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The politicization of science and the acid rain debate: past and future conflict in Canadian-U.S. relations

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The Politicization of Science and the Acid Rain Debate:
Past and Future Conflict in Canadian-U.S. Relations

by
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Abstract

As the title implies, this thesis explores the relationship between science and politics in the acid rain debate between Canada and the United States. Acid rain first emerged as a bilateral issue in the 1970's after the scientific community identified the relationship between industrial emissions of sulfur dioxide and environmental damage. Furthermore, it was discovered that large quantities of these emissions were being transported by prevailing weather patterns and being deposited in distant geographic regions. The concentration of industrial activity in the U.S. midwest was found to be resulting in the long range transport of acidic precipitation to portions of eastern Canada.

The first part of this thesis summarizes the causes and effects of acid rain, as it is essential to understanding the linkages between science and politics. A review of the evolving body of scientific evidence and subsequent legislative efforts illustrate that both those advocating and opposed to acid rain control used science (or the shortcomings thereof) to legitimize their political agenda. The role of the mass media in the acid rain debate is discussed, as it facilitated the dissemination of politicized information by both advocates and opponents of emission control measures. Further, current legislative efforts are evaluated, illustrating weaknesses revealed by the increasing body of scientific knowledge.

In order to sample perceptions of informed elites, a polling of the U.S. and Canada's government and academic communities was conducted in the summer of 1991. This study revealed that among these communities, there is a general perception that further control measures will be necessary in the future.
The conclusions of this thesis find that the evolving nature of scientific knowledge will reveal shortcomings in current legislative efforts to control acid rain. Furthermore, those opposed and advocating acid rain control will continue to use scientific evidence to legitimize their positions, with the mass media serving as a vehicle for the dissemination of politically biased information.
Preface

Acidic deposition, commonly referred to as acid rain, has become an issue of increasing importance over the last two decades. With recognition of the phenomenon and its widespread impact in the 1970's, acid rain developed into an issue of public policy with international implications. More specifically, the issue of acidic precipitation constituted the most politically divisive issue between the United States and Canada throughout the 1980's.

The unlimited consumption of hydrocarbons is regarded as the lifeblood of economic development in modern industrial societies. However, the processes associated with modern energy production and utilization have resulted in stresses to the natural environment on an unprecedented scale. One of these major stresses is the formation and dispersion of acid rain, now recognized as a serious problem in North America, Scandinavia, and a large number of European nations. Attention was first drawn to the North American problem of acid rain in the 1970's, a decade of increasing environmental awareness.

As Steven Clarkson (1986) points out, Canada is both economically and ecologically dependent upon the United States. However, unlike economic dependence, ecological dependence in an unavoidable consequence of geography.¹ There are over five thousand miles of border between Canada and the United States, and subsequently the two nations

share common airsheds and watersheds. Inevitably, anthropogenic [human] activities on one side of the border affect conditions on the other.

Throughout the 1980's, the political debate between the United States and Canada regarding acid rain control raised questions of international law and the state of bilateral relations, and was characterized by the politicization of scientific evidence surrounding the issue.

After a decade of political wrangling, the United States in 1990 enacted revisions to the Clean Air Act specifically addressing acid rain control, and enacted a bilateral accord with Canada (Acid Rain Accord, March 1991). Furthermore, in 1985 Canada embarked upon its own Acid Rain Control Program, designed to reduce acid rain precursor emissions in the eastern provinces 50% from 1980 allowable levels. In light of legislative progress, the acid rain debate appears to have come "full circle".

This, however, is not the case. Increasing scientific understanding of the phenomenon will serve to expose fundamental weaknesses in the newly enacted legislation. This is not to discredit advances being made in acid rain control, but rather to enhance understanding of the need for a continuing revision of legislation, based upon the evolving nature of scientific knowledge.

In the social sciences, there has been little effort to compare and contrast professional opinions and legislative efforts on acid rain, except in the broadest terms. Therefore, for the purpose of this thesis, a survey was conducted to support the issues presented and discussed.

The survey was conducted in the summer of 1991, and targeted an informed elite in the area of acid rain control and legislation. Government employees in Canada and the United States were selected on
the basis of their professional experience, as well as previous work in the field on acid rain. In addition, selected academic communities in both countries were polled in order to balance the results.

This thesis tests the hypothesis that the acid rain debate has not "come full circle", as increasing scientific understanding of acid rain and its effects will expose fundamental weaknesses in legislative efforts. The format of this study will be as follows: a discussion of acid rain and its effects; a history of the evolving understanding of the phenomenon; a review of legislation in the Canadian-American context; the role of the media and the politicization of scientific evidence; survey results; conclusions and recommendations.
Chapter 1
CAUSES AND EFFECTS OF ACID RAIN

Introduction

It is useful to review the causes and effects of acid rain in order to develop a comprehensive understanding of the issues addressed in this thesis. This is not intended to be an exhaustive scientific review, but rather an introduction to the adverse effects of acid rain.

Acidic precipitation is principally derived from emissions of sulfur and nitrogen oxides released into the atmosphere as byproducts of the combustion of hydrocarbons. In the United States the principal sources of these releases are coal-fired thermal power generating plants and vehicle emissions. The combination of power plants and factories account for 90-95% of sulfur dioxide emissions, while nitrogen oxides are principally derived from vehicle emissions and industrial boilers. Total SO2 production in the United States has been estimated to be between 17 and 19.7 million tons annually, based upon 1982 data.\(^2\) Canadian sources of sulfur dioxide and nitrogen oxides are rooted in a) the smelting of sulfide ores, and b) vehicle emissions, although there is also a less significant contribution from coal-fired generating stations.

These sulfur and nitrogen compounds are transported through the atmosphere by prevailing weather patterns. In the eastern half of North America, the jet stream generally carries weather patterns from the west to a northern track along the east coast of the Atlantic ocean. Consequently,

emissions released in the heavily industrialized region of the Ohio River Valley are dispersed over areas in the northeastern portion of the United States and eastern Canada. Although emissions of these pollutants are found nationally, the concentration of emitters in this region is particularly important in the Canadian-American context, as the aforementioned weather patterns are the root of the transboundary nature of the phenomenon.

This is due to the use of so-called "tall stacks", often constructed over 1000 feet in height to disperse pollutants. Paradoxically, the construction of these stacks was caused by the polluters meeting local environmental standards, ensuring that a large percentage of their emissions would be carried away and dispersed across a large area. Consequently, estimates based upon monitoring networks and projection models conclude that up to fifty percent of acidic deposition occurring in Canada is attributable to U.S. sources.3

While aloft, the emitted sulfur and nitrogen compounds are transformed by atmospheric chemical processes and are deposited in wet or dry form. Secondary pollutants are formed when sulfur dioxide (SO2) and nitrogen oxides (NOx) mix with water vapor (and radical forms of water) while airborne, and are oxidized and hydrolyzed into sulfuric acid (H2SO4) and nitric acid (HNO3).4 In the absence of water vapor while airborne, these pollutants may settle in dry form and later react with water to form these acids at ground level. The term "acid rain", however, has come to

represent both wet and dry deposition. When these newly formed acids are introduced to terrestrial and freshwater ecosystems, they accumulate over time (at a rate depending upon acid neutralizing capabilities of the afflicted area), and consequently disrupt the natural balances of fragile ecosystems. Sulfuric and nitric acids have also been found to damage man-made structures built of limestone, marble, metal and paint. Damage from acidic deposition in urban areas is dramatic, and has been documented in cities in North America and Europe. Thus, the effects of acid deposition are not limited to the natural environment, but affect the man-made environment as well.

Aquatic Effects

The negative effects of acidification are not usually associated with a direct impact, but rather with a cumulative effect over a period of time. This is the primary reason that the phenomenon was not recognized as a serious environmental problem until quite recently. In aquatic ecosystems, the pH of the water body is the principal measure of acidification. More specifically, the pH is a measure of the concentration of hydrogen ions (H+) in the water. As hydrogen ion concentration increases, the water is rendered more acidic. Conversely, as ion concentration decreases, the water is rendered less acidic, or more alkaline. When sulfuric and nitric acids dissociate, they release hydrogen ions into the water; thus when they are introduced to aquatic ecosystems through precipitation and runoff the watershed may experience acidification.

These ions are measured quantitatively in their concentration, and are expressed on the pH scale. This scale has a range of 1 to 14, with 7 representing a neutral solution. Acidity and alkalinity are based on a
negative logarithmic scale, with lower pH values representing an increased concentration of hydrogen ions.\(^5\)

Natural rainfall registers a pH of 5.6, attributable to the formation of carbonic acid from the presence of carbon dioxide in the atmosphere (thus lowering the neutral pH (7) of pure water). However, sulfuric and nitric acids dissociate completely when introduced to H\(_2\)O, and consequently have a greater potential for acidification. Furthermore, the (aquatic) acidification potential of sulfuric acid is twice that of nitric acid, resulting in an emphasis on SO\(_2\) reduction in legislative efforts.\(^6\)

When acidifying compounds are introduced into a watershed, the degree of acidification has a strong relationship with the assimilative (or buffering) capacity of the soils in the area. If the assimilative capacity in the area is low, then deposition over a period of time can result in surface water acidification. As many aquatic organisms are sensitive to the pH of their environments, the acidification of lakes and streams has been linked to the decline of a wide range of species. More specifically, a typical species decline pattern in North American lakes begins with lake trout, brook trout, and walleye, with perch being one of the more resistant species.\(^7\)

Acidification is both directly linked to the decline of species due to their acid intolerance, as well as the effects of metal pollution. This is the case as metals are generally more soluble under more acidic conditions. Species not sensitive to acidification, therefore, may experience decline if

they are susceptible to metal pollution. Further, species are also at risk if their natural prey is removed from the food chain due to the effects of acidification or metal pollution.

Algae communities in affected lakes also become less diverse in lakes with lowered pH, as do rooted plants. Conversely, attached algae and bottom-growing (benthic) mosses flourish, ultimately lowering the rate of decomposition. This results in lower productivity, as the process of nutrient recycling is made less efficient. In addition, elevated concentrations of aluminum, manganese, zinc, cadmium, lead, mercury, copper and nickel have been documented to increase in lakes affected by acidification, although it is not yet determined whether this is attributable to introduction through deposition or leaching from sediments by acidified water.

**Terrestrial Effects of Acid Rain**

Unlike aquatic effects of acidic precipitation, terrestrial effects are less completely understood. This is because terrestrial ecosystems are much more complex than aquatic, and because there are a wide range of factors influencing growth and health of land based ecosystems. By nature, this renders it most difficult to isolate the effect of acid rain as an individual variable. However, it has been determined that acid rain can:

- damage foliage, accelerate the erosion of the waxy covering of leaves which may lead to the loss of water or which may reduce a plant's ability to resist the attack of disease-causing organisms;
- inhibit the germination of seeds and the growth of seedlings; decrease the respiration of organisms living in the soil which may in turn affect the availability of some nutrients;
- increase the leaching of

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nutrient ions from the soil; and enhance the solubilization of aluminum in the soil, which can have a negative effect on biological processes. 9

In recent years, there has been a dramatic decline of sugar maple stands in eastern Canada, as well as a dieback of high elevation red spruce in the northeastern United States. There is strong evidence linking these declines to acid rain, but a definitive cause-effect linkage has yet to be made. Despite the lack of a definite linkage, there have been significant forest productivity declines documented in the United States and Canada in areas with high levels of acidic deposition. In these areas, growth reductions of 40-50% in the last twenty years alone have been observed. 10

However, the role of nitrogen is being given increased emphasis in acidification due to its mobility in soils and its recently detected effects on naturally acidic forest systems. This development represents a critical shortcoming of legislative efforts, as only 2 to 4 million tons of nitrogen oxides of the 14 million tons emitted annually are scheduled for reduction under the 1990 revisions to the U.S. Clean Air Act. These revisions concentrated on the reduction of sulfur dioxide emissions by 50 percent, based upon what was understood of freshwater acidification processes. 11

The effects of nitrogen oxides had been primarily associated with their linkage to the formation and effect of ground level ozone, as NOx is a precursor of ground level O3 production and nitric acid. Ground level

ozone has been found to damage terrestrial growth, while nitrate deposition had not been directly linked with forest decline. This resulted in emphasis on the ozone linkage of NOx rather than its role in acidification in formulating public policy. The implications of nitrogen deposition and the evolving state of knowledge regarding its effects will be explored further in the legislative review and the results of the survey returns.

Risks To Human Health

Although acid rain has not been linked directly to adverse effects to human health, there is a growing consensus that certain population groups may be at risk. Waters affected by acidification are under scrutiny, as they are often used for human consumption. Drew Lewis (1986) expressed concern that indirect affects resulting from the increased content of dissolved heavy metals was of some concern.12 These metals may be leached from natural aquifers and from lead pipes or soldered joints. Increased concentrations of lead in drinking water subject consuming populations (especially children) to an increased risk of lead poisoning.

In addition, microscopic particles are formed when sulfur dioxide is oxidized in the atmosphere, with a great potential for penetrating the human respiratory system. These compounds have been linked to the aggravation of emphysema and bronchitis in susceptible persons. Further, a similar phenomenon is experienced with NOx, which has the potential to suppress the functions of pulmonary scavenger cells in removing insoluble

particulates from the lungs.\textsuperscript{13}

Acid rain has not yet been linked directly to crop failure, although as the neutralizing capabilities of cultivated land decreases, this situation may reverse. Nitrogen oxides and their transformation into ground level ozone, however, have been directly linked with crop damage. The potential of heavy metals to affect root absorption has also been documented in forested areas, indicating cause for concern among the forest products and tourism industries.

\textbf{Effects On Man Made Structures}

Carbonate stone (limestone, marble) is known to deteriorate when exposed to acid rain. This is also the case for galvanized metals and carbonate paints due to the presence of the dilute acids. Therefore, as Lewis and Davis found, "the damage thus caused not only can result in economic loss, but the loss of cultural and historic resources as well."\textsuperscript{14} The Brookhaven National Laboratory and the U.S. Army Corps of Engineers estimated in 1986 that damages to buildings in seventeen states located in the Midwest and Northeast could run as high as $16\text{ billion} \text{ annually. This report also suggested that a high proportion of the pollutants originates outside the local areas, and that marble statues and monuments were "literally being eaten away".}\textsuperscript{15}

The Canadian government has assessed that 48,000 Canadian

\textsuperscript{14} Lewis and Davis, 1986. p. 12.
\textsuperscript{15} Scheiman, 1986. p. 6.
lakes are at risk of acidification, jeopardizing a $1.1 billion/year sport fishing industry directly linked with the $10 billion/year tourism industry.\textsuperscript{16} The forest products industry which earns approximately $14 billion per year, as well as providing 10\% of Canadian jobs, has also been perceived to be at risk.\textsuperscript{17} The U.S. National Academy of Scientists have estimated that U.S. damages (in materials) from acid rain are in the area of $6 billion per year.\textsuperscript{18}

**Conclusions**

Clearly, the effects of acid rain are as widespread as its dispersion. That is, acid rain, directly or indirectly, effects a wide spectrum of environments ranging from the natural to the man-made environment. With this established, and understanding of the basic scientific principles associated with the formation of acid rain, a better understanding of the difficulties encountered with its control is facilitated.

\begin{itemize}
\item \textsuperscript{16} Institute for U.S.-Canada Business Studies, 1990. p. 3.
\item \textsuperscript{17} Institute for U.S.-Canada Business Studies, 1990. p. 3.
\item \textsuperscript{18} Schieman, 1986. p. 6.
\end{itemize}
Chapter 2

THE INTERNATIONAL JOINT COMMISSION AND INTERNATIONAL LEGAL PRINCIPLES IN THE ACID RAIN DEBATE

Introduction

The acid rain debate is a bilateral environmental issue between Canada and the United States. In light of this, it is useful to examine structures designed to accommodate bilateral environmental issues, as well as the international legal principles associated with transboundary pollution. The International Joint Commission has been the most important bilateral organization in addressing environmental issues.

