SHEET IN NEW DINGELL CLEAN AIR ACT PROPOSAL (July, 1982).

61. *See A Bill to Amend the Clean Air Act to Better Protect Against Interstate Transport of Pollutants, to Control Existing and New Sources of Acid Deposition, and for Other Purposes, 1981: Hearings on S. 1706 Before the Comm. on Environment and Public Works*, 97th Cong., 1st Sess. 763 (1981). As originally introduced on Oct. 6, 1981, the Mitchell bill would have capped eastern sulphur dioxide emissions as of January 1, 1981, and required a 10 million ton reduction in eastern sulphur dioxide emissions (below 1980 levels) by 1990. *Id.* A counterpart bill was introduced in the House by Rep. Toby Moffett on October 22, 1981. H.R. 4829, 97th Cong., 1st Sess. 183 (1981).

research, but also a program designed to reduce by 1995 annual sulphur dioxide emissions in a thirty-one state area east of the Mississippi to a level eight million tons below 1980 emission levels.[62]

In part because Administration bilateral acid rain policy, in calling for expanded research while allowing for increased United States emissions, was simply an extension of the prior policies pursued by the Administration and its domestic allies in the reauthorization process, developments on the bilateral plane in 1981 and 1982 increasingly tended to converge with the progress of the reauthorization debate. Ironically, one consequence of Administration resistance to bilateral abatement action was to increase what appeared at that time to be the prospects for domestic abatement action. Prior to Senate Committee approval of the Mitchell bill, for example, a majority of the Senate Foreign Relations Committee had taken it upon themselves to write directly to the Chairman and Ranking Minority Member of the Environment and Public Works Committee, urging adoption of the bill in the interests of "preserving a stable and cooperative bilateral relationship between the United States and Canada."[63] Characterizing such measures as "essential to meeting the United States commitment to Canada under the Memorandum of Intent," the nine signatories of the letter warned that "delay or intransigence by the United States in moving to deal effectively with the acid rain problem could bring about a serious deterioration in bilateral relations," with "unfortunate consequences for other

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62. Under the Mitchell bill as modified by the Senate Committee, eastern state governors were to be given eighteen months after enactment to agree upon the allocation of the 8 million ton reduction. Failing agreement, reductions would have been automatically allocated on a basis proportional to each state's actual utility SO_2 emissions in excess of NSPS (1.2 pounds of SO_2 per million Btu's). Since under either reduction scenario Ohio Valley sources would have been significantly curtailed, the Mitchell bill would have had substantial transboundary benefits for eastern Canadian ecosystems. For this reason Senate Committee approval of the Mitchell bill was greeted with a unanimous resolution of commendation from the Canadian House of Commons the same day of the vote:

> [t]hat this House go on record as supporting the action of the Senate Environment and Public Works Committee in attempting to force action on the urgent problem of acid rain, and that this House express its appreciation to Senator Stafford and his fellow Senators from both American political parties for their efforts to improve Canadian-American relations with regard to environmental questions.

124 PARL. DEB. H.C. 386, 32d Parl., 1st Sess., at 19581 (July 22, 1982).

63. Letter from Senators Dodd (D-Conn.), Pell (D-R.I.), Boschwitz (R-Minn.), Tsongas (D-Mass.), Cranston (D-Calif.), Zorinsky (D-Neb.), Sarbanes (D-Md.), Mathias (R-Md.) and Pressler (R-S.D.) to Senators Stafford (R-Vt.) and Randolph (D-W.Va.) (June 17, 1982).

aspects of United States–Canada relations of great importance to our country."[64]

By late 1982, however, with the domestic acid rain debate having evolved into a choice between policy options corresponding closely to the very alternatives which had proven irreconcilable at the bilateral level, the reauthorization process came to eclipse bilateral efforts to promote resolution of the North American acid rain problem. Prospects for resolution of the bilateral dispute have now come to depend largely on the manner in which Congress will choose to resolve the competing options of research and emission reduction. Resolution of the debate in favor of a strong emission reduction amendment would constitute recognition of a serious domestic problem and, coincidentally, serve to break the bilateral impasse, mandating the emission reductions which from the Canadian perspective have always been the primary raison d'etre of the MOI exercise. Resolution in favor of Administration environmental policies, however, would only serve to intensify current levels of acid rain damage in both eastern Canada and the northeastern United States, placing even greater stress on already strained Canada–United States environmental relations.

Regardless of which view will eventually weigh more heavily with Congress, what will ultimately tip the scales towards either action or inaction will be the relative weight ascribed to the considerations of scientific certainty and economic cost which have become fundamental to acid rain policy-making regardless of context. Should such considerations be weighed objectively by Congress in the final resolution of the acid rain debate, there seems no doubt that the balance will incline toward enactment of an acid rain control bill requiring significant reductions in United States acid precursor pollutant emissions. Whether such considerations will be weighed objectively, however, seems largely to depend on the extent to which science and economics can emerge from the fog of rhetoric and hyperbole in which opponents of acid rain control have sought to envelop them.

