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The Problem of Ozone Depletion - Is There an International Solution

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The Problem of Ozone Depletion—Is There an International Legal Solution?

I. Introduction

Stratospheric ozone depletion has been the subject of theory and debate for the past decade and was recently described by an environmental lawyer with the World Resources Institute as "the most divisive environmental issue I've ever seen." The controversy, on a scientific level, surrounds the accuracy and significance of studies that indicate a global thinning of the ozone layer, the chemical shield high in the stratosphere which protects the earth from the sun's harmful ultraviolet rays. While scientists have worked to clarify some of these uncertainties, environmental lawyers and policymakers on the national and transnational levels have struggled with the legal implications of the depletion problem. One particularly difficult question has been raised—is there an international legal solution to the problem of ozone depletion? This paper will explore that issue, looking to what has been done on the international level and considering the scientific, economic, and political factors which make a simple answer impossible.

To appreciate more fully the complexity of the issue presented by the ozone controversy, it is first necessary to review the current status of scientific knowledge in this area. The function of the ozone layer, evidence of its depletion and possible causes and results of that depletion are all important foundational concerns. Another preliminary matter to considering the legal implications of ozone deterioration is an overview of international environmental law, focusing on the basic philosophy that gave birth to this body of law and to the organizations which have contributed to its growth. Once this groundwork has been laid, the problem of ozone depletion in the context of international environmental law can be properly analyzed and possible solutions to that problem can be considered.

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II. The Science of Stratospheric Ozone

A. What the Ozone Layer Does

The term "ozone" refers to unstable oxygen atoms formed when ultraviolet radiation from the sun interacts with ordinary oxygen.\(^2\) Ozone is present throughout the earth's atmosphere, from the ground level (troposphere) to the outer limit of the stratosphere (approximately thirty miles above the earth's surface).\(^3\) Although a harmful pollutant in low-level smog, ozone in the stratosphere shields the Earth from dangerous solar radiation. Despite this important shielding function, ozone exists in minute amounts in the stratosphere and is constantly being produced and destroyed by a balance of natural chemical reactions.\(^4\) The production rate cannot be changed by human intervention since man has no control over either the strength of the sun's radiation or the amount of normal oxygen in the atmosphere.\(^5\) In terms of the destruction phase, scientists have estimated that seventy percent of the threat comes from a natural catalytic cycle involving nitrogen oxides; the remaining thirty percent has been attributed to human activities.\(^6\)

B. Evidence of Depletion

Until recent years the fear that ozone in the stratosphere was being destroyed more rapidly than produced had been based more on theoretical predictions than on scientific observation. Advances in technology, however, have now enabled scientists to test the accuracy of these depletion theories. One such advance has been the development and improvement of ozone measurements from satellites. According to an atmospheric scientist with NASA, these satellites are now providing global data that is accurate enough "for us to see what is responsible for these long-term changes in the global distribution of ozone . . . . We don't know what is responsible for these long-term changes, but we're certain that they're taking place."\(^7\)

Based on an analysis of transmissions from the Nimbus-4 and Nimbus-7 satellites, a NASA scientist has estimated that global ozone levels fell by approximately 0.15 percent per year from 1970 to 1981.\(^8\) From 1978 to 1984, however, the depletion appears to have

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\(^3\) Brodeur, Annals of Chemistry: In the Face of Doubt, 62 New Yorker 70 (1986).

\(^4\) See Boville, Paper 1: Environmental Aspects of Stratospheric Ozone Depletion, The Ozone Layer 4 (A. Biswas ed. 1975) [hereinafter The Ozone Layer]. Dr. Boville provides a detailed analysis of the various chemical interactions within the ozone layer.

\(^5\) Id.


\(^8\) Id.
OZONE DEPLETION

been 0.5 percent per year.\(^9\) Altogether, according to NASA, this may indicate a 2.5 percent shrinking of the ozone layer.\(^10\) These findings affirm the inadequacy of prior theoretical predictions since scientists had not anticipated a 2.5 percent decrease until the twenty-first century.\(^11\)

While global ozone depletion has been estimated at 0.5 percent per year, the loss is more pronounced in high latitudes and polar regions.\(^12\) In 1983, scientists at the Arosa, Switzerland, ozone-monitoring facility reported that the average level of ozone in the atmosphere above their stations was eight percent below the annual average for the previous fifty years and was at that time the lowest yearly value they had observed.\(^13\) That same year, recordings from a weather station in the Bavarian Alps of West Germany indicated a seven percent reduction in ozone levels—the lowest values ever recorded in the station’s twenty year history; and Canadian researchers reported a three percent reduction of ozone over their five station ozone-monitoring network.\(^14\) “As a result of these and other measurements around the world, scientists at the National Oceanic and Atmospheric Administration calculated that during the first half of 1983 there had been a drop of between five and seven percent in ozone concentrations over the entire Northern Hemisphere.”\(^15\)