The International Joint Commission

The legal foundation of Canadian-American environmental relations is the Boundary Waters Treaty of 1909. Within this treaty, it was agreed (Article IV) that "waters flowing across the boundary shall not be polluted on either side to the injury of health or property of the other."\(^{19}\) This principle has provided the general framework for all subsequent legislative efforts to control transboundary pollution between Canada and the United States.

Also established by the Boundary Waters Treaty was the International Joint Commission (IJC), a binational organization designed to ensure full implementation of the treaty, as well as to undertake

investigations of specific environmental issues. The IJC, with three members appointed by each country, acts as a unified body by reaching decisions through a simple majority. Although the treaty was entered into primarily to prevent disputes "regarding the use of boundary waters and provide for the adjustment and settlement of questions arising between the two countries along their common frontier"20, the IJC has also provided the framework for the monitoring and investigation of questions related to transboundary air pollution.

The IJC's functions under the Boundary Waters Treaty are essentially three-fold: 1) Quasi-judicial; as the IJC approves applications to construct works that will affect the natural levels or flows of water. Orders of Approval contain "conditions to ensure suitable protection or indemnity of all interests of either country along its frontier", in cases referred to by the governments for investigation.21 Further, International Boards of Control ensure compliance with the Orders of Approval. 2) Investigative; the IJC investigates concerns involving the rights, interests and obligations of either country along the frontier referred to by the governments for investigation and report. Investigations include completing technical reports and conducting public hearings. At the conclusion of the investigative process the IJC presents the governments with its conclusions and recommendations, which are not binding. 3) Surveillance/Coordination; through panels of technical experts, the IJC may monitor or coordinate the implementation of recommendations that the governments have accepted.

That is, recommendations of the IJC do not constitute binding obligations, unless agreed to by the governments.

The IJC has the distinction of being the only permanent joint institution operating in transboundary environmental issues. Through the first thirty years of its existence, the IJC dealt primarily with water appointment permits under its quasi-judicial authority granted under Articles III, IV, and VIII of the Boundary Waters Treaty. These matters were primarily local and regional issues, resulting in a concentration on engineering expertise rather than conflict resolution.

However, role of the IJC has grown in recent decades to serve in a much broader capacity. Increasingly, references to the Commission have been made relating to issues of national, rather than localized, scale. Consequently, the Commission has gained experience (and prestige) in issues with widespread implications for both the United States and Canada.

Perhaps the most significant examples of the IJC's growth as an institution are Great Lakes Water Quality Agreements (GLWQA). After releasing study results of the Great Lakes and St. Lawrence River containing detailed assessments and recommendations, the first Agreement was signed on April 15, 1972. The Agreement recognized the rights of each country to use the Great Lakes, but established a commitment by each nation to restore water quality in the Great Lakes. Under the 1972 Agreement, the Commissions duties were defined as follows:

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1) collecting, analyzing, and deseminating information on the operations and effectiveness of the governments' programs and other measures to improve the water quality of the Great Lakes.

2) tendering advice and recommendations to federal and state or provincial governments for dealing with water quality problems.

3) assisting in the coordination of joint efforts to control pollution of these boundary waters, including the discharge of phosphorus into the lakes.23

The 1972 Agreement was expanded by a 1978 Protocol that called for the "virtual elimination" of toxic pollutants in the Great Lakes ecosystem. This served to expand the role of the IJC even further, as did the 1987 Protocol. The 1987 Protocol assigned the IJC the responsibility of monitoring airborne toxins in the Great Lakes region, with a concentration on its independent oversight functions.

According to an Environment Canada official:

The 1972 Agreement showed that it was possible for two sovereign governments to cooperate in solving a very difficult transboundary environmental problem, a very valuable lesson for the even greater challenges that lay ahead ... The Agreement, with its commitment to control a transboundary environmental problem and to specific pollution reduction targets and schedules, is a valuable model for the resolution of common environmental problems, such as acid rain.24

Although this position was put forth by the Canadian government, there has been serious criticism of the performance of the IJC. Many believe that the Commission has been successful in areas such as scientific fact finding, but has fallen short of its potential. Others view the

IJC as a "pawn of governments designed to validate or rubberstamp decisions made by others.25 In Carrol's (1986) opinion, the IJC:

[S]tands for the institutionalization and stability under a set rules of of procedure and priorities in contrast to the politically constrained but freer atmosphere of diplomatic negotiation. Its work and findings cannot be controlled by the bilateral negotiators beyond the stage of writing the references, nor can the behavior of sometimes controversial commissioners be controlled. Thus its work, especially if expanded to include initiatory authority or binding recommendations, may be perceived as a threat to freedom of diplomatic negotiation.26

Thus, the Canadian government's assertion that the Great Lakes Water Quality Agreements should be used as a model for controlling acid rain is quite controversial. Canadians, in general, have historically been more supportive of the IJC in that they are more aware of its existence and provide more funding than their U.S. counterparts. In absolute economic terms, the United States, although it has more at stake in matters relating to pollution control, has been less supportive of IJC recommendations in recent years. A 1989 State Department assessment of the IJC revealed that the United States had implemented 29 of the 56 recommendations (52%) outlined in the GLWQA, 20 (36%) had not been implemented, 4 (7%) had been partially implemented, and that there was disagreement as to whether 3 other recommendations (5%) had been implemented.27 The effectiveness of the IJC, therefore, is subject to question.

25 Carroll, 1990. p. 52
26 Carroll, 1988. p. 52
According to a panel of U.S. officials, the reasons for not implementing a number of agreements are: 1) budgetary constraints; 2) U.S. agencies decided to fund their own projects rather than those of the IJC; 3) the governments either unilaterally or bilaterally decided that certain IJC recommendations should not be carried out or that recommendations be addressed in the context of their respective domestic programs; 4) implementation of the recommendations would go beyond the limit of applicable U.S. laws and regulation; and 5) U.S. agencies decided that financing binational projects outside the framework of the IJC would be more effective.28

Furthermore, the report concluded that there was a need for the U.S. to provide an established mechanism to provide prompt responses to the IJC's recommendations; this has yet to be acted upon. Clearly, the United States and Canada have varying ideas regarding the role of the International Joint Commission and its subsequent "ideal" role in the acid rain debate. This issue will be further explored in the legislative review and more specifically in the discussion of the 1991 Acid Rain Accord.

International Legal Principles and the Acid Rain Debate

Perhaps the most frequently cited transboundary air pollution case in the realm of international law is that of Trail Smelter. The root of the dispute was that a copper smelter, located in Trail, British Columbia was causing damage (via fumes) to agricultural interests (orchards) in the U.S. State of Washington. The U.S. government protested, and an arbitration

panel held that:

No State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or property of the persons therein, when the case is of serious consequences and the injury is established by clear and convincing evidence."29

The complainants were eventually awarded monetary compensation from the Canadian government, and more importantly this settlement established a precedent in international law. However, the main shortcoming of the decision was that there have been no subsequent international decisions establishing liability for transboundary air pollution.30 Eric Moller (1989) has argued that while the opinion provides principles applicable to all transboundary disputes, it "stands as a lone beacon for the proposition that a government should be held liable for transboundary air pollution."31

Similarly, both the United States and Canada signed the 1972 Stockholm Declaration, of which Principle 21 states that States have the responsibility "to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States."32 In addition, both countries are parties to the 1978 Convention on Long-Range Transboundary Air Pollution in which States agreed to "endeavor to limit and, as far as possible, gradually reduce and prevent air pollution including

long-range transboundary air pollution."33

These agreements constitute "soft law" as they are not binding obligations; however, a large enough number of states have accepted them that they can be considered as the current *opinio juris*. Irene van Lier (1987) has speculated that in due course these principles may become part of the international legal structure.34

The concepts of due diligence and good neighborliness have been brought forth as principles related to the acid rain debate. In international law, however, it has been required that victim states link environmental injury to specific identifiable foreign sources. This has been one of the most difficult issues in the acid rain debate, the source-receptor relationship. That is, it is not possible to clearly determine a direct linkage between emitters of pollutants and damages elsewhere, owing to the long distances covered from emission to deposition.

The position of the United States throughout the Reagan Administration was that extensive research into the causes and effects of acid deposition was needed before existing control programs could be expanded. The justification for this position was that conclusive benefits for any control strategy were not available, and through more research would be. However, as Gunther Handl (1986) points out, this raises the international legal question whether a state can lawfully refuse to take action to reduce transboundary harm on the premise that "scientific uncertainties preclude a precise determination of exactly what measures

34 For a more complete discussion, see Irene van Lier's *Acid Rain and International Law*, (Toronto: Bunsel Environmental Consultants, 1987).
might provide effective relief." 35 Canadians rejected the U.S. stance, asserting that the weight of scientific evidence was sufficient to trigger the United States' customary legal obligation to enact remedial action immediately. Indeed, they dismissed U.S. calls for more research as an excuse to delay policy action.

Clearly, the principles of international law are directly related to the acid rain debate. However, the task of coming to terms with such principles is difficult in the domestic political arena, as opposing interests place different values on pollution control.

Chapter 3
BRIEF HISTORY/LEGISLATIVE REVIEW

Introduction

The phenomenon of acidic precipitation has been an elusive environmental problem. Although there has been some understanding of the phenomenon for quite some time, the scope of the problem has gone undetected until quite recently. Scientific understanding of acid rain is by no means complete or, some would argue, conclusive. As an issue with great economic and environmental implications, the "state of science" has been a focal point in the public policy debate. Throughout the period beginning when acid rain was recognized as a widespread problem, through to the present, scientific uncertainties have complicated efforts to combat the problem. These uncertainties and their role throughout the acid rain debate can be best illustrated by looking at some of the legislative efforts, both domestic and bilateral (U.S.-Canada), and the nature of evolving scientific evidence.

History of Scientific Understanding and Early Control Efforts

The term "acid rain" was first utilized by the English chemist Dr. Robert Angus Smith in 1872. Smith had been analyzing the chemical content of precipitation near industrial centers of England for a period of twenty years. In his book Air and Rain: The Beginnings of a Chemical Climatology, he revealed that "the chemistry of the precipitation in various areas depended upon such things as the amount of coal being burned and
the direction the wind was blowing." Thus, Smith was the first to recognize the modification of the chemical composition of precipitation due to man-made emissions.

The second major contributor, Dr. Eville Gorham studied the relationship between changes in the chemistry of precipitation and that of surface waters near industrial centers in Canada and England. It is interesting to note that these writers received little attention for these works, which were widely disregarded by the scientific community. The focal point of these works, however, dealt with local sources of acid rain precursors rather than the more subtle long range transport of such pollutants.

By the late 1960's Scandinavian scientists had undertaken comprehensive studies regarding the effects of acid rain which was suspected in forest decline and lake acidification. Furthermore, these acidification episodes were linked to emissions of sulfur dioxide in Britain and continental Europe. These studies were undertaken at a time of increasing environmental awareness in North America, where the significance of acidic deposition and its effects were being given greater attention. This awareness took root in the United States in the early 1970's.

The Clean Air Act of 1970 is the primary legislation for U.S. national air pollution policy, supplemented by the Clean Air Act Amendments of 1977. Until 1970, control of air pollution was primarily the responsibility of state and local governments. With the 1970 Clean Air Act,

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however, federal standards and enforcement powers were established.

National Ambient Air Quality Standards (NAAQS), requiring that ambient loadings of pollutants be limited to protect public health and welfare, were introduced in the 1970 Clean Air Act. Six particular pollutants were restricted within the legislation, namely: lead, solid particulates, sulfur dioxide, nitrogen oxide, carbon monoxide, and ozone. Individual states were given the responsibility for ensuring that the standards prescribed through NAAQS are met within their jurisdictions through State Implementation Plans (SIP's). Although SO2 and NOx (acid rain precursors) are among those pollutants under control, the methods of control were ultimately to contribute to the process of long range transport of air pollutants (LTRAP).

To meet LAAQS (Local Ambient Air Quality Standards) requirements, coal-fired electricity stations and industrial plants heavily concentrated in the Ohio River Valley erected "tall stacks" in order to disperse pollutants over a larger area. Currently 108 of these 700-1100 foot high "tall stacks" have been erected in the United States since the 1970 Clean Air Act. The main idea behind building these stacks was to increase the atmospheric dilution factor, rendering the pollutants less environmentally damaging. However, at the time of construction, there was not an understanding of the process of conversion of SO2 to sulfuric acids. It has been found that approximately 1% per hour of sulfur dioxide is converted to sulfuric acid in the atmosphere; thus, the longer SO2 is airborne, the greater

the amount is converted into sulfuric acid.  

The concentration of high-sulfur coal mining in the Ohio River Valley, as well as the region's heavy reliance on coal for electrical generating, resulted in the concentration of tall stacks in a limited geographic area. This concentration, affected by similar prevailing weather patterns, inevitably contributed to increased levels of acidic deposition in eastern Canada and the northeastern United States. In effect, the 1970 Clean Air Act increased the occurrence of transboundary pollution, due to the emphasis on ambient concentrations (at a localized level) rather than total loadings of pollutants. These ambient concentrations were measured at ground level, so there was no need to reduce pollutants. Hence, by sending emissions higher in the atmosphere, their long range transport is ensured. Furthermore, by constructing "tall stacks," the resulting increase in atmospheric dilution ensured that actual reductions of emissions were not required. Stronger wind currents in the upper atmosphere culminate in the LRTAP, and subsequently transboundary acid rain.

Within the Clean Air Act, section 115 provides a mechanism for addressing transboundary air pollution. The Secretary of State or the Administrator of the EPA may invoke this provision if it is believed that air pollution from United States is contributing to or causing endangerment to "public health or welfare in a foreign country." With such a provision, it can be assumed that section 115 could have been invoked to address

transboundary acidic deposition. Neither the EPA nor the Secretary of State, however, chose to invoke section 115 in the course of the acid rain debate. This is despite the fact preparations were being made to do so under Administrator Costle (1981) of the Carter Administration. With the inauguration of Ronald Reagan, these efforts would cease.

The issue of local transboundary air pollution was examined by the International Joint Commission in the Detroit-Windsor region, indicating a serious transboundary flow of sulfur dioxide (1973). Consequently, the Ontario and Michigan governments established a system to reduce emissions temporarily on one side of the border when unacceptable air quality had been declared on the other side.

The Canadian government sought to expand this state-provincial agreement to a formalized international agreement, but the Nixon Administration was unwilling to comply with this wish. Michigan and Ontario subsequently implemented their agreement, and requested their respective national governments to have the International Joint Commission monitor the results.

By 1974, Dr. Steven Likens and Dr. John Borman were the first North American scientists to study the link between contaminated precipitation (from LTRAP) and the decline of forests. In the process, they found that nitric and sulfuric acids were increasing the acidity of precipitation at an alarming rate. Thus, they found a strong correlation between modern air pollution (referring to combustion processes) and forest decline.  