SCIENTIFIC UNCERTAINTY

Opposition to acid rain control in both the domestic and bilateral contexts has relied heavily on arguments based on alleged scientific un-

64. *Id.* Similar warnings of "a likely spillover of the acid rain question into other unrelated areas and a resultant souring of the bilateral relationship" should the United States fail to respond to Canadian concerns, were issued by Professor John Carroll in a report on the bilateral acid rain dispute. J. CARROLL, ACID RAIN: AN ISSUE IN CANADIAN AMERICAN RELATIONS 50 (July 1982) (a report for the Canadian–American Committee sponsored by the C.D. Howe Institute and the National Planning Association, Toronto and Washington, D.C.)

certainties. It is commonly urged, for example, that acid precipitation has not been conclusively linked with man-made emissions of sulphur and nitrogen oxides; that even if there is some causal relationship, there is no certain correlation between reductions in emissions and decreases in acid loadings; and that even if such a correlation could be established, the acid rain problem is not in any event sufficiently serious to warrant costly acid rain abatement actions.[65] The message sought to be conveyed by such arguments is clear: "[r]ushing into additional costly and complex regulations at this time would only cause confusion with no certainty of any positive effect on air quality or other environmental considerations."[66]

Given the present state of scientific knowledge, however, arguments such as these have become increasingly unreal. While environmental acidification processes are not fully understood, there is no longer any doubt among the majority of expert scientific researchers that North American acid rain is largely a man-made phenomenon. In the view of the National Academy of Sciences: "Although claims have been made that direct evidence linking power-plant emissions to the production of acid rain is inconclusive . . . we find the circumstantial evidence for their role overwhelming."[67] While the relationship between emission reductions and acid loadings may not be linear, most European and North American scientists are now of the view that significant emissions cutbacks will significantly reduce acid loadings, and that such abatement action has become urgent. According to the final declaration of the 1982 Stockholm Acidification Conference:

> The acidification problem is serious, and even if deposition remains stable, deterioration of soil and water will continue and may increase unless additional control measures are implemented and existing control policies are strengthened. . . .
>
> The Conference considered the establishment and implementation of the concerted programmes for the reduction of sulphur emissions to be a matter of urgency. Similar actions

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65. *See* Bagge, *Acid Rain: Perspective of the National Coal Association*, 14 NAT. RESOURCES L. NEWSLETTER 3, 4 (1982); CLEAN AIR ACT AND INDUSTRIAL GROWTH: AN ISSUES WORKBOOK FOR THE 97TH CONGRESS (National Environmental Development Association/Clean Air Act Project eds. 1981); CURTIS, BEFORE THE RAINBOW: WHAT WE KNOW ABOUT ACID RAIN (1980).

66. CLEAN AIR ACT AND INDUSTRIAL GROWTH: AN ISSUES WORKBOOK FOR THE 97TH CONGRESS, *supra* note 65, at 37.

67. NATIONAL ACADEMY OF SCIENCES COMMITTEE ON THE ATMOSPHERE AND THE BIOSPHERE, ATMOSPHERE BIOSPHERE INTERACTION: TOWARDS A BETTER UNDERSTANDING OF THE ECOLOGICAL CONSEQUENCES OF FOSSIL FUEL COMBUSTION 3 (1981).

> should be taken as soon as possible for reducing emissions of nitrogen oxides.[68]

Substantially similar conclusions have in recent years been reached by the bipartisan National Commission on Air Quality,[69] the International Joint Commission,[70] and by the work groups under the MOI in their initial reports. During the summer of 1982, one hundred prominent United States scientists joined together to urge immediate United States abatement action:

> Although gaps remain in our knowledge of acid precipitation and further research is needed to fill these gaps, we the undersigned scientists believe that what is already known about acid deposition justifies and requires immediate legislative steps to begin abating sulfur and nitrogen oxide emissions, particularly in the eastern half of the United States.[71]

CONTROLS AND COSTS

Significant acid precursor pollutant emission reductions will of course involve considerable cost, particularly for midwestern electric utilities and their ratepayers. However, utility-prepared cost projections based on a ten million ton sulphur dioxide reduction program (forecasting $6-7 billion in annual costs, with utility rate increases in some midwestern areas in excess of 100%) seem to be grossly exaggerated.[72] According to the Congressional Research Service, for example,

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68. Stockholm Conference on the Acidification of the Environment, *supra* note 20.

69. In its final report, the Commission recommended that "Congress should require a significant reduction by 1990 in the current level of sulphur dioxide emissions in the eastern United States" and that Congress "consider whether to adopt a phased program requiring interim reductions by 1985." TO BREATHE CLEAN AIR, *supra* note 19, at 3.

70. SEVENTH ANNUAL REPORT, *supra* note 37. In its report the Commission noted that "[v]irtually all of eastern Canada and portions of the northeastern United States experience rains with acidity equal to or exceeding that which can adversely affect susceptible ecosystems." *Id.* at 50. It recommended that both Canada and the United States "undertake further actions to reduce atmospheric emissions of the oxides of sulfur and nitrogen from existing as well as new sources." *Id.* at 5.