Perhaps more than any other finding, recent studies of ozone concentrations above Antarctica have brought the problem of ozone depletion into the public forum. A dramatic seasonal drop in ozone levels over Antarctica was first reported by a team of British researchers in May 1985.\(^16\) These researchers had observed a steady loss of stratospheric ozone levels over Antarctica since 1977 and noted especially large, albeit temporary, decreases every October.\(^17\) Now known as “Antarctica’s Ozone Hole,” though actually only a thinning, this phenomenon has been confirmed by data transmitted from NASA’s Nimbus-7 satellite: the reduction of ozone above the continent in October 1983 was nearly forty percent, and had increased to almost sixty percent in October 1985.\(^18\) A particularly troubling aspect of this “hole” is that it apparently did not exist prior to 1977—at least data collected between 1957 and 1977 does not

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\(^9\) Id.


\(^11\) Id.

\(^12\) See Weisburd, supra note 7, at 404.

\(^13\) See Brodeur, supra note 3, at 82.

\(^14\) Id.

\(^15\) Id.

\(^16\) Id. at 84.

\(^17\) Id.

\(^18\) Id. The “hole” has been estimated to be the size of the contiguous 48 states. The Hole in the Ozone: Can It Have Been the Cans?, Discover, July 1986, at 8 [hereinafter The Hole in the Ozone].
While the fact of Antarctica's ozone "hole" is undisputed, scientists have not reached a consensus on the cause of the seasonal thinning. Susan Soloman, a chemist with the National Oceanic and Atmospheric Administration and leader of an eighteen member team that went to Antarctica in August of 1986, commented after two months of on-sight research: "At the present time we cannot say that we have conclusively established the cause of the ozone hole."

Appearing before a congressional subcommittee in March 1987, Soloman announced that her research team had discovered unusually high levels of chlorine dioxide over Antarctica—twenty to fifty percent higher than anticipated. She attributed this abundance of chlorine molecules to chlorofluorocarbons (CFCs) and similar chemicals manufactured primarily for use as refrigerants, insulators, foam packages, and aerosols. Despite this connection, however, Ms. Soloman felt it would be premature to conclude on the basis of her findings that CFCs were the cause of the ozone depletion over Antarctica, citing the polar climate as a possible contributor to the phenomenon.

C. Causes of Depletion

The chemical processes which are thought to account for the Antarctica ozone hole are basically the same as those attributed to the problem of stratospheric ozone deterioration globally. A leading theory is that man-made chlorofluorocarbons breakdown in the stratosphere when hit by sunlight, forming chlorine atoms, which, after a series of catalytic reactions, act to destroy ozone atoms. When the CFC-ozone depletion connection was originally hypothesized in the mid-1970s, the major source of CFCs was aerosol sprays in which these gases were used as a propellant. In the autumn of 1978, the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) reacted to this finding by imposing a ban on the manufacture and use of CFCs as aerosol spray propellants. Canada, Finland, Norway, and Sweden later took action as well to reduce CFC emissions and encouraged all European countries, the Soviet Union, and Japan to limit the nonessential uses of aerosols.

These efforts, according to the Chemical Manufacturers' Association,
have resulted in a decline in the worldwide production of CFCs by twenty-one percent since 1974, but have not been as effective in curbing worldwide aerosol and non-aerosol uses of the compounds which increased by seven percent from 1982 to 1983.  

Because CFCs have been identified as a major contributor to the ozone problem and because the production of these chemicals for aerosol purposes has been somewhat reduced, much of the attention of environmentalists, especially in this country, has focused on curbing or banning the non-aerosol uses of chlorofluorocarbons. The primary non-aerosol uses are as refrigerator coolants and plastic foams, e.g., fast food containers—products which are in high demand, particularly in developed countries. An effort was made by the EPA to curtail these non-aerosol uses, not long after it placed the ban on aerosol uses of CFCs in the United States. This second phase of the EPA's response to the CFC threat was soon abandoned, however, when it was determined that substitutes for these chemicals in refrigeration and foam plastics would be too costly and difficult to produce.33 Since 1978, when "Phase Two" was rejected, the chemical industry has made little effort to find or implement alternatives to the continued manufacturing and use of CFCs; this may be explained by two factors: First, the compounds are "nearly ideal refrigerants [and second, preliminary studies reaffirm that] substitutes would be uneconomical to make, require difficult changes in manufacturing plants, take a minimum of ten years to develop and market, and involve controversial toxicity testing for adverse health effects."34