In the Canadian-American context, the issue was first formally addressed in 1978 because of a "mutual concern and interest regarding acid rain". The United States-Canada Research Consultation Group was formed in order to study the phenomenon of long range transport of air pollutants (LTRAP). More specifically, its duties were to aid in the coordination of research studies and the exchange of scientific information between the two countries regarding acidic precipitation and its relationship to LTRAP. In its preliminary report (October 1979), the Consultation group "identified acid precipitation as the problem of greatest common concern at the present time."44 In addition, this report also confirmed that the United States sources contributed five more than Canada to transboundary flows.

At this time, Ontario Hydro had proposed to build a coal fired thermal generating station in Atikokan, located in northwestern Ontario near the Minnesota border. The proposed plant was to be without emission controls, sparking protest among environmental groups in Minnesota. John Carroll (1990) asserts that the debate would have been purely between the Ontario/Canadian governments and these local environmentalists had it not been for the effective organization of these groups. These citizens forced a reluctant U.S. government to represent them, although the administration saw potential damages to U.S. interests to be minimal.45

This incident was of great importance to the acid rain debate, as the U.S. Senate passed a rider to the Foreign Relations Authorization Act of 1978 requiring the Department of State to start negotiations for an air quality agreement with Canada. Canada responded by proposing an international

joint agreement on acid rain. Thus, this incident raised the arguments and "set the stage" for the acid rain debate of the 1980's.

At this time the Carter Administration was mandating the use of postcombustion technologies in all new coal-fired stations, regardless of the sulfur content of the fuel. These New Source Performance Standards (NSPS) were outlined in the Clean Air Act Amendment of 1977. Acid rain was recognized by the administration as a domestic and international problem, and research was to be used to facilitate government intervention to resolve it. Thus, research was being used not to delay policy responses, but rather to be undertaken with political measures to address concerns raised by increasing knowledge.

There was, however a seeming contradiction in the Carter Administration's policy. In response to the dependence of the United States on imported oil (and the second "oil shock" of 1979), the administration proposed a $10 billion program designed to convert 107 power plants to coal-fired generating systems. Since these plants were not new sources of emissions, but rather were conversions, the NSPS would not apply. Canadian negotiators were dismayed, as the program would introduce an additional 400,000 tonnes (metric) of sulfur dioxide emissions into the atmosphere.46

In a 1980 statement in the Journal of the Air Pollution Control Association, Raymond M. Robinson (Assistant Deputy Minister, Environmental Protection Service, Canada) stated,

The well established practice of advance notice and consultation between our two countries, on matters of this kind, calls for detailed information sufficient to assess the environmental impact of the options under consideration. ...[T]here does not appear to have been any meaningful attempt to consider the very real impacts of the conversion program on Canada.\textsuperscript{47}

This represents a key argument that would surface in the course of the acid rain debate. Clarkson (1985) pointed out that polluters (in the United States) were distorting the theoretical free market by imposing the ecological costs of industrial activity on another sovereign state. That is, the main dilemma of the Canadians was to persuade the United States to internalize the costs of pollution abatement. \textsuperscript{48} This would prove a difficult task, in view of the scientific uncertainties surrounding the effects of acid rain.\textsuperscript{49}

However, negotiations with the Canadian government proceeded and on August 5, 1980 Canada and the United States signed the Memorandum of Intent (MOI) on Acid Rain. The purpose of the agreement was to:

\textsuperscript{47} Quoted from reprint of article by Ramond M. Robinson, former Assistant Deputy Minister of the Environmental Protection Service of Environment Canada, entitled, "Acid Rain Canada, and the Coal Conversion Program", from the May 1980 issue of the Journal of the Air Pollution Control Association. Reprint series entitled: Insight From the Policy Makers.

\textsuperscript{48} Clarkson, 1986. p. 185.

\textsuperscript{49} An externality is a cost or benefit arising from an economic transaction that falls on a third party and that is not taken into account by those who undertake the transaction. Source: Michael Parkin, Economics (New York: Addison-Wesley, 1990). p. 504. Sulfur dioxide emissions, originating in the midwest and deposited in the northeast U.S. and eastern Canada constitutes an externality, as the costs are not absorbed by those receiving the benefits of power generation. Therefore, the externality of acid rain constitutes a market failure.
1. develop a bilateral agreement which will reflect and further the development of domestic control programs and other measures to control transboundary air pollution.
2. to facilitate the conclusion of such an agreement as soon as possible.
3. pending conclusion of such an agreement, to take interim actions available under current authority to combat transboundary pollution

The MOI also included a framework for establishing five bilateral working groups to provide scientific and technical advice to the Coordinating Committee. Along with the MOI, the federal government passed the Acid Precipitation Act of 1980, which represented the first federal attempt to address the issue of acid rain in a focused manner. Furthermore, the Act formulated the Interagency Task Force on Acid Rain, whose purpose was to develop a comprehensive research program on acid rain, the National Acid Precipitation Assessment Program (NAPAP),

Seemingly, the United States was embarking in two different directions regarding acid rain control.

It is important to note that at this time there was strong opposition to reducing emissions in the United States. This resistance was due to the regional impact that emission controls would have on the Midwest, by a) requiring the installation of expensive pollution control devices, and b) having negative implications for high sulfur coal mining in the region. Gaps in scientific knowledge were used to justify delaying any immediate mandate of emission controls, as illustrated by Representative Joe Rahall's (D-WV) testimony before Congress in 1981:

The scientific community has yet to reach consensus on the atmospheric conversion of acid precipitation precursors and the long range transport of sulfates and nitrates...There presently exists no credible body of evidence to support immediate and costly new controls...in an effort to reduce occurrences of acidic precipitation.51

This view was supported by the Reagan Administration as it took office in January, 1981. The gaps in complete scientific understanding of acidic precipitation were the justification for delaying any policy action regarding acid rain. The new emphasis was in the interest of industry, and the deregulation efforts of the Reagan Administration were pursued further. In calling for the phenomenon of acid rain to be better understood through scientific study, the Reagan Administration appeared (at least briefly) to be moving ahead with the issue. As Dickinson (1984) describes:

Those either opposing new regulations or seeking to have existing ones weakened have done so by challenging their scientific rationality. Demands from industry are made for "proof" and "certainty" of environmental or health damage before regulations are introduced for new technologies. A detailed description of the relationship between "cause" and "effect" is said to be necessary before any action is taken against the former in order to prevent the latter. Corporate lobbyists contend that scientific questions should be answered before any regulatory action is taken; if only partial answers are available, then regulations should be based upon scientific judgments. In a growing number of ways, an appeal to "scientific" rather than "political" judgement has become the touchstone separating "good" from "bad" regulation.52

Thus, in the pursuit of deregulation of industry, the Reagan Administration devoted significant resources to studying acid rain rather than enacting new control measures. This course could be legitimized as long as there was no consensus within the scientific community. However, as scientific evidence accumulated, this course of action eventually began to undermine efforts to delay taking action on acid rain.

The Canadian government was convinced that there was sufficient evidence to justify reducing emissions of acid rain precursors. With more at risk than their American counterparts, this position is understandable on the part of the Canadians. As John Carroll reminds us, Canada had become the complainant in the acid rain debate for some very convincing reasons:

a) Canada is one of the most vulnerable nations on earth to the effects of acidic deposition, in both aquatic and terrestrial environments. The U.S. is quite the opposite, or at least perceives itself to be (which is the same thing in politics). For these reasons of differences in vulnerability, the people of the U.S. are significantly less aware and less interested in acid rain and its possible effects than are their Canadian neighbors, and because many Americans across a vast portion of the country are also dependent on the problem-causing gaseous emissions for the sustenance

b) A second factor underlying Canada's complaint is the imbalance of the pollutants moving back and forth across the border. Although each nation contributes to the other's acidity, the U.S. is responsible for at least 50 percent of Canada's total acid deposition, spread over a vast area, while Canada is responsible for less than 20 percent of U.S. acidic deposition, and this is largely restricted to Northern New York and New England. 53

Furthermore, Carroll points out that the Canadian population is

more aware of the problem due to these imbalances, as well as the heavy reliance on forest products in their economy. The Canadians, therefore, were more able to generate more grass-roots support for acid rain control than their American counterparts.

Advocates of control faced a hostile political climate in the United States in the early 1980's. The Reagan Administration replaced the top levels of the Environmental Protection Agency (EPA) with supporters of their deregulatory policies. In addition, the agency's budget declined 26 percent from fiscal year 1981 to 1983, with a staffing cutback of nearly 24 percent. According to Don Munton (1982), these developments marked a striking departure from the agency's traditional role. "The present crop is loyal, firm, and even aggressive in its pursuit of deregulation and government withdrawal from pollution control and research." This philosophical commitment to deregulation lent credibility to assertions that the Reagan Administration was using gaps in the scientific certainty of acid rain to legitimize its preconceived political agenda.

The position of the EPA (and the Reagan Administration) can be effectively summarized by Kathleen M. Bennet's testimony on October 29, 1981 before the Committee on Environment and Public Works:

Any Administration action must be based upon a reasonable degree of certainty that it will, in fact, accomplish its intended purpose. The American people have the right to expect that their government will not impose an additional multi-billion dollar program without first determining some assurance that the intended environmental benefits will be achieved. In this case, quick and simple solutions are unlikely. Given the length of time it has taken to recognize the

54 Quoted in: Clarkson, 1986.

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magnitude and complexity of the problem and the many fundamental questions that remain to be unanswered, Congress wisely authorized a comprehensive research program. 55

Stated simply, the argument was that further scientific understanding is essential in order to assure that control measures would be effective from a cost-benefit analysis perspective. The research program that Ms. Bennet referred to was the National Acid Precipitation Assessment Program, established within the Acid Precipitation Act of 1980.

With the advent of the Reagan Administration acid rain negotiations had come to a standstill. Negotiations were held in June and November 1981, and then in February and June 1982, with few results. In the February session, Canada made the first formal proposal calling for each nation to reduce emissions by 50 percent. The proposal was rejected, prompting Environment Minister John Roberts to state, "The implication of this stick-in-the-mud stance of the Americans is that we have to ask ourselves whether it makes any sense to have officials flying back and forth." 56 Negotiations collapsed on June 15, 1982 due to the refusal of the United States to take specific remedial action.

In an address before the Stockholm Conference on Acidification of the Environment, Kathleen Bennent made the following observations:

Since 1970, we have reduced sulfur dioxide emissions

55 Statement of Kathleen M. Bennet, Assistant Administrator for Air, Noise, and Radiation, United States Environmental Protection Agency, Before the Senate Committee on Environment and Public Works, United States Senate (October 29, 1981).
56 Bennet, 1981.
by 15%, in spite of significant industrial growth. Sulfur dioxide emissions in the United States would be nearly 58% higher today in the absence of environmental controls. These reductions have been achieved, in part, by the installation of 88 operational scrubber units on U.S. power plants which produce 33,000 megawatts of electrical generating capacity. By the year 2000, it is estimated that the emissions of 50% of all coal-fired electrical generating capacity will be scrubbed. Approximately four billion dollars has already been spent in the installation of these operational scrubbers. The requirement that all new power plants install scrubbers will drive consumer costs for electricity higher. Nevertheless, from the mid-1970's SO2 emissions of utilities in our 10 largest emitting states have dropped by nearly five million tons, and states thought to contribute transboundary emissions to our friends to the north have significantly reduced sulfur dioxide emissions over the last 10 years.57

In addition, Ms. Bennet noted that NOx emissions from automobiles was 90% below the levels of once uncontrolled vehicles. By emphasizing reductions in SO2 emissions that occurred since the 1970's, the underlying message was that emissions would continue to fall as a function of market factors. That is, since the Clean Air Act went into effect, New Source Performance Standards have required that new sources of SO2 emissions install effective emission-scrubbing systems. Over a period of time, it was argued, older plants would be replaced by new, cleaner plants. This progression would ideally reduce outputs of SO2 without further control measures. The shortcoming of this interpretation was that utility companies were extending the useful lives of older facilities in order to avoid the tremendous costs associated with building new facilities. Additionally, part of the reductions claimed were in fact attributable to an


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economic downturn which reduced demand for electricity.

By February 1983 the reports of the working groups established within the MOI were released. The Canadian team claimed that the "acceptable" level of acidic deposition is 20 kg/hectare/year; this is necessary to protect sensitive ecosystems. Further, they asserted that this level of deposition could only be reached by reducing emissions by 50 percent in both the United States and Canada. The National Academy of Science in 1983 found that continued emissions of SO2 and NOx "at current or accelerated levels" posed clear evidence of "serious hazards to human health." These findings were for the most part ignored by the Reagan Administration, as the U.S. continued to refuse further mandatory reductions in emissions.

Throughout this period, the Canadian government had taken an adversarial stance within the United States, using public relations techniques to stress the damage that was being done to Canada. For example, in his address to the Air Pollution Control Association, Canada's Environment Minister John Roberts said,

Stated very bluntly, I see no reason why Canada's ecosystems, let me be blunter yet, Canada's people, tourist camp operators, fishing guides, commercial fishermen, loggers, other forest products workers, building owners and tenants and possibly our asthmatics or others with respiratory illness, should have to pay the price of keeping the electricity rates of those coal-producing middle-western states well below those being paid along the United States' eastern seaboard.59

This is merely one example of the intense Canadian effort to

influence U.S. domestic policy, an effort that encompassed lobbying, media campaigns, and grass roots activism. However, these aggressive tactics were later viewed as a tactical error, as Canada was emphasizing damage to its territory, rather than damage to portions of the United States. Consequently, the Canadians "found out that they [the United States] were not particularly interested in what they were doing to us." 60 These efforts were further complicated by the lack of consensus within the scientific community regarding the causes and effects of acid rain.

In 1983, there were two meetings between Secretary of State George Schultz and External Affairs Minister Allan MacEachen. These meetings accomplished little other than the exchange of scientific information between the two governments. In May 1983, however, there was increasing optimism regarding the resolution of the issue, as William D. Ruckelhaus replaced Anne Burford as administrator of the EPA.

Under directions from the Reagan Administration, the issue of acid rain was to be the top priority for the new administrator. Funding for scientific research on acid rain was subsequently doubled, while other EPA programs were scaled back. Throughout the remainder of 1983, Ruckelhaus sought to devise a strategy that would reduce emissions while retaining support from a coalition of interests. His resulting strategy, however, was met with opposition from the Cabinet Council of Natural Resources. Budget Director David Stockman and Energy Secretary Donald Hodel opposed further controls because they feared Ruckelhaus' proposal would be too costly to electric power companies and their rate payers.

Afterwards, in hearings before the Senate Committee on Environment and Public Works, Ruckelhaus backed off, and affirmed his support for the administration's position. He later stated that a SO2 reduction program would have to meet the following criteria: a) improved information on what new controls would accomplish, b) a reasonable consensus among the most affected parties, and c) a system for sharing the cost of controls by the entire nation. This position was restated by Ronald Reagan in his 1984 State of the Union Address, in which he reaffirmed the U.S.'s "research before action" strategy. Clearly, gaps in scientific knowledge were providing a legitimizing function for the delay of control measures.