71. The petition was circulated by the National Wildlife Federation, publicly released on June 28, 1982, and inserted in full by Rep. Toby Moffett (D. Conn.) in the Congressional Record. *See* National Wildlife Federation, *100 Experts Support Acid Rain Controls According to National Wildlife Federation—Position Refutes Administration Policy, reprinted in* 128 CONG. REC. E3763 (daily ed. Aug. 10, 1982).

72. On June 19, 1982 the Board of Directors of the Coalition of American Electric Consumers adopted the following policy statement:

> We do not believe that the control of acid rain need be an untoward economic burden upon the nation as a whole, upon the states and citizens of the Ohio River Valley, or particularly upon the customers of AEP. We denounce as fanciful the figures on the costs of acid rain control which AEP subsidiaries have

the annualized costs in 1990 of a ten million ton sulphur dioxide reduction program would, depending on methods used to reduce emissions, range from $2.4-4.6 billion.[73] At the same time, a report prepared for the National Wildlife Federation and the National Clean Air Coalition estimates that the cost of acid rain controls could be expected to increase utility costs in the eastern half of the country by only $2.5 billion a year (in 1990), which represents an average increase in utility rates of 1.4%.[74]

Costs of this magnitude, while substantial, do not seem excessive when one considers the present and future environmental and economic benefits associated with acid rain control action. The estimated $5 billion value of reducing acid rain in the eastern third of the United States alone exceeds any of the more credible acid rain control cost projections.[75] But because acid rain damage is a long term phenomenon, present day costs and benefits are only part of the acid rain cost-benefit analysis. Because of the cumulative and "time-sensitive" nature of acidification damage, contemporary policy-makers must also consider the future economic costs associated with present regulatory inaction. Control programs started sooner will be far less expensive, and far more efficacious than those begun later. Further delay will not only drive up the long-term costs of mitigation, by increasing the extent of the future environmental damage, but will also increase the amount of that damage which will be irreversible unless control programs are begun today. Given the present and future economic importance to the Canadian and United States economies of the tourist, recreation and forestry industries which are dependent on a healthy natural resource

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been giving to their customers in bill stuffers.
Coalition of American Electric Consumers, A Policy Statement on Acid Rain and American Electric Power Company (June 19, 1982).

73. R. Trumbule & L. Parker, *Acid Precipitation: A Serious and Growing Environmental Problem*, Library of Congress Congressional Research Service Issue Brief Number IB 80022 (updated ed. Dec. 7, 1982) (archived Apr. 22, 1983) at 12. These cost estimates assume that only SO_2 emissions are the object of the reduction program, and that the only polluter attacked are the utilities. A reduction program which would include the potential for cost-effective industrial emission reductions would reduce the burden of such a program on the utility industry. *Id.*

74. Kamlet, Bakalian, Einbender & Wall, *supra note* 16, at 9. The highest rate increases anywhere in the region would be only 7.5 percent. *Id.*

75. The $5 billion figure includes $2 billion in effects on materials, $1.75 billion in damage to forest ecosystems, $1 billion in direct effects on agriculture, $250 million in effects on aquatic ecosystems and $100 million in various other effects including damage to water supply systems. *See* EPA OFFICE OF HEALTH AND ECOLOGICAL EFFECTS AND OFFICE OF RESEARCH AND DEVELOPMENT, METHODS DEVELOPMENT FOR ASSESSING ACID PRECIPITATION CONTROL BENEFITS (1981). *See also* Kamlet, Bakalian, Einbender & Wall, *supra* note 16, at 6, 9.

base, the counsel of delay seems dangerously shortsighted. Whether Congress will ultimately concur, however, remains very much to be seen.

CONCLUSION

Concern over the adverse environmental and economic effects of North American acid rain has in recent years become widespread in Canada and the northeastern United States. A growing body of alarming evidence and disturbing inference has fuelled public and scientific pressure in both countries for immediate acid rain abatement action. While such pressure has sparked substantial Canadian emission reduction decisions it has been greeted with resistance and criticism by some United States administration spokesmen. In the bilateral context, Administration policies and practices have precipitated a scientific and diplomatic impasse, raising the temperature of an already heated bilateral dispute, and engendering wider concerns in both countries over the future direction of what has, until recently, been a tradition of cooperative and successful management of the transboundary environment.

As Canada has been forced to turn increasingly towards Congress, the acid rain debate has in a sense come full circle. What began with a congressional resolution now, five years later, is to be decided in a congressional reauthorization. That reauthorization has constituted Congress not only as the forum for resolution of the domestic acid rain debate, but also as a kind of court of final bilateral appeal for the larger North American acid rain case. It is not yet clear whether that case will be heard and decided on its merits. Considerations of science, economics and foreign policy would all seem to compel a reauthorization resolution in favor of a strong acid rain amendment. But domestic opposition to acid rain control action is nonetheless strong and firmly entrenched, and may yet prove sufficient to forestall effective United States acid rain abatement action.

Acid rain will remain an important bilateral issue and a major irritant in Canada–United States relations until such time as a meaningful control program is endorsed by Congress and the Administration. Continued lack of progress can only widen and intensify the extent and severity of United States and Canadian environmental damage, increase future mitigation costs and place even greater strains on Canada–United States relations.