Although industry has preferred to minimize the problem of ozone deterioration and the role of CFCs in that destruction, the EPA is apparently reevaluating its 1978 decision not to require cut-
backs on production of the chemicals. A recently released report from the Agency recommended that the threat posed by depletion of the ozone be treated as a priority concern. Lee Thomas, Administrator of the EPA, has also lent his support to a proposed international agreement to protect the ozone layer, noting: "It strengthens the United States position that immediate worldwide actions are necessary to reduce emissions into the atmosphere of chemicals suspected of depleting the ozone layer. While our current understanding of all the factors involved is less than complete, the potential consequences are too great to delay action." 

D. Results of Depletion

As EPA administrator Thomas suggests, the potential consequences of continued ozone depletion are "too great to delay action." Increased ultraviolet radiation, which results from a thinning of the ozone layer, has been linked to "increased skin cancer, suppression of human immune responses, reduced crop yields and climatic changes." Alterations in the world's weather patterns have been hypothesized as a danger of ozone destruction because it is believed that such destruction could shift stratospheric temperatures sufficient to bring about these changes. Additionally, Dr. Ralph Cicerone, Director of the Atmospheric Chemistry Division of the National Center for Atmospheric Research, has estimated that one-third of the greenhouse effect, a phenomenon many fear is causing a global warming, may be attributed to CFC emissions. In terms of the threat to Earth's ecosystem, the National Academy of Science warned in 1979 that increased solar radiation "could have intolerable consequences for the world's food supply by reducing crop yields, killing the larvae of several important seafood species (including shrimp and crab), and destroying microorganisms at the base of the marine food chain." Furthermore, scientists have esti-
mated that 150 of the 200 major crops are highly vulnerable to ultraviolet radiation.  

The possible direct consequences of ozone depletion on human health are a major concern of those studying the problem. According to a recent study by the EPA, ozone depletion will cause forty million additional cases of skin cancer and 800,000 more cancer fatalities in the next eighty-eight years. Others calculate that a ten to fifteen percent decrease in the ozone layer could mean 1.5 million new skin cancer victims worldwide each year, by the end of the twentieth century. In addition to this dramatic increase in skin cancer cases, more ultraviolet radiation would also result in painful eye irritations and complications within the body's immunity system.

Based on these findings by leaders in the physiological, ecological, and meteorological sciences, it would seem that the time has come to take firm and concerted action to find a solution to the ozone problem. Because chlorofluorocarbon molecules do not respect national or continental boundaries, the danger they present to the ozone layer should be an international concern. However, while the scope of the problem is international, that is not to say that the most viable solution is necessarily that broad. Regardless, the viability of an international solution must be considered in the context of present international environmental law.

III. International Environmental Law

A. Introduction

The concept of an international law of the environment is largely a product of the twentieth century—its technological advances, increased scientific understanding of the ecological results of those advances, and subsequent public concern about the future of our planet. In recent years, this area of law has been developing at...
a rapid pace as current problems such as oil spills, acid rain, and transboundary pollution, generally, have affirmed that "the environment knows no frontier." There has been a growing recognition that "pollution and other sorts of environmental harm are propagated regardless of state sovereignty and its limits. [And that] [a]s a consequence, the struggle against it must be international." Furthermore, "the quality of the environment and natural resource management are no longer regarded as solely domestic concerns, for environmental impacts may be much more wide-ranging: they may dramatically affect foreign economies, or public health, and they may even ignite belligerent actions."

Focusing on the international nature of the problems facing our environment, legal solutions were initially conceptualized within the rubric of traditional international law, with little emphasis being placed on ecological concerns. For example, "[i]n the earliest treaties, arbitrations, and adjudications involving environment-related disputes, established principles of international law were extended to environment-related issues rather than legal concepts being modified or enlarged by environmental concepts."