In fact, between fiscal years 1981 and 1983, research funding for acid deposition increased by nearly 70%, for a three year total of $64.5 million in new funds. This position was still fundamentally objected to by the Canadians, who favored immediate action rather than further research and rhetoric. The Canadian government's position is effectively summarized by the following statement, taken from "Acid Rain: A Canadian and International Perspective", a background paper for Parliamentarians:

The Government of Canada considers acid rain to be one of the most serious environmental threats ever to confront this country...continued acidic deposition could measurably reduce Canadian forest production within 50 years...(the federal) government has reached an agreement with the provinces east of Saskatchewan that states that the amount of acid deposition should be reduced to 20 kilograms per hectare per year of wet sulfate...In order to achieve this level, a 50% reduction east of the Manitoba-Saskatchewan border, and east of the Mississippi River in the United States, is required. Although Canada is willing to commit itself to

61 William Ruckelhaus, Testimony Before the Senate Committee on Environment and Public Works.
achieving this goal by 1990, this commitment is contingent upon parallel action in the United States. 62

Thus, the Canadians in 1983 were committed to delaying their policy of acid rain controls until similar measures were adopted in the United States. However, this position was not maintained for an extended period of time, because opponents of legislative restriction in the United States were quick to point out weaknesses in Canadian clean air legislation.

In 1983 there were no operational scrubbers in Canada, and vehicle emission standards were not as stringent as those in the United States. In terms of NOx emissions, without stricter controls Canadians projected a rise of 70% by the year 2000, compared with a projected 15% rise in U.S. emissions over the same period of time. 63

By 1984, the Canadian government found itself in a difficult position. In order to achieve an "acceptable" rate of deposition in the eastern provinces, U.S. reciprocity was necessary. The federal government, therefore required provincial participation for a national program, and the provinces were unable to bargain for U.S. reciprocity without the leadership of the federal government. Everett Cataldo (1990) argued that these were the mutually reinforcing incentives that provided the basis for a Canadian Acid Rain Control Program. 64

Due to the weaknesses in Canadian policy, as well as the

unwillingness of the U.S. government to mandate emission reductions, the Canadian government was faced with essentially three choices. Cataldo lists them as such: a) retreat (not politically possible), b) continue to hammer away at the United States, or c) resolve its own domestic impasse.65

Canada opted for a combination of the last two: Political persuasion efforts continued in the United States and acid rain was brought to the top of Ottawa's domestic political agenda. Efforts to control acidic deposition were concentrated in the provinces east of the Manitoba-Saskatchewan border.66 Subsequently, on March 5, 1985 Suzanne Blais-Grenier (Minister of the Environment) announced the Canadian Acid Precipitation Abatement Program. In her announcement, she stated:

We [Canada] are the first country to set an acid rain policy based upon achieving a specific environmental objective. The 50% reduction by 1994 of sulfur dioxide emissions in eastern Canada is the largest tonnage cut-back for acid rain of any nation. Our new motor vehicle emission standards are as tough as any other national standards and tougher than most...in short, it is the most ambitious environmental program that this country has ever put forward and one that is not equalled anywhere.67

The Canadian program relies primarily upon the control and reduction of emissions from a small number of large polluters. The primary source of Canadian sulfur dioxide emissions is non-ferrous ore smelters, located in Ontario and Quebec. Under the new agreement, provinces are

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65 Efforts were concentrated in this region as acid rain is deposited here in much greater quantities than elsewhere in Canada, and the buffering capacities of this area (acid tolerance) is small.
required to reduce SO2 emissions to meet an aggregate total of 2.3 million tonnes per year by 1994. The federal-provincial program further requires that the provinces be responsible for intra-provincial pollution, with the federal government having jurisdiction over extra-provincial pollution. In short, the role of the federal government is to coordinate the program, seek international agreement with the United States, and assist in the funding of ore smelter emission reduction.68

The controls mandated in the Canadian program were alone not sufficient to control deposition to an "acceptable" degree, so the need for U.S. controls was still present. By adopting their own control strategy however, the Canadians demonstrated the resolve necessary to continue efforts designed to achieve parallel action by the United States.

The Canadian program brought mixed reviews in the United States. Many viewed the controls as an initiative to control acid deposition in the light of U.S. inaction. Others viewed them as merely "catching up" to U.S. air pollution standards, claiming that, "the new standards for automobiles and light-duty trucks will be equivalent to current U.S. standards for similar vehicles."69 However, the U.S. Congressional Research report conceded that the Canadian Program went beyond U.S. efforts to control acid rain as it reduced the gross loadings of SO2 on a specific schedule, while no similar program was in effect in the United States.


Yet, a closer look at the Canadian Acid Rain Control Program reveals that the projection of a 50 percent sulfur dioxide reduction is somewhat deceptive. The base year for emissions was 1980, in which there were 4,516,000 allowable tons of SO2 emissions in eastern Canada. In fact, 1984 emissions were approximately 3.2 million tonnes. The 1994 target emission was announced as 2,619,000 tonnes, resulting in an actual emission reduction of only 581,000 tonnes from emissions at the time of the Program's announcement. The 1994 allowable levels, however, were strengthened in 1987 by another 144,000 tonnes in mandated reductions. Despite this improvement, the Canadian Acid Rain Control Program will effectively reduce sulfur dioxide emission by only 35 percent rather than the 50 percent claimed. This demonstrates that both parties in the acid rain debate are guilty of politicizing scientific data to support their political agenda.

On the diplomatic front, Ronald Reagan and Brian Mulroney met in Ottawa in March 1985 at the so-called "Shamrock Summit." In relation to the acid rain debate, each head of state agreed to appoint a Special Envoy to examine the issue and report before the spring of 1986. This was the first time that such a bilateral investigation team (appointed by each government) was to review jointly the acid rain issue. Further, the Envoys were assigned the four following tasks:

1. to pursue consultation on laws and regulations related to pollutants thought to be linked to acid rain;

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70 Figures taken from: "Progress Report: Canada's Acid Rain Control Program", "Canada's Acid Rain Control Program: Catching up or Pulling Away". Note: A true fifty percent reduction will be made by 1994 using 1980 allowable (rather than actual) emission data.
2. to enhance co-operation in research efforts, including research on clean fuel technology and smelter control;
3. to pursue means to increase exchange of relevant scientific information;
4. to identify efforts to improve the U.S. and Canadian environments;\footnote{Lewis and Davis, 1986. p. 3.}

The report, in its executive summary, stated that the two most important things that the envoys learned were that:

1. Acid rain is a serious environmental problem in both the United States and Canada. Acidic emissions through the atmosphere undoubtedly are contributing to the acidification of sensitive areas in both countries cross their mutual border, thus causing a diplomatic as well as an environmental problem;
2. Acid rain is a serious transboundary problem. Air pollutants emitted by sources in both countries cross their mutual border, thus causing a diplomatic as well as an environmental problem.\footnote{Lewis and Davis, 1986. p. 4.}

Furthermore, the envoys stated that at the present time there are only a limited number of potential avenues for achieving major reductions in acidic air emissions, and that all of these carried a high socio-economic cost. The Canadian government's main criticism of the report was that it did not recommend a cleanup program. Instead, the report recommended a $5 billion expenditure (in U.S. funds) over five years to research more efficient technologies by which U.S. power plants might burn coal, the major source of Canada's acid rain.\footnote{Lewis and Davis, 1986. p. 6.}

Critics of the report maintained that the technologies already existed for burning coal more cleanly, and that these funds would be more
properly appropriated for control measures rather than research. But in calling for more research, the report was consistent with the views of the current U.S. administration. Consequently, Ronald Reagan gave his full endorsement to the Report of the Special Envoys in March 1986 at the conclusion of his meetings with Brian Mulroney.

Other scientific reports were, however, affirming the causal relationship between acidification and SO2 emissions. In March 1986, the National Research Council of the U.S. National Academy of Sciences released a study conducted by U.S. and Canadian scientists. The study concluded that "there is a causal relationship in eastern North America between SO2 emissions and and the wet deposition of sulfate and the progressive acidification of lakes and streams." Increasingly, the scientific community was developing consensus on the causes and effects of acid rain. Although the Reagan Administration's strategy of delaying policy action until the scientific community reached consensus was being undermined, there were to be continuing illustrations of the interaction of science and politics.

In 1987, the Interim Report of the National Acid Precipitation Assessment Program was released amidst charges of politicization. That is, the report's executive summary was criticized within the scientific communities in the United States and Canada for being misleading and flawed, and containing misrepresentations in its conclusions. The executive summary can be summarized in the following five points:

1. The effects of acid rain are neither widespread nor

serious;
2. The will be no abrupt changes in the effects of acid rain for
the next several decades;
3. Emission levels of sulfur dioxide have been nearly
constant since the 1920's, are currently stable, and will
decrease substantially over the next three to four decades
through the application of new technologies to market
forces;
4. The effects of acid rain are less than were anticipated ten
years ago;
5. Sufficient uncertainties remain to preclude
determining whether abatement action is needed or the
nature of that action; 75

Many felt that the NAPAP executive summary was written to
reflect the administration's preconceived policy agenda, rather than
accurately represent the entire body of data generated by the program. The
Canadian government issued a critique of the NAPAP Interim Assessment
Report, indicating specific dissatisfactions with its content. For example, in
the NAPAP study, the pH level of an aquatic ecosystem considered to be
acidified was 5.0. The Canadian report took issue with this level, as species
decline due to acidification "occur near pH 6.0, with many species
disappearing in the range pH 6.0 to 5.0." 76

Therefore, a pH level of 6.0 was considered a more appropriate
threshold level of acidity. If this level was used in the NAPAP study, a
much larger number of aquatic ecosystems would have been considered
damaged. The NAPAP study also ignored the fact that patterns of U.S.
emissions had changed substantially due to the use of "tall stacks," which

75 Canada. Federal/Provincial Research and Monitoring Committee.
"A Critique of the U.S. National Acid Precipitation Program Interim
disperse pollutants over a large geographic area. The result from this change in emission patterns is increased acidic deposition over eastern Canada and the northeastern United States. The executive summary makes no mention of this fact, one which is paramount in the transboundary nature of the issue.

In general, the NAPAP Interim Assessment Report was described as appearing to be designed to support the preconceived policy position that no further control action was warranted. This was accomplished through the selective use of the total North American information base and through inaccuracies in the interpretations of data in the Executive Summary. Subsequently, the Canadian Minister of the Environment described the document as "flawed, incomplete and misleading," and "out of step with prevailing scientific judgement and expert opinion," although he did not imply any a direct involvement by the Reagan Administration. Environment Minister MacMillian took a more diplomatic approach:

I do not think there is any kind of conspiracy to cook the evidence among all of the different agencies within the U.S. government which participated in the NAPAP report. Something was lost between the time the main body of the report was prepared and the executive summary was produced. Who is the culprit? Who took the scientific evidence so selectively when it came to preparing the executive summary? We take issue with some facets of the broader study, especially its incompleteness, but we think it is basically sound science as far as it goes.78

The main concern for the Canadian government was outlined in the 1988 Report of the Special Committee of Acid Rain. The Committee was originally established in June, 1985, and re-established in October, 1986 due to "the recognition of the seriousness that this pollutant [acid rain] poses for the Canadian environment and the need for a determined effort for all Members of Parliament to work toward a solution." The major concern was that the Interim Assessment of NAPAP would be used by members of Congress or the next administration to "support acid rain policies inimical to Canada's interests". The Committee stopped short of trying to identify effective political control over the Interim Assessment, as they felt that this would be a moot point and impossible to verify.

On the diplomatic front, efforts were continuing in order to persuade the United States to set new emission controls. In an address before the U.S. Congress in 1988, Prime Minister Brian Mulroney continued efforts to persuade Congress to break the impasse in acid rain policy. He linked Canada's Acid Rain Control Program with incentives for action in the U.S.:

We acknowledge responsibility for some of the acid rain that falls in the United States, and by the time our program reaches projected targets, our export of acid rain to the United States will have been cut an amount in excess of 50 percent. We ask nothing more than this, in return, from you ... We invite the Administration, and the Leadership of Congress, to conclude an accord whereby we agree on a schedule and targets for reducing acid rain that crosses our border. The cost of reducing acid rain is substantial, but the cost of inaction is

greater still. 81

In a position paper widely disseminated by the Canadian embassy in Washington D.C., the Canadian government supported this desire for an international accord. Their rationale for striking an accord with the United States can be summarized as follows: Acid rain is an international, transboundary issue rather than two parallel national problems and effective policy is predicated on action taken in both nations. Such an accord would:

... confirm and define each country's obligations vis-a-vis the other, as a matter of international law, as from incidental treatment of Canadian concerns under United States law ... and ... facilitate coordination national and joint research efforts and provide for dispute settlement measures ... and ... establish standards by which to measure the performance of each party. 82

There would be no movement on the diplomatic front, however, until the inauguration of President George Bush. In his campaign, Bush promised action on the environmental agenda, including revisions to the Clean Air Act with specific acid rain controls.


82 Embassy of Canada. “Acid Rain: The Need For An Accord” (Ottawa: Department of External Affairs, 1989). Note: This document was sent out by the Public Affairs Division of the Embassy with all information requests, regardless of information requested. (Source of this information: personal internship at the Embassy of Canada, Summer 1989)
Chapter 4

THE BREAK IN THE IMPASSE: U.S. CLEAN AIR ACT REVISIONS AND THE ACID RAIN ACCORD

U.S. Clean Air Act Revisions

Shortly after the inauguration of George Bush as president of the United States, a diplomatic visit to Canada foreshadowed activity on the U.S. policy agenda regarding acid rain. Although no specific reductions were proposed, the issue had been placed at the top of outstanding bilateral issues on the part of the United States. In the words of George Bush,

I think the Prime Minister is aware of the political divisions and political waves there are in our country on this issue. But I assured him that the time for pure study is over, and that we've now approached the time for legislative action...and discussions with Canada, [in order to negotiate] an accord that I think will be beneficial to both countries.83

This statement marked the first clear commitment from the United States to address the acid rain issue with direct legislative efforts. In response, Prime Minister Brian Mulroney stated,

I think that this represents quite substantial progress. It wasn't so long ago that Canada was sort of going it alone in many ways domestically in the United States, which is a condition precedent, and the President is signaling, as well, subsequent discussions that will lead to an acid rain accord to benefit both the United States and Canada.84

The negotiation of a bilateral accord had long been an objective

84 United States. Department of State, 1989. p. 27.
of the Canadian government to assure that emission reductions were an international obligation rather than a domestic policy issue. The statements by Bush and Mulroney both confirmed that such an accord would eventually be negotiated, after legislative progress had been made in the United States. This two-pronged approach marked a clear departure in the U.S. government attitude toward the issue of acid rain.

On June 12, 1989 President George Bush proposed amendments to the Clean Air Act, including specific acid rain controls. This action marked a break in the political impasse which had impeded Clean Air Act revisions since 1981, namely, policies of the Reagan Administration. The Bush Administration's bill (H.R. 3030 and S. 1490) was introduced in the Senate by Senator John Chaffe (R-RI) and in the House of Representatives by Energy and Commerce Committee Chairman John Dingel (D-MI).

The new acid rain controls are designed to achieve a true 10 million ton reduction in sulfur dioxide emissions by the year 2000, using 1980 as a base year. Nitrogen oxide emissions are scheduled to be reduced by 2 million tons from projected 2000 levels, and 2.5 million tons from projected 2010 levels. By requiring new pollution sources to be offset by reductions from existing sources, the reductions are designed to remain permanent. 85

The Senate Subcommittee on Environmental Protection wrote up three separate bills delineating the revisions into the following categories: S.816 on air toxics (submitted by Senator Durenburger, R-MN), S.1630 on nonattainment and mobile source control (submitted by Senator Baucus, D-MT), and an acid rain proposal (proposed by Senators Baucus and Mitchell D-ME). These three proposals were packaged together and submitted as S.1630 on November 16, 1989.

The Clean Air Act amendments added a new title to the Clean Air Act, i.e., Title V--Acid Deposition Control, consisting of new sections 501 to 515. The purposes of this section were outlined in section 501, which stated that "emissions of sulfur dioxide and nitrogen oxides are being transformed into acidic deposition that represent a threat to natural resources, ecosystems, materials, visibility, and health."86 This marked the first recognition of acid rain in clean air legislation.

Of the 10 million ton SO2 reduction, nine million tons are to be from electric utilities, with the remaining one million from non-electrical sources. However, the initial proposal states that "most models suggest that the one million tons from non-industrial sources has already [emphasis added] been achieved since 1980."87 In effect, the SO2 reductions called for amount to 9 million tons in actual "new" reductions.

The reductions are to be attained in two phases, beginning on January 1, 1995 and December 31, 1999 respectively. In phase I, 111 of the

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heaviest SO2 emitters located in 21 states (primarily in the midwestern U.S.), are required to reduce emissions to prescribed levels beginning January 1, 1995. The plants listed in phase I emit sulfur dioxide at a rate above 2.5 pounds per million British thermal units. When phase I is completed, each of these plants must reduce their emissions to a level equal to 2.5 lbs./mmBtu multiplied by its average 1985 to 1987 fuel consumption. This phase, by reducing emissions in a concentrated geographic area, is intended to reduce the occurrence of LTRAP in the northeastern U.S. and eastern Canada. By the end of phase I, the Canadian government has estimated that transboundary flows will be reduced by 25%, and 50% by the end of phase II.

The second phase, beginning in 2000, is designed to maintain a permanent cap on SO2 emissions of 8.9 million tons/year. Beginning January 1, 2000, large utility plants emitting at a rate above 1.2 lbs./mmBtu must reduce emissions to levels equaling 1.2 lbs./mmBtu multiplied by their average fuel consumption in the 1985-87 period. Smaller units will have their emission rates determined by a series of formulas that vary with plant size.

The Clean Air Act revisions also establish an emissions trading system, whereby utilities are allotted allowances to emit sulfur dioxide. Each allowance would constitute a federal permit to emit one ton of SO2 for the year. Utilities will be permitted to trade allowances among each other, or bank excess allowances for future use. In the event that a utility exceeds the allowances it holds (in actual emissions), a penalty of $2,000 per excess ton of SO2 will be assessed, and the utility must offset the excess emissions in the
following year. 88

This provision has provoked a measure of concern from many Canadian critics. Sheila Copps of the Liberal Party expressed concern over "pollution being a commodity that can be bought and sold", and asked what would result "if a company close to the Canadian border decides they want to evade regulations by purchasing a permit to pollute." 89 This reflects the concern that "dirty" states, such as Indiana, would purchase allowances from "clean" states located further away from the border. This is a potential weakness of the emissions trading system, although Phase I plants will be required to meet emission standards before the trading system goes into effect.

Officials of the Canadian government expressed less concern, as illustrated by Environment Minister Bouchard's remarks: "We think that the economics of it [emissions trading] will play in our favor because most of the pollution crossing the border comes from plants that are the most outdated ... so the area where a dollar will be the most cost-efficient will be in those places." 90

The emission reduction requirements prescribed by the Clean Air Act revisions, however, will not go into effect until 1995 for the 110 worst polluters, and not until 2000 for the majority of utility companies in

the United States. This is one of the major weaknesses of the Clean Air Act revisions; there is little incentive for utilities to reduce emissions until the SO2 cap of 8.9 million tons/year takes effect in 2000. Essentially, this ensures continued deposition exceeding "acceptable" levels (deemed 18 lbs./acre/year) to sensitive ecosystems in the United States and Canada for another decade.

The danger associated with the extended timeframe for implementation is the irreversibility of acid overload in an affected ecosystem. That is, once the neutralizing capacity of an ecosystem has been exceeded ("used up"), it is not possible for the affected area to recover naturally. Thus, ecosystems that are subjected to continued deposition and exceed their assimilative capacities in the 1990's will be severely damaged. Although the extent of this threat is impossible to determine, it does illustrate one fundamental weakness in the new clean air legislation. This delay could have been partially compensated for by initiating liming programs in susceptible aquatic ecosystems until deposition reached tolerable levels. However, no such program exists in either the United States or Canada.

Nitrogen Oxides and Evolving Scientific Understanding

In the area of nitrogen oxides, there appear to be critical shortcomings in both our understanding of their effects and our attempts to control their emission into the atmosphere. The U.S. Clean Air Act amendments call for a 2 million ton reduction in NOx emissions, based upon projected emissions for 2000. That is, 2000 was chosen as the baseline year for calculating allowances, by which time it is estimated that there
will be a 2 million ton increase in emissions over current levels. Thus, the Clean Air Act Amendments provision for NOx emission reduction effectively amounts to a freeze at current levels. Emission patterns are expected to change (from industrial sources to automobiles) but no actual reductions are expected or prescribed. This has sparked concern within the scientific community as expressed by John Flynn:

"We passed an emissions bill based upon the tolerance of lakes and streams that we've understood since 1980. We now have to take a whole new look because we ended our acid rain research programs before we determined the tolerance levels of sensitive forests ... It's a real thing. There is no inorganic buffer for nitrogen, whose retention mechanisms (in the soils) are generally controlled by biological processes, whereas sulfurs are controlled by chemical reactions."\(^91\)

The significance of this cannot be understated. The danger presented by the accumulation of nitrogen in sensitive forest systems is the critical issue. According to this interpretation, all legislation addressing acid rain control is based upon the understanding of aquatic ecosystems, as evidenced by announced 50 percent sulfur dioxide levels of reductions in Canada and the United States. These levels of reduction have been proposed by the Canadians since 1980, with the understanding that most North American aquatic ecosystems would be protected (based upon 18 lbs./acre/yr. deposition of sulfate). However, as Flynn points out,

Nitrogen, while considered secondary to sulfur in eastern freshwater acidification, is now believed to have more serious short and long-term consequences in forests. U.S. scientists have come to understand in the past year that long-term nutrient loss is promoted by nitrogen deposition and is followed by the decline and mortality

that is being detected over an ever-widening area.92

Throughout the acid rain debate, the major source of discussion was lake acidification as measured by the direct linkages that were established between deposition and its effects. The very complexity of the soil and forest ecosystems makes isolating the effects of soil acidification difficult. By 1987, however, many scientists were calling for more emphasis on nitrogen oxide reduction rather than sulfur dioxide reduction. The journal Science was the first to do so, linking nitrogen oxide with the formation of ozone and their combined damaging effects on vegetation growth.93 Further, in a 1989 report in the journal BioScience, John Abner and others defined the risks posed by nitrogen saturation, defined as the availability of ammonium and nitrate in excess of the total combined plant and microbial nutritional demand, or, in other words, excess nitrogen deposited within a forested ecosystem that is taken up and utilized as a nutrient.94 This study concluded that excess nitrogen content in foliage hinders frost hardiness of spruce, as well as causing increased cation leaching from soil which reduces soil fertility and increases soil acidity. Furthermore, the BioScience report went on to say:

It is time to consider the nitrogen component as at least as serious an environmental threat as sulfate. This perspective should be applied to both the acid deposition research program and the development of acid-deposition control strategies. [emphasis

93 The major effect of ozone on forests is the reduction of net photosynthesis as a linear function of total dose (hours x concentration). Source: John Abner et al., 1989. p. 379.
It must be noted that there is not a scientific consensus on this issue. This is clearly illustrated by excerpts from an article by Edward C. Krug published in the spring of 1990 in the conservative journal *Policy Review*:

Recent research, however, suggests that acid rain has little or nothing to do with these problems [lake acidification]. Surveys of lakes in New England and New York show much less acidity than anticipated, while other studies show that acid rain has very little effect on surface water acidity. Perhaps most intriguing, studies of fossil records in lake sediments reveal that many lakes that are acidic today have been highly acidic for centuries, except for several decades in the late 19th century and early 20th century when they were unnaturally alkaline.96

Krug goes on to argue that the fluctuating acidity of lakes in the northeast is due to the cutting and burning of surrounding forest areas, rendering the soil more alkaline. After the forests have grown back, he argues, the soil and lakes have returned to their naturally acidic levels. Regarding concerns of high altitude forest damage, Krug is dismissive, arguing that "these forests make up a fraction of 1 percent of eastern forests, and even here, the influence of acid rain is uncertain."97 Furthermore, he argues that NOx emissions are unimportant, as all of the nitric acid deposited is absorbed as a nutrient in forest ecosystems. It is interesting to note that this author excludes any connection between NOx emissions and the formation of ground level ozone, despite the fact in areas adjacent to the Ohio River Valley deposition levels exceed absorption by two to four

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97 Krug, 1990. p. 44.
times. 98

These conflicting opinions illustrate the evolving nature of scientific information, and the fact that even as information evolves, consensus is not necessarily reached.

**The Acid Rain Accord Canada-United States**

The Acid Rain Accord, long sought by Canada, was finally signed on the 13th of March, 1991. The bilateral agreement contains agreements to reduce acid rain emissions, as well as to codify the principle that countries are responsible for the effects of their air pollution upon one another. In addition, both nations are required to notify each other of activities that may cause significant transboundary air pollution, and report publicly on progress being made in addressing transboundary pollution issues. The agreement also provides for a dispute settlement mechanism for matters associated with transboundary air pollution.

Disputes are to be settled through one of four procedures: 1) negotiation between the parties; 2-3) submission to the International Joint Commission under Article IX or X of the Boundary Waters Treaty; and 4) if none of the previous options are chosen or sufficient, referral to another agreed form of dispute resolution. 99

Article IX of the Boundary Waters Treaty instructs the Commission to investigate referrals, and to “make a joint report to both [parties] in which all or a majority of the Commissioners agree.” The report of the Commission,

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98 Flynn, 1991, p. 32.

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however, is "not ... regarded as decisions of the questions or matters so submitted either on the facts of the law, and shall in no way have the character of an arbitral award." This article, in effect, assigned the investigative function of the Commission and is not intended to settle disputes. Article X, however, assigns arbitration power to the Commission when referred to by consent of both parties. It is interesting to note that the parties may refer any dispute to another agreed form of settlement without referral to the IJC. This illustrates a limit to the utilization of the IJC, whose role has been altered profoundly in the context of Canada-U.S. environmental relations.

A closer look at the acid rain annexes to the accord reveal that no further emission reductions are scheduled, but rather the reductions listed are those committed to under both countries' domestic legislation. Further, the accord does not necessarily bind either government to compliance, as an accord is not ratified by the United States Senate but is rather an executive agreement. In the words of Canadian Ambassador Derek Burney, "There's nothing preventing any country from breaking an international agreement at any point in time, so it's not fool-proof insurance." The accord is, however, a formal recognition of acid rain as a transboundary problem and through it the United States does give the Canadians a legal (as well as moral) commitment to the acid rain issue.

One major weakness found in the Acid Rain Accord is the lack of a third party enforcement mechanism. Instead, the accord calls for the

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101 "Acid Rain Pact Nears" in *The Ottawa Sun*, (December 30, 1990).
formulation of an Air Quality Committee, composed of an equal number of Canadians and Americans. The role of the committee, as defined under Article VIII of the treaty, includes:

"a) reviewing progress made in the implementation of this Agreement, including its general and specific objectives;
b) preparing and submitting to the Parties a progress report within a year [emphasis added] after entry into force of this Agreement and at least every two years thereafter;
c) referring each progress report to the International Joint Commission for action with Article IX of this Agreement; and
d) releasing each progress report to the public after its submission to the Parties"102

The referral to the International Joint Commission under Article IX requires the Commission to collect and synthesize public comment and submit them to the Air Quality Committee. This is a much reduced role for the IJC, a long-standing bilateral environmental organization with much experience in transboundary pollution issues. This limited role assigned to the IJC raises important questions, prompting this writer to seek an interview with Edward Bailey, a technical advisor to the IJC at the Commission's Ottawa headquarters. The telephone interview took place in October 1991.

In the course of questioning, Mr. Bailey expressed the following concerns regarding the role of the International Joint Commission:

a) "The United States government was unwilling to assign any third party or independent assessment role to any group, whether the Commission, or outside body, or anybody, and the specific concern they

102 Acid Rain Accord. Article VIII.
referred to was the Clean Air Act. That is, Section 115 of the Clean Air Act refers to individual groups and the status they would have with respect to legal issues."

b) According to a contact (name omitted by request) in Environment Canada, regarding the Air Quality Committee, "We haven't formed it yet and we're not exactly sure who the members will be ... they haven't gotten down to facing the matter directly and it's a little disturbing, I guess, because they are supposed to make their first report one year after the signing of the accord."

c) "As for the role of the Commission, it is fairly well defined within the Agreement. It is a much different role from that assigned in the Great Lakes Water Quality Agreements, insofar as it really is the perogative of the two governments. And at this point in time they have chosen to give that rather limited role to the Commission in the way of seeking public comment. That's about all I can say."\(^\text{103}\)

Although Mr. Bailey did not state directly that he was disappointed with the role assigned to the IJC, his statements alluded to this fact. This limited role may restrict the enforceability of the Acid Rain Accord, which may be considered a symbolic political gesture rather than a significant new development in acid rain control. That is, by confirming actions already taken (no new control measures) and being limited in enforceability, the Acid Rain Accord serves more of a diplomatic than substantive purpose.

It is interesting to note that the bilateral Air Quality Committee

\(^{103}\) Interview with Edward Bailey, Advisor to the International Joint Commission, Ottawa Headquarters (October 15, 1991).
has not yet formed (as of December, 1991), indicating a lack of commitment to translate the language of the accord into immediate political action. This is especially troubling because the report of the Committee is due March 13, 1992; this represents time lost, and will surely affect the quality of the Committee's first report. Regarding the effectiveness of the Acid Rain Accord, only time will reveal if the Accord can serve its intended purposes. The Canadian government has recently committed $30 million over the next six years to monitor the effectiveness of the new control programs domestically as well as within the United States.\textsuperscript{104} In addition, part of this funding is devoted to assessing how well lakes and rivers recover from the effects of acidic deposition, and determining its role in forest decline. Canadian Environment Minister Jean Charest reported that these programs will, "by 1994 [enable us to report] on the cause of forest decline and indicate whether further emission reductions are needed."\textsuperscript{105}

With the continuing evolution of scientific knowledge, shortcomings in public policy are revealed. This is applicable to the acid rain debate, as environmental dilemmas are characterized by a chronic gap between the evolving state of scientific knowledge and the inadequacy of public policy. Policy seldom catches up with the needs identified by science, and these shortcomings are often exploited by opposing political interests.

\textsuperscript{105} CP News Wire, September 24, 1991.
The Politicization of Science and the Mass Media

Evolving scientific knowledge will reveal that current legislative efforts are in need of reform, especially in the area of nitrogen oxide emissions, further sulfate reductions, or both. This process will likely be characterized by continual politicization of scientific evidence, in part facilitated by the mass media.

Uncertainty has been the key issue in the acid rain debate: uncertainty in determining the causes and effects of acid rain, and uncertainty predicting the consequences of alternative policies for the environment and economy. Throughout the 1980's, as illustrated in the preceding legislative review, scientific and political actors differed greatly in their interpretations of scientific information. This was facilitated by the fact that relatively little is known about how specific changes in acidic deposition will affect changes in the impact of this deposition.