Basically, two principles of international law have been applied to environmental issues. First, "a nation should not permit action within its territorial jurisdiction to harm the interests of other nations." Second, "nations should cooperate to serve the mutual interests of their respective peoples." Recent modifications in these concepts include the notion that this international cooperation


50 A. Kiss, supra note 49, at 12.


53 L. Caldwell, supra note 52, at 12.

54 Id. This was established as a tenet of international environmental law in the Corfu Channel Case (1949), which involved the destruction of two British military vessels in the Corfu Channel of the Adriatic Sea by mines placed in the Channel by the Albanian government. Id. at 13. The International Court of Justice held that "every state has an obligation not to allow knowingly its territory to be used for acts contrary to the rights of other states." Corfu Channel Case (U.K. v. Alb.), 1949 I.C.J. 4.

A corollary to this principle is that there should be international liability for injury to the environment. See A. Kiss, supra note 49, at 29. [However,] injury caused to the environment is not illegal in itself in present positive international law. But, in certain cases the environmental injury will cause private damages and consequently, international liability for damages caused to other States or to their nationals by environmentally harmful activities.

Id. at 41.

55 L. Caldwell, supra note 52, at 12-13.
should take the form of legal efforts to preserve and protect the environment\textsuperscript{56} and that international law should recognize a human right to a "clean, pure, healthy, and even decent environment."\textsuperscript{57}

While current environmental problems have necessitated the development of new international legal theories, the problems have also influenced the way man thinks about himself, others, and their shared ecosystem. No longer is man viewed as a master and exploiter of Earth, but as its custodian or steward.\textsuperscript{58} Additionally, a new sense of man’s interdependence "has fostered a growing realization in foreign ministries around the world that many international activities—trade, industrial investment, development assistance—have profound implications for the environment."\textsuperscript{59} Many nations now recognize a shared responsibility to safeguard human health and to "preserve the common natural heritage."\textsuperscript{60} Three other sociological concepts have been identified as influencing contemporary views of international environmental law: (1) the unity of the biosphere, recognizing that Earth is a biophysical unity which can only be protected by the common effort of all people and nations; (2) the unique nature of Earth, emphasizing the rarity of "life" in the Universe; and (3) the natural limitations of political fiat, declaring the impracticality of absolute state sovereignty in cases of transboundary environmental injury.\textsuperscript{61} Together, these five concepts may be seen as the philosophical underpinnings of the two basic principles of international environmental law highlighted above.

To the extent nations believe they should not allow actions within their boundaries to cause injury to the environment of other nations and inasmuch as they recognize a need to cooperate to protect and preserve the biosphere, there exists a body of customary international environmental law.\textsuperscript{62} As in international law generally, this corpus of law is based on "the conduct of states in practical life, and the acceptance by other states of this practice."\textsuperscript{63} Such customary law is binding between states "because of the fact that states hold

\begin{itemize}
\item \textsuperscript{56} See A. Kiss, \textit{supra} note 49, at 29.
\item \textsuperscript{57} W. Gormley, \textit{supra} note 49, at 1.
\item \textsuperscript{58} See B. Johnson, \textit{International Environmental Law} 10 (1976). "[M]an’s obligations as Earth’s custodian have been reinforced by the demands of his fellows that they not be required to suffer from the Earth-destroying activities of other men." L. Caldwell, \textit{supra} note 52, at 22. Thus, the notion of a custodianship role as to the environment has more force than a mere moral conclusion. \textit{Id}.
\item \textsuperscript{59} Foreign Policy, \textit{supra} note 49, at 55.
\item \textsuperscript{60} \textit{Id}. See also L. Caldwell, \textit{supra} note 52, at 20-21.
\item \textsuperscript{61} See L. Caldwell, \textit{supra} note 52, at 18-23.
\item \textsuperscript{62} See B. Johnson, \textit{supra} note 58, at 10-11. Other labels for this field of law include general international environmental law and international law of the environment. \textit{Id}. See A. Kiss, \textit{supra} note 49, at 18. The latter would also include those treaties which have been "universally accepted as reflecting existing international [environmental] law." \textit{Id}.
\item \textsuperscript{63} B. Johnson, \textit{supra} note 58, at 11.
\end{itemize}
the opinion that a certain rule of customary law is a rule of law."\textsuperscript{64} These laws based on custom constitute one source of international environmental law and are often derived from another contributor, treaty law. Other sources of this ever-developing body of law include resolutions of international organizations and recommendations and declarations promulgated by intergovernmental organizations or by international conferences.\textsuperscript{65} Like treaties, some resolutions of international organizations have a legally binding effect on their signatory states.\textsuperscript{66} This, however, is not the case with recommendations and declarations which generally have no binding force.\textsuperscript{67} "They constitute what is called 'soft law,' i.e., rules which have to be considered as law insofar as they fix norms with which States should comply, but which cannot be enforced in the traditional meaning of the term."\textsuperscript{68} Together with treaties and resolutions of international organizations, these recommendations and declarations embody what has been termed "the conventional law of the environment."\textsuperscript{69}