The main dilemma associated with policy formulation and scientific evidence is the politicization of scientific information; that is, the presence of incomplete (and sometimes contradictory) scientific information regarding the precise causes and effects of acid rain has allowed policy actors to legitimize (and publicize) their positions with their interpretations of available information. This is illustrated clearly by recent articles from the Op-Ed page of the *New York Times*:

Today, hundreds of Lakes in New England, the Upper Middle West, the Mountain states, and the Southeast that once teemed with fish have been spoiled by acidification.¹⁰⁶

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The findings [from research] have been far from conclusive. Sulfur dioxide emission in the Middle West have not been proven to contribute significantly to lake and stream acidity.\textsuperscript{107}

Certainly, the political agenda of each author is clear. The first excerpt, from an article entitled, "Why Do We Ignore the Evidence", was submitted by Rep. Henry Waxman, an outspoken advocate of acid rain control in the United States. The latter excerpt, from an opposing article entitled, "The Case Has Yet to be Proven", was written by Carl E. Bagge of the National Coal Association, reflecting an entirely different political agenda. The titles of the opposing articles alone are indicative of the divisive nature of the role of science. In Bagge's interpretation, the effects of acid rain are neither widespread nor serious, and do not appear to be worsening. We are therefore to assume that there is no need to restrict emissions, a costly and industry-damaging endeavor. Political decisions regarding environmental policy have become enormously more complex over the past decade. As James Regens (1988) has concluded, science often serves a valuable legitimization function for decisions made on other grounds.\textsuperscript{108}

M.E. Rushefsky (1984) holds that science is often manipulated by bureaucracies, and this manipulation can result in abuse of the scientific enterprise itself.\textsuperscript{109} Not only do these decisions become more difficult, but the uncertainties of scientific knowledge provide a ready rationale for those

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\textsuperscript{108} Regens and Rycroft, 1989. p. 113.

opposed to controls for delaying action. The mass media's role in shaping public opinion is recognized by governments, journalists, and scholars. The combination of the mass media and the government's manipulation of scientific information to support a specific policy agenda culminate in the dissemination of biased information. Edward Herman and Noam Chomsky contend that dependence on information from officials and agents of government and business contribute to marginalizing dissent, and allow the government and dominant interests to get their messages across to the public in ways that promote elite hegemony and suppress opposition to official policy.\textsuperscript{110} Martin Lee and Norman Solomon (1990) state that "an article on an important foreign policy or domestic issue might quote only official U.S. sources ... and ... the spectrum of opinion is narrowly framed by the kinds of 'experts' ... featured ... and left out."\textsuperscript{111}

Richard Barton's television study (1983-1984) illustrated the effects of such "sourcing" in his analysis of network news broadcasts addressing acid rain. He found that "the tendency to invoke scientific discourse, uncritically, as final authority on environmental issues is the recurring example", of attempts to confirm current policy by repressing discourse.\textsuperscript{112} That is, government officials' arguments are based on support of the administration's (and industry's) position, which are claimed to be in the public's best interest. The rationale behind this message is that the

"efficient" performance of American industry is in the interest of all Americans. Sourcing is one of the "five filters" of Herman and Chomsky's propaganda model: through the operation of this propaganda model, the dominant message (supporting the government and industry line) is filtered to the public through television. 113

The politicization of scientific information is by no means limited to one side of the acid rain debate. For example, Ontario's efforts to politicize the issue among the American public is well documented. With regard to such activity, the Ontario Ministry of the Environment has stated that, "We are convinced that ... communication activities have done much to awaken the American public, including the news media and the U.S. legislators, to the acute problem of acid rain."114 Furthermore, in 1983 Canadian Ambassador Allan Gotlieb outlined the modus operandi of the Canadians:

No country inevitably becomes so much engaged in the domestic process of another country as does Canada in that of the U.S. This is because Canada is so greatly affected by U.S. domestic legislation and regulations. Thus a great deal of U.S. foreign policy towards Canada is not really its foreign policy at all, but its domestic policy. And we, whether we like it or not are drawn into the American political process.115

113 The "five filters" which turn the media into propaganda channels are: the concentration of ownership and large size of influential news organizations; reliance on advertising as the prime source of income; dependence on information provided by government officials and agents of government and business; "flak" or pressure from organized elites; and the impact of the 'national religion' of anticommunism. (Herman & Chomsky, 1988)


In the context of the acid rain debate, these activities politicize the issue from the other end of the political spectrum. In seeking action on the U.S. policy agenda, scientific information is often used to justify the need for emission controls.

Regarding these efforts, Richard Funkhouser, then acting director of the Office of International Activities in the EPA, was quoted in the New York Times as being "annoyed and concerned that they [the Canadians] put out a so-called fact sheet that is riddled with mistakes and errors" to Congress. It is interesting to note that there was no elaboration regarding specific errors of the document in question. Indeed, a recent review of the document itself revealed no "mistakes and errors" in its content. The justification of this "mistakes and errors" concept was the Reagan Administrations' interpretation of the scientific evidence, which was facilitated by the lack of consensus within the scientific community. This is illustrated in the following reports by the Office of Technology Assessment and the Environmental Protection Agency:

We estimate that 3,000 lakes and 23,000 miles of streams, or about 20 percent of those in sensitive areas are now extremely vulnerable to further acidic deposition or have already become acidic.

In the United States, only in the Adirondack region have adverse effects of acidification on fish populations been observed...Loss of fish populations have been documented for about 180 Adirondack lakes (out of a total of approximately 2877), although

In the course of the acid rain debate, forms of mass media other than television have played a significant role. For example, in 1981 the Canadian Film Board released two films designed to increase public awareness of acid rain in the United States. These films, Acid From Heaven, and Acid Rain: Requiem or Recovery, were labeled foreign "political propaganda" by the U.S. Justice Department in 1983. This classification was challenged, but the Supreme Court upheld the Justice Department's classification under the Foreign Agents Registration Act. This Act includes the following definition:

The term 'political propaganda' includes any oral, visual, graphic, written, pictorial, or other communication or expression by any person ... which is reasonably adapted to, or which the person deseminating the same believes will, or which he intends to, prevail upon, indoctrinate, convert, induce or in any other way influence a recipient or any section of the public within the United States with reference to the political or public interests, policies, or relations of a government or a foreign country or a foreign political party or with reference to the foreign policies of the United States.119

This classification was met with opposition from both the Canadian government and individuals in the United States. In the New York Times it was stated that, "it [the propaganda classification] reflects a general and dangerous characteristic of the Reagan Administration: a fear of open debate and information, a fear of freedom."120 An interesting theory

120 Anthony Lewis, "Afraid of Freedom", in The New York Times
arose from the electric utility and coal mining industry in the United States. By exploiting the acid rain issue, they asserted, Canada was seeking to render the cost of producing electricity in the United States prohibitive. They maintained that, with the expansion of hydroelectric power facilities underway in Canada, the Canadians were positioning themselves to become the primary source of electricity in the eastern United States. The media publicized these claims, as far fetched as they were, and subsequently brought legitimacy to this point of view.

The role of the media in politicizing the issue has continued throughout the acid rain debate, illustrated most recently by the CBS newsmagazine 60 Minutes. In December 1990, 60 Minutes aired a controversial piece attacking the Bush Administration and Congress for ignoring NAPAP's findings in developing the Clean Air Act Amendments. In particular, they picked up on James Mahoney's comment that "There's no evidence of a general or unusual decline of forests in the United States or Canada due to acid rain."121 This comment was also picked up on by the New York Times, in its article, "Worst Fears On Acid Rain Unrealized"122. This illustrates the pitfalls associated with "sourcing" by the media, and how it serves as a vehicle for the politicization of science. The final assessment released by NAPAP, released in September of 1990, came under attack for misrepresentations of evidence within the executive summary, much as

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was the case with the 1987 Interim Assessment.\textsuperscript{123}

In response to allegations of misrepresentation within the executive summary, Mahoney stated, "It is exquisitely difficult to write something neutral in tone. I am not saying that there is no effect."\textsuperscript{124} This is a clear example of downplaying the House Science Committee assertion that there has been not been real scientific debate over the past five or six years; but rather, the relevant questions concerned potential control measures and the costs associated with them. The media has therefore served as a vehicle for the politicization of science throughout the acid rain debate. With evolving scientific data regarding forest decline and NO\textsubscript{x} emissions, there is no reason to assume that the media will not serve as such a vehicle in the future.

In order to obtain a perspective on the existing state of knowledge regarding current acid rain control legislation, a survey of informed elites was conducted in the summer of 1991. The survey addressed both general perceptions of the acid rain debate, and specific issues such as the perceived importance of NO\textsubscript{x} emission control. The results are discussed in the following chapter, and the actual survey and tables are found in the appendixes.

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Chapter 5
SURVEY PROJECT AND RESULTS

Discussion

Although there exists a vast literature addressing scientific and technical issues raised by the phenomenon of acidic precipitation, there has been comparable little research in the social sciences. In the course of fifteen years of research, more than 3,000 scientific papers have been published documenting the causes and effects of acid rain. A more limited body of research exists in the social sciences addressing perceptions of acid rain and its relationship to public policy.

In regard to perceptions of acid rain as an environmental issue, Canadians have seen themselves as victimized by United States, as Canada imports more pollution from the U.S. than the U.S. imports from Canada. Furthermore, most studies have concluded that Canadians, in bearing a disproportionate share of the problem, are more likely to perceive higher levels of risk than Americans. Steel and Soden's (1989) survey of Ontario and Michigan residents concluded that Ontario residents were more likely to support change in current policies. They found this pattern to be consistent with ideological and cultural differences between the United States and Canada.125

Leslie Alm (1990) concentrated on the role of science in the acid rain debate through his survey of those involved in the debate. Alm found that in the United States, there was still present a faction disputing the contention that science has provided enough information to act on acid rain


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control. He concedes that science alone is incapable of bringing about a resolution to the acid rain debate, and until lingering questions are acceptably resolved, "the politicians on either side of the border will continue groping for an effective acid rain strategy." 126

An acid rain strategy has been hammered out, but its effectiveness is questionable. Since increasing scientific knowledge has continually modified the context of the acid rain debate (Gould 1985), we can assume that it will serve the same function in the future. 127 Furthermore, as perceptions of informed actors are determinants of public policy, it is valuable to sample feedback from recently enacted acid rain legislation from a pool of informed elites in Canada and the United States. This survey represents a limited pool of informed elite perceptions. By polling selected government and academic communities, the following inferences may be drawn:

a) concerns of business and industry are not represented in this survey, rendering the conservative viewpoint moderated.

b) concerns of organized environmental groups are not represented in this survey, rendering the liberal viewpoint moderated.

Methodology

The intention of the survey project is to test the state of knowledge and current perceptions regarding current legislative efforts to control acid rain. Initial survey results were published in the proceedings of the Canada, Mexico and the United States: Market for the 21st Century conference, held at Skidmore College (October 25-26, 1991).

Government employees (federal and state, and provincial) and academics in the United States and Canada. Participants were selected on the basis of their prior experience with issues related to the acid rain debate, as well as their professional positions. Sixty five surveys were sent out during the summer of 1991, with a 48% rate of return representing 31 cases.

Based upon these returns, 38.7% (12 cases) were from Canadian government sources, 19.4% (6 cases) from U.S. government sources, 29% (9 cases) from the U.S. academic community, and 12.9% (4 cases) from the Canadian academic community. The response patterns are interesting in themselves, as a much larger proportion of Canadian government employees responded than did their American counterparts. Furthermore, American academics were more likely to respond than their Canadian counterparts, rendering inverse response rates between groups and their respective nationality.

This phenomenon may be attributable to a higher awareness of transboundary pollution among Canadian government employees than their American counterparts, as Canadian territory is more

128 Participants include Association for Canadian Studies in the United States Members (ACSUS), LTRAP researchers (Canadian program), EPA employees, state and provincial employees (in areas related to environment), and Canadian academics.
susceptible to damage from acidic deposition. Furthermore, the Canadian government has been more active in lobbying and research activities than the U.S. government. Differences in the response of the academic community may be attributable to American participants being involved in Canadian Studies Programs. Since these programs are in their infancy in many respects across the nation, there is a sense of community and support with regards to research pertaining to Canada.

Furthermore, the polling was conducted during the summer a time when many faculty (both U.S. and Canadian) are less likely to respond to correspondence. This may account for the relatively low response rate from the Canadian academic community. Appendix 1 contains the cover letter and survey questions sent to potential respondents.

Results

The first five survey questions were presented as thermometer scales with one (1) representing the lowest score and one hundred (100) representing the highest score. These questions were intended to measure: general perceptions of the importance of acid rain (and transboundary pollution) as an issue; perceptions of the influence exerted by each Canada and the United States on each other in formulating their control strategies, and the perceived effectiveness of resulting legislation.

The first question, "How important an issue is transboundary pollution between Canada and the United States?", provoked a high score. The mean score for all respondents was 80.968. This indicates that transboundary pollution is perceived as an important issue in both Canada and the United States.
Mean scores for government employees of both Canada and the United States were higher than the scores for academics in both nations. Canadian government employees scored highest, with a group mean of 84.6. U.S. government employees reported the second highest mean, 80.0. U.S. academics rated this question 78.1, and Canadian academics scored it 77.5. Cumulative scores based upon nationality did not reveal as sharp a difference. The Canadian cumulative average was 82.813, while the U.S. cumulative average was 79.000. The difference between the government and academic communities may be attributable to the fact that transboundary pollution issues are addressed through governmental mechanisms, rendering the importance of the issue more identifiable to government employees.

The second question, "How serious an environmental issue is acid rain?", also provoked a high score, with a mean for all respondents of 77.9. However, all groups scored this question above 72 on the thermometer scale (based upon cumulative means) indicating that acid rain is still regarded as a serious environmental problem in North America. Canadian government officials' mean score for this question was 82.8, far above their U.S. counterparts' mean of 73.333. This difference may be attributable to the greater amount of Canadian territory at risk, and the highly publicized NAPAP executive summary, which downplayed the seriousness of acid rain as an environmental problem in the United States. Conversely, Canadian government assessments of this document are critical of its findings, as are many scientific reports. Surprisingly, the academic communities displayed an inverse relationship. U.S. academics were more likely than Canadian academics to regard acid rain as a more serious issue. This, however, may be
attributable to the the low response rate of the Canadian academic community, in which one respondent's low scoring affected the group's mean profoundly.

The mean for all respondents on question 3, "How much influence (if any) did Canada have in bringing about the United States' revisions of the Clean Air Act?", was 53.8. This indicating a reasonable, although not overwhelming, degree of influence was perceived. U.S. government employees mean response was 59.2, indicating a relatively strong perception that Canadian efforts to influence U.S. policy were successful. Canadian government employees also recognized this influence, to close to the same degree, (58.3). The most skeptical of the responses came from the academic communities, who scored 47.5 (Canadian) and 47.222 (U.S.). One respondent noted that U.S. self interest was paramount in the revisions, but perhaps Canada had exerted some moral suasion.

Conversely, question four was phrased: "How much influence (if any) did the United States have in bringing about Canada's Acid Rain Control Program (1985)?" Although this influence was primarily fostered by inaction, it provided the impetus for Canada to institute its own control program. Cataldo (1990) asserts that because of efforts to influence U.S. policy were not likely to meet with immediate results, Canadian policymakers forced the acid rain issue to the top of their own domestic policy agenda as a way of "putting their own house in order".129

Interestingly, while U.S. academics were the most likely to recognize this influence, (group mean score of 63.8), U.S. government

employees were, as a group, the least likely to recognize or perhaps acknowledge this indirect influence. (group mean: 33.333) This represents the most radical departure of national subgroups in the survey.

Canadian government employees' mean score was 49.1, with the academic community scoring closely at 43.1. Thus, Canadians were not strongly inclined to acknowledge indirect influence from the United States, although this influence is widely recognized in relevant literature.

Question five, the final thermometer scale inquiry was phrased as follows: "How effective will existing legislation be in reducing the sources of acid rain?" This question was intended to measure perceptions of the strength of reduction schedules and target schedules of sulfur dioxide (SO2) and nitrogen oxides emissions (the primary acid rain precursors) in the United States and Canada. "Existing legislation" encompasses the U.S. Clean Air Act Revisions (Public Law 101-549), the Canadian Acid Rain Control Program (1985), and the Acid Rain Accord (U.S. / Canada 1991). Note: the Canadian Acid Rain Control Program is dependent upon provincial legislation and enforcement.

The mean score for all categories was 63.9, indicating a relatively positive perception among all participants. U.S. government employees registered a group mean score of 60.0, indicating a less enthusiastic, although generally supportive perception. Surprisingly, Canadian government employees registered the most positive response rate, with a group mean score of 66.3. Because Canadians have borne a disproportionate share of the problem and were assumed to perceive higher levels of risk from this pollution, Canadians were expected to be more pessimistic regarding the effectiveness of existing legislation. Perhaps this
attributable to a positive perception resulting from the break in the impasse with the United States.

The next group of questions were presented as multiple choice. Respondents were instructed to choose one of the possible selections, except where otherwise noted. When asked "Which country has accomplished more in the area of acid rain control?", 45.2 percent of all respondents chose Canada, 16.1% chose the United States, 25.8% felt that both countries had accomplished "about the same", while 12.9% chose "don't know". While it is noteworthy that perceptions of both Canadian and U.S. respondents favor Canada as accomplishing more, U.S. respondents were much less convinced of this. Of Canadian respondents, 56.3% chose Canada, 6.3% chose the United States, and 31.1% registered "about the same". The perception that Canada has accomplished more in the area of acid rain control may be attributable to awareness of the issue in Canada, as well as to Canada's public relations campaign of the 1980's in the United States to influence policy. Of Canadian respondents, 56.3% chose Canada, 6.3% the United States, and 31.1% registered "about the same". Of Americans, 33.3% chose Canada, 26.7% United States, and 20 percent chose "about the same". In absolute terms, the size of the U.S. SO2 cuts are much larger than those called for under Canadian legislation owing to the relative sizes of each economy and subsequent emissions. However, these results were somewhat surprising, given that both the Canadian Acid Rain Control Program and the U.S. Clean Air Act Revisions cut respective domestic emissions of sulfur dioxide by 50%. Only one group, U.S. academics, appeared sensitive to this, in that they identified the United States as the country accomplishing more in the area of acid rain control.
Question seven inquired: "With legislation reducing sulfur dioxide outputs approximately 50 percent in both the United States and Canada, what are the likely environmental consequences?" A number of respondents noted that the degree of recovery varied by locale and that vast areas were in question. Although environmental consequences will obviously vary region to region, the question's intent was to measure general perceptions rather than determine definitive rates of recovery. The choices were: "a) full recovery of aquatic and terrestrial ecosystems, b) partial recovery of aquatic and terrestrial ecosystems, c) status quo: no increase or decrease in the rate of acidification, d) decrease in the rate of acidification, but no recovery, e) continued damage to aquatic and terrestrial ecosystems, f) don't know". An overwhelming majority of all respondents felt that there would be partial recovery of aquatic and terrestrial ecosystems (77.4%), indicating a general belief that the reductions made will be beneficial. No respondents (Canadian or American) believed that full recovery would result from legislative efforts, and 12.5% of Canadians felt there would be no recovery (no U.S. respondents felt this way). Furthermore no Canadian respondents chose "don't know", while 14.3% of their U.S. counterparts registered this response. This suggests a higher confidence in knowledge concerning acid rain among Canadians, and their subsequent higher willingness to "shoot from the hip".

Question eight was phrased: "The Acid Rain Accord (1991) provides that the U.S. reduce NOx emissions by approximately 2 million tons from 1980 emission levels (14 million tons) by 200, and for Canada to reduce emissions 100,000 tonnes from 2000 forecast levels, with further reduction requirements to be achieved by 2000 and/or 2005. There are
conflicting views regarding the role of nitrogen deposition in acidification, particularly in terrestrial ecosystems. Which of the following is closest to your view on the subject?" The question was intended to probe knowledge of NOx and its role in acidification of terrestrial ecosystems. Any linkage between NOx emissions and the formation of ground-level ozone were purposely excluded from the question. In order to test the hypothesis that currently there has not been sufficient exposure of these new assertions among Canadians and Americans to a) be recognized as valid shortcomings of current acid rain legislation, and b) warrant their attention from government employees. There has been throughout the acid rain debate a concentration on SO2 emissions and their role in acidification. It was originally believed that the acidifying potential of NOx was one half that of sulfur dioxide based upon freshwater data, resulting with its primary role in regulatory efforts. However, recent studies have indicated nitrogen with increased "emphasis in the acidification process because of its mobility in soils, and its recently detected effects on naturally acidic forest systems."130 NOx emissions have been linked with the formation of ground-level ozone (O3) and their subsequent negative effects on vegetation. The terminology "regarding the role of nitrogen deposition in acidification" was used in order to introduce the fact that the ground-level ozone issue was to be excluded. The possible answers were phrased: "a) nitrate deposition is beneficial to "nitrogen deficient" forested areas, in that they are enriching the soils, b) nitrate deposition is secondary to that of sulfate deposition, and consequently has not been studied enough to warrant further action, c)

nitrate deposition will be sufficiently controlled through existing legislation, d) nitrate deposition must be reduced by a significant margin to relieve damage to terrestrial ecosystems, and e) don't know".

The exclusion of the ground level ozone linkage provoked a series of protests. "This misses the ozone issue completely", "but the main reason for reducing NOx emissions is to reduce ground level ozone", and "misses the point completely", were a few of such responses. However, as one respondent noted, current legislative efforts were not going to be effective unless NOx reductions were increased. This indicates that there is a lack of knowledge concerning the evolving state of scientific understanding of acid rain and its consequences.

In response to the choices 48.4% of all respondents felt that nitrate deposition must be reduced by a significant margin to relieve damage to terrestrial ecosystems. Of these, a higher percentage of Canadians felt this to be case (56.3%) as opposed to their American counterparts (40%). 40% of U.S. respondents chose "don't know", while 18.8% of Canadians were undecided. Again, this reaffirms the fact that Canadians are generally better informed in matters concerning acid rain. Also of interest is the fact that 0% of respondents felt that nitrate deposition was beneficial to nitrogen deficient soils (as suggested by the NAPAP Executive Summary), or that nitrate deposition will be sufficiently controlled through existing legislation.

The final question of the survey presented the respondent with a list of choices regarding general issues related to recent legislative efforts. The question was phrased in the following manner: "Regarding the legislation that has recently resulted from the acid rain debate (Canadian Acid Rain Control Program, U.S. Clean Air Act Revisions, and the bilateral
Acid Rain Accord), which of the following statements are consistent with your views on the subject?" Participants were informed that they were free to choose more than one of the answers, with a total of eleven possible choices.

The most popular response was (e) "there is sufficient scientific evidence to justify existing controls". 71% of all respondents felt that this was an appropriate response, although there was a noticeable difference based upon nationality. 75% of Canadians chose this response, as opposed to 66.7% of U.S. respondents. This may be attributable to the strong stance of the U.S. during the Reagan Administration that further scientific research was needed to determine the precise causes and effects of acid rain.

The second most popular response, based upon cumulative mean was (c) "acid rain is an avoidable consequence of modern industrialized society, and existing legislation must be supplemented to restrict emissions even further". 67.7% of all respondents chose this answer, indicating a relatively strong perception that existing legislation will not be sufficient to control the consequences of acid rain. Again, Canadians were more likely to choose this response than their American counterparts, with a division of 75% to 60% respectively.

The third most chosen answer was (g) "there is sufficient scientific evidence to justify further controls". 58.1% of all respondents felt this to be the case, although there was a wide gap between rates of response from Canadians and Americans. 68.8% of Canadians felt there was sufficient scientific evidence to warrant further controls, while 46.7% of American respondents felt this to be the case. Again, this reaffirms the notion that Canadians are more likely to support controls of acid rain precursors, for a
variety of reasons detailed in preceding chapters. The next two most chosen answers concerned the potential future nature of the acid rain debate, exploring prevailing attitudes regarding the divisiveness of the issue. More specifically, the responses were phrased, (h) "the acid rain debate will no longer be a divisive issue between Canada and the United States", and (i) "the acid rain debate will remain a divisive issue between Canada and the United States." Results were quite surprising, as each question was scored evenly on both the cumulative and nationality scales. That is, 35.5% of all respondents chose each answer respectively, with 43.8% of Canadians and 26.7% of U.S. respondents on nationality breakdown. Although these results are not conclusive, they present some interesting speculations. Canadians were much more likely to choose either answer than their American counterparts, indicating a higher level of understanding of the acid rain debate as a divisive issue. That is, by not responding, American subjects conveyed an indirect lack of knowledge regarding the historical divisiveness of the issue. Further, the patterns of response indicate an uncertain perception regarding the future of the debate, indicating a potential for disagreement.

The next most selected option was (b) "acid rain is a consequence of modern industrialized society, and existing legislation will reduce its effects to an acceptable degree". This choice generated a cumulative percentage of 25.8%, with American respondents registering 33% as opposed to 18.8% of Canadians. This indicates the general perception among Americans is more likely to view the consequences of acid rain as "acceptable", while Canadians are much less likely to do so. This difference
is not surprising, as the effects of acid rain are felt much more in Canada than the United States, although the U.S. is responsible for much of the damage occurring in Canada. That is, Americans are more likely to accept damage occurring in Canada as a consequence of their industrial activity, which has been a cause of great emotional distress for Canadians throughout the acid rain debate.

The next two responses addressed the timetables associated with implementing current legislation, primarily in the United States. This is the case, as the Canadian Acid Rain Control Program is scheduled to meet its 50% sulfur dioxide reductions by 1994. The U.S. Clean Air Act Revisions, however, are not scheduled for full implementation until 2000. The choices were as follow: (j) "the legislation is a positive step, but the timetables for implementation are too long", and (k) the legislation is a positive step, and there is not a problem with the timetables for implementation". 22.6% of all respondents felt that the timetables were too long, while 16.1% of respondents felt that there was no problem with the timetables. Of these, 25% of Canadians felt the timetables were too long, while 20% of their American counterparts felt this to be the case. 12.5% of Canadians felt that there was no problem with the timetables for implementation, while 20% of Americans felt this way. Once again, Canadians displayed more skepticism regarding legislative efforts than Americans, although there was a general lack of response to either choice. This indicates either a) many respondents were not familiar enough with the timetables for implementation to answer informatively, or b) many had failed to think of the potential implications of gradual implementation.

The next choice (by rank order) provoked a cumulative 86
response rate of 6.5%, of which 0% were Canadian. That is, 13.3% of U.S. respondents felt that (d) "there is not sufficient scientific evidence to justify existing controls". Although there was comparatively little support for this statement, the 13.3% rate of response for Americans was higher than expected. Related to this choice was (f) "there is not sufficient scientific evidence to justify further controls". Again, 0% of Canadians chose this statement, although 6.7% of U.S. respondents did so. This response rate was expected to be higher, as 13.3% of U.S. respondents did not feel that there was sufficient scientific evidence to justify existing controls, while only 6.7% felt that there was not sufficient scientific evidence to further control measures.

Interestingly, 0% of all respondents felt that (a) "acid rain is not a serious problem, and existing controls are already too stringent". This indicates that acid rain has been accepted as a serious issue among informed elites, and that the control measures are not too radical in their method or scope. This, of the eleven possible choices, was the only one that did not register a single selection by either the Canadians or Americans.

The survey was successful as a measure of the perceptions held by the communities surveyed. Although it was not comprehensive in the scope of perceptions held, it is valuable in that it provided confirmation of the evolving state of scientific knowledge regarding acid rain and its control among informed elites in academia and government.
Chapter 6

CONCLUSIONS

The acid rain debate has not been permanently removed as a divisive issue between Canada and the United States. The issue was characterized by the politicization of science throughout the 1980's, and this is likely to continue in the future as opponents and advocates of further emission controls seek to legitimize their positions through appeals to scientific evidence. The evolution of understanding of acidic deposition and its adverse effects on terrestrial and aquatic ecosystems will (and is beginning to) reveal flaws in control strategies. This is consistent with public policy literature, which suggests a systemic response by policy makers to issues on the policy agenda.

A model of this process would be as follows: a) a triggering event (Atikokan and the signing of the MOI); b) formulation of the policy agenda (control strategies); c) policy discussion (which may lead to inaction, as with the U.S.); d) policy formulation (Canadian Acid Rain Control Program, U.S. Clean Air Act Revisions); and d) policy implementation, Furthermore, feedback from implementation may serve as (a) a triggering effect, or (b) a re-formulation of the policy agenda. The value of increased scientific knowledge is therefore paramount to the development of successful public policy. Thus, the acid rain debate will continue to evolve due to shortcomings in the presentation and understanding of scientific evidence.

The issue will remain divisive, as current structures may prove
unable to cope with potential future problems. At this point in time, the United States has moved towards internalizing the externalities associated with the burning of coal to produce electricity. Although this is a positive development, this internalization is not complete as transboundary flows of pollution will be reduced by 50 percent at best. Similarly, Canadian flows of pollution to the United States will not be eliminated through their Acid Rain Control Program, but will be reduced. Therefore, each nation will still be imposing an externality upon each other when reduction programs are implemented in their entirety (year 2000). This externality, in absolute terms, will be imposed to a larger extent upon Canada due to the relative aggregate totals of each country's emissions. Furthermore, an period of economic decline in North America could serve to reduce each government's desire to further impose the cost of pollution control upon their industrial sectors.

The international legal principles concerning environmental protection have not developed to a point where they may be considered international law; and further, the Acid Rain Accord may be abandoned at any point by either party. Still, the survey results revealed that currently many informed elites favor further control measures, particularly those relating to NOx emissions.\textsuperscript{131}

In short, the acid rain debate will likely continue until the abandonment of combustion of hydrocarbons as an energy source. The phenomenon is essentially a side effect of this utilization of fossil fuels.

\textsuperscript{131} Although the survey returns indicate favoring increased controls, it is important to note that these do not include the opinions of industry elites or environmental organizations.
Technology controlling emissions from such processes will not, in the foreseeable future, alleviate the root of the problem. Although this technology exists, the prohibitive costs associated with its utilization ensure that government will not mandate absolute controls.

The acid rain debate has some very interesting applications when considering larger environmental phenomena such as global warming and ozone depletion. The questions raised by scientific evidence invariably result in a substantial amount of uncertainty regarding causes and effects, and therefore appropriate control strategies. In order to ensure adequate protection, international cooperation and action is essential. Politicizing the scientific evidence in order to delay such controls is a self-defeating behavior in the long run. The problems experienced in the acid rain debate can serve as a model for avoiding such pitfalls in the future. This is not likely, however, as the acid rain debate is not resolved now, nor will it likely be in the near future.
Appendix 1

Question 1: How important an issue is transboundary pollution between Canada and the United States?

<table>
<thead>
<tr>
<th>Rank Order</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Canadian governmental employees</td>
<td>84.583</td>
<td>50-100</td>
</tr>
<tr>
<td>2. Government cum (U.S./Canadian)</td>
<td>83.056</td>
<td>40-100</td>
</tr>
<tr>
<td>3. Canadian cum (government/academic)</td>
<td>82.813</td>
<td>50-100</td>
</tr>
<tr>
<td>4. U.S. governmental employees</td>
<td>80.000</td>
<td>40-95</td>
</tr>
<tr>
<td>5. U.S. cum (government/academic)</td>
<td>79.000</td>
<td>40-100</td>
</tr>
<tr>
<td>6. U.S. academics</td>
<td>78.333</td>
<td>50-100</td>
</tr>
<tr>
<td>7. Academics cum</td>
<td>78.077</td>
<td>50-90</td>
</tr>
<tr>
<td>8. Canadian academics</td>
<td>77.500</td>
<td>50-90</td>
</tr>
</tbody>
</table>

Question 2: How serious an environmental problem is acid rain?

<table>
<thead>
<tr>
<th>Rank Order</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Canadian governmental employees</td>
<td>82.833</td>
<td>75-99</td>
</tr>
<tr>
<td>2. Canadian cum (government/academic)</td>
<td>80.250</td>
<td>40-99</td>
</tr>
<tr>
<td>4. U.S. academics</td>
<td>76.667</td>
<td>20-100</td>
</tr>
<tr>
<td>5. Academics cum</td>
<td>75.385</td>
<td>20-100</td>
</tr>
<tr>
<td>6. U.S. cum (government/academic)</td>
<td>75.333</td>
<td>20-100</td>
</tr>
<tr>
<td>7. U.S. governmental employees</td>
<td>73.333</td>
<td>40-95</td>
</tr>
<tr>
<td>8. Canadian academics</td>
<td>72.500</td>
<td>40-90</td>
</tr>
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Question 3: How much influence (if any) did Canada have in bringing about the United States' revisions of the Clean Air Act?

<table>
<thead>
<tr>
<th>Rank Order</th>
<th>Mean</th>
<th>Range</th>
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<tr>
<td>1. U.S. governmental employees</td>
<td>59.167</td>
<td>40-75</td>
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<tr>
<td>2. Government cum (U.S./Canadian)</td>
<td>58.611</td>
<td>15-75</td>
</tr>
<tr>
<td>3. Canadian governmental employees</td>
<td>58.333</td>
<td>15-75</td>
</tr>
<tr>
<td>4. Canadian cum (government/academic)</td>
<td>55.625</td>
<td>15-75</td>
</tr>
<tr>
<td>5. U.S. (government/academic)</td>
<td>50.833</td>
<td>15-75</td>
</tr>
<tr>
<td>6. Canadian academics</td>
<td>47.500</td>
<td>30-60</td>
</tr>
<tr>
<td>7. Academics cum</td>
<td>47.308</td>
<td>10-95</td>
</tr>
<tr>
<td>8. U.S. academics</td>
<td>47.222</td>
<td>10-95</td>
</tr>
</tbody>
</table>
Question 4: How much influence (if any) did the United States have in bringing about Canada's Acid Rain Control Program (1985)?

<table>
<thead>
<tr>
<th>Cumulative mean (all categories)</th>
<th>Mean</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>46.667</td>
<td>10-95</td>
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</table>

**Rank Order**

1. U.S. academics 63.750 20-95  
2. Academics cum 55.833 20-95  
3. U.S. cum (government/academic) 50.714 20-95  
4. Canadian governmental employees 49.169 10-80  
5. Canadian cum (government/academic) 43.125 10-80  
6. Government cum (U.S./Canadian) 40.556 10-80  
7. Canadian academics 40.000 20-50  
8. U.S. governmental employees 33.333 10-60

Question 5: How effective will existing legislation be in reducing the sources of acid rain?

<table>
<thead>
<tr>
<th>Cumulative mean (all categories)</th>
<th>Mean</th>
<th>Range</th>
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<tbody>
<tr>
<td>63.871</td>
<td>40-90</td>
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</tbody>
</table>

**Rank Order**

1. Canadian governmental employees 66.250 50-80  
2. Government cum (U.S./Canadian) 65.000 50-100  
3. U.S. academics 64.440 50-80  
4. Canadian cum (government/academic) 64.063 40-90  
5. U.S. cum (government/academic) 63.667 50-80  
6. U.S. governmental employees 62.500 50-80  
7. Academic cum 62.308 40-90  
8. Canadian academics 57.500 40-90
Question 6: Which country has accomplished more in the area of acid rain control?

a) Canada  b) United States  c) about the same  d) don't know

Cumulative Results (All Categories)

<table>
<thead>
<tr>
<th>Answer</th>
<th>Government</th>
<th>Academics</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Canada</td>
<td>45.2%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) United States</td>
<td>16.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) about the same</td>
<td>25.8%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) don't know</td>
<td>12.9%</td>
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Canadian Responses

<table>
<thead>
<tr>
<th>Answer</th>
<th>Government</th>
<th>Academics</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Canada</td>
<td>66.7%</td>
<td>25%</td>
<td>56.3%</td>
</tr>
<tr>
<td>b) United States</td>
<td>08.3%</td>
<td>50%</td>
<td>06.3%</td>
</tr>
<tr>
<td>c) about the same</td>
<td>25.0%</td>
<td>0%</td>
<td>31.1%</td>
</tr>
<tr>
<td>d) don't know</td>
<td>0.0%</td>
<td>25%</td>
<td>06.3%</td>
</tr>
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United States Responses

<table>
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<tr>
<th>Answer</th>
<th>Government</th>
<th>Academics</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Canada</td>
<td>50.0%</td>
<td>22.2%</td>
<td>33.3%</td>
</tr>
<tr>
<td>b) United States</td>
<td>16.7%</td>
<td>33.3%</td>
<td>26.7%</td>
</tr>
<tr>
<td>c) about the same</td>
<td>16.7%</td>
<td>22.2%</td>
<td>20.0%</td>
</tr>
<tr>
<td>d) don't know</td>
<td>16.7%</td>
<td>22.2%</td>
<td>20.0%</td>
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Governmental Employees Cumulative (U.S. and Canadian)

<table>
<thead>
<tr>
<th>Answer</th>
<th>Percentile</th>
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<tbody>
<tr>
<td>a) Canada</td>
<td>61.1%</td>
</tr>
<tr>
<td>b) United States</td>
<td>11.1%</td>
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<tr>
<td>c) about the same</td>
<td>22.2%</td>
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<tr>
<td>d) don't know</td>
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Academics Cumulative (U.S. and Canadian)

<table>
<thead>
<tr>
<th>Answer</th>
<th>Percentile</th>
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<tbody>
<tr>
<td>a) Canada</td>
<td>23.1%</td>
</tr>
<tr>
<td>b) United States</td>
<td>23.1%</td>
</tr>
<tr>
<td>c) about the same</td>
<td>30.8%</td>
</tr>
<tr>
<td>d) don't know</td>
<td>23.1%</td>
</tr>
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</table>
Question 7: With legislation reducing sulfur dioxide outputs approximately 50 percent in both the United States and Canada, what are the likely environmental consequences?

a) full recovery of aquatic and terrestrial ecosystems
b) partial recovery of aquatic and terrestrial ecosystems
c) status quo: no increase or decrease in the rate of acidification
d) decrease in rate of acidification/damage, but no recovery
e) continued damage to aquatic and terrestrial ecosystems
f) don't know

<table>
<thead>
<tr>
<th>Cumulative</th>
<th>Canadian</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) full</td>
<td>00.0%</td>
<td>00.0%</td>
</tr>
<tr>
<td>b) partial</td>
<td>77.4%</td>
<td>81.3%</td>
</tr>
<tr>
<td>c) status quo</td>
<td>06.5%</td>
<td>06.3%</td>
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<tr>
<td>d) decrease</td>
<td>06.5%</td>
<td>12.5%</td>
</tr>
<tr>
<td>e) continued</td>
<td>03.2%</td>
<td>00.0%</td>
</tr>
<tr>
<td>f) don't know</td>
<td>06.5%</td>
<td>00.0%</td>
</tr>
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</table>

Question 8: The Acid Rain Accord (1991) provides that the U.S. reduce NOx emissions by approximately 2 million tons from 1980 emission levels (14 million tons) by 2000, and for Canada to reduce emissions 100,000 tonnes from 2000 forecast levels, with further reduction requirements to be achieved by 2000 and/or 2005. There are conflicting views regarding the role of nitrogen deposition in acidification, particularly in terrestrial ecosystems. Which of the following statements is closest to your view on the subject?

a) nitrate deposition is beneficial to "nitrogen deficient" forested areas, in that it is enriching the soils
b) nitrate deposition is secondary to that of sulfate deposition, and consequently has not been studied enough to warrant further action
c) nitrate deposition will be sufficiently controlled through existing legislation
d) nitrate deposition must be reduced by a significant margin to relieve damage to terrestrial ecosystems
e) don't know

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<th>Cumulative</th>
<th>Canadian</th>
<th>U.S.</th>
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<td>b) secondary</td>
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<td>18.8%</td>
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<td>c) controlled</td>
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<td>d) reductions</td>
<td>48.4%</td>
<td>56.3%</td>
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<tr>
<td>e) don't know</td>
<td>29.0%</td>
<td>18.8%</td>
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Question 9: Regarding the legislation that has resulted from the acid rain debate (Canadian Acid Rain Control Program, U.S. Clean Air Act Revisions, and the bilateral Acid Rain Accord), which of the following statements are consistent with your views on the subject? (You may choose more than one)

a) acid rain is not a serious problem, and existing controls are already too stringent
b) acid rain is a consequence of modern industrialized society, and existing legislation will reduce its effects to an acceptable degree
c) acid rain is an avoidable consequence of modern industrialized society, and existing legislation must be supplemented to restrict emissions even further
d) there is not sufficient scientific evidence to justify existing controls
e) there is sufficient scientific evidence to justify existing controls
f) there is not sufficient scientific evidence to justify further controls
g) there is sufficient scientific evidence to justify further controls
h) the acid rain debate will no longer be a divisive issue between Canada and the United States
i) the acid rain debate will remain a divisive issue between Canada and the United States
j) the legislation is a positive step, but the timetables for implementation are too long
k) the legislation is a positive step, and there is not a problem with the timetables for implementation

<table>
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<th>Canadian</th>
<th>U.S.</th>
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<td>e) existing (+)</td>
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<td>c) supplement</td>
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<td>75.0%</td>
<td>60.0%</td>
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<tr>
<td>g) further (+)</td>
<td>58.1%</td>
<td>68.8%</td>
<td>46.7%</td>
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<tr>
<td>i) divisive</td>
<td>35.5%</td>
<td>43.8%</td>
<td>26.7%</td>
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<tr>
<td>h) not divisive</td>
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<td>b) acceptable</td>
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<tr>
<td>j) too long</td>
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<tr>
<td>k) not long</td>
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<tr>
<td>d) existing (-)</td>
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<td>f) further (-)</td>
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<td>00.0%</td>
<td>06.7%</td>
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<tr>
<td>a) too stringent</td>
<td>00.0%</td>
<td>00.0%</td>
<td>00.0%</td>
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</table>
Appendix 2

Reactions to Acid Rain Legislation Survey
Sponsored by: Lehigh University Canadian Studies Program

Respond to Questions #1-5 on a scale of 1 (low) to 100 (high)

1) How important an issue is transboundary pollution between Canada and the United States? ______

2) How serious of an environmental problem is acid rain? ______

3) How much influence (if any) did Canada have in bringing about the United States' 1989 Revisions of the Clean Air Act?_____

4) How much influence (if any) did the United States have in bringing about Canada's Acid Rain Control Program (1985)? ______

5) How effective will existing legislation be in reducing the sources of acid rain? ______

Multiple Choice Questions (Circle answers)

6) Which country has accomplished more in the area of acid rain control?
   a) Canada b) United States c) about the same d) don't know

7) With legislation reducing sulfur dioxide outputs approximately 50 percent in both the United States and Canada being implemented, what are the likely environmental consequences?
   a) full recovery of aquatic and terrestrial ecosystems
   b) partial recovery of aquatic and terrestrial ecosystems
   c) status quo: no increase or decrease of acidification

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d) decrease in rate of acidification/damage, but no recovery

e) continued damage to aquatic and terrestrial ecosystems

f) don’t know

8) The Acid Rain Accord (March 1991) provides that the United States reduce nitrogen oxides by approximately 2 million tons from 1980 emission levels (14 million tons) by 2000, and for Canada to reduce emissions 100,000 tonnes from 2000 forecast levels, with further annual national emission reduction requirements to be achieved by 2000 and/or 2005. There are conflicting views regarding the role of nitrogen oxides in acidification, particularly in terrestrial ecosystems. Which of the following statements is closest to your view on the subject?

a) nitrate deposition is beneficial to “nitrogen deficient forested areas, in that they are enriching the soils.

b) nitrate deposition is secondary to that of sulfite deposition, and consequently not been studied enough to warrant further action.

c) nitrate deposition will be sufficiently controlled through existing legislation.

d) nitrate deposition must be reduced by a significant margin to relieve damage to terrestrial ecosystems.

e) don’t know

9) Regarding the legislation that has resulted from the acid rain debate (Canadian Acid Rain Control Program, U.S. Clean Air Act, and the bilateral Acid Rain Accord) which of the following statements are consistent with your views on the subject? (You may choose more than one)

a) acid rain is not a serious problem, and existing controls are already too stringent.

b) acid rain is a consequence of modern industrialized society, and existing legislation will reduce its adverse effects to an acceptable degree.

c) acid rain is an avoidable consequence of modern industrialized society, and existing legislation must be supplemented to restrict emissions even further.
d) there is not sufficient scientific evidence to justify existing controls.

e) there is sufficient scientific evidence to justify existing controls.

f) there is not sufficient scientific evidence to justify further controls.

g) there is sufficient scientific evidence to justify further controls.

h) the acid rain debate will no longer be a divisive issue between Canada and the United States.

i) the acid rain debate will remain a divisive issue between Canada and the United States.

j) the legislation is a positive step, but the timetables for implementation are too long.

k) the legislation is a positive step, and there is not a problem with the timetables for implementation.

Thank you for your time in completing this survey. If you are interested in receiving a copy of the final results, please check the appropriate area below.

Yes ______  No _______

In addition, please feel free to include any additional comments below regarding your reaction to acid rain legislation, or the nature of this survey. All additional comments will be included in the final analysis.
Bibliography


Davis, William G. "Notes for Remarks by the Honourable William G. Davis to the Chautauqua Institute Science and Technology Week", Speech read before meeting of the Chautauqua Institute, Chautagua, NY., August, 1986.


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VITA

Matthew Aaron Porett was born in Philadelphia, Pennsylvania on December 17, 1968. He attended Albright College in Reading, Pennsylvania (1986-1990), where he received his Bachelor of Arts degree in Political Science. Mr. Porett interned with the Public Affairs Division of the Canadian Embassy, Washington D.C. in the Summer of 1989, and pursued his education in matters pertaining to environmental protection. Furthermore, Mr. Porett presented a paper at the "Canada, Mexico, and United States: Market for the 21st Century" Conference, (Skidmore College, Saratoga Springs, NY, October 1991) where it was published in the conference proceedings. Upon receipt of his Master's degree, Mr. Porett will be seeking employment in areas related to environmental protection.
END
OF
TITLE