\textbf{B. International Organizations and the Environment}

A plethora of transnational organizations now exists which engage in environmental protection activities.\textsuperscript{70} In fact, one writer has observed: "There must be few international institutions which are not concerning themselves with environmental questions and contributing to the growth of 'the conventional law of the environment' in one form or another."\textsuperscript{71} A survey of the activities and contributions of all of these organizations is beyond the scope of this paper, but a brief overview of the work of four such organizations, the Council of Europe, the European Economic Community (EEC), the Organization for Economic Cooperation and Development (OECD) and the United Nations (UN), provides a useful framework for considering the feasibility of an international solution to the problem of ozone depletion. Because the United Nations Environment Programme (UNEP) has taken the lead in addressing the ozone problem, greater emphasis will be placed on that agency and on the work of the UN generally.

On a regional level, the Council of Europe has long been the political organization in the vanguard of international environ-

\textsuperscript{64} \textit{Id.}
\textsuperscript{66} See \textit{id.} at 20.
\textsuperscript{67} See \textit{id.} at 23.
\textsuperscript{68} \textit{Id.} (citation omitted).
\textsuperscript{71} See Brown, \textit{supra} note 69, at 25.
mentalism. Though not particularly impressive in terms of the number or significance of conventions it has sponsored, the Council has adopted a number of declarations and charters designed to protect the environment and has illustrated "that the formulation of general rules in a regional framework in view of the harmonization of national legislation can be effective." The Council has achieved that harmonization largely through the efforts of various committees and conferences which have worked to stimulate public interest in the problem of environmental degradation. One such conference, the European Conservation Conference of February 1970, is particularly noteworthy for its recommendation that an International Charter for the Defense of Nature be compiled and for its adoption of a Declaration on the Management of the Natural Environment of Europe which, among other things, called for a conventional harmonization of pollution standards and the preparation of a Protocol to the European Convention on Human Rights (1950), guaranteeing the right of every individual to enjoy a healthy and unspoiled environment.

As a supranational organization, the nine-member European Economic Community has the potential to become an important contributor to environmental protection. However, because of a lack of specific powers in the Treaty of Rome, which governs the EEC, this potential has not yet been realized. Furthermore, the Treaty compels EEC nations to act in harmony with one another which has frustrated attempts to regulate chlorofluorocarbons in EEC nations because those opposed to such action have been able to prevent strong controls.

A graphic illustration of the Commission's significant, but not totally successful efforts to protect the Eu-

72 See W. Gormley, supra note 49, at 4. The Council's activities in this area go back as early as the 1950s. Id.
74 A. Kiss, supra note 49, at 104.
75 See Brown, supra note 69, at 27.
76 Id. at 27-28 (citation omitted).
77 See id. at 28. The author notes three reasons for this potential:
First, in terms of integration and real powers, this supranational institution is by far the most advanced in Europe and is in a position to mold and harmonize the environmental legislation of its nine Member States. Second, as a major trade bloc, the EEC is in a position to influence the environmentally-relevant policies of industry in other States by requiring imports from these States to meet stringent anti-pollution standards. Third, as a major source of development aid, the EEC is in a position to assist developing States to meet the costs of environmental policies which might otherwise be considered too expensive in socio-economic terms.
87 Id. at 28-29.
78 Id. at 29.
european environment is the Convention on Long-Range Transboundary Air Pollution. The Convention, held in November 1979, was called to address the problems of transboundary air pollution and culminated in the signing of the first multilateral agreement dealing with the problems. It has been asserted, however, that the agreement was merely a symbolic victory for the environment since it contains no numerical goals for pollution abatement, no timetable for clean-up actions, and no abatement and enforcement provisions.

Like the EEC, the Organization for Economic Cooperation and Development is organized on a regional intergovernmental level and has been especially active in addressing environmental issues in recent years. "[C]onsisting of the industrialized countries of the Western World with over two-thirds of the world's trade and a high standard of living, [the OECD] is a unique body for dealing with the economic implications of environmental problems as they affect a market economy." This potential for influencing its constituent nations can be clearly seen in the OECD's Governing Council, which has the authority to issue decisions binding all members and can submit nonbinding recommendations to members for their implementation. The Council's authority is limited, however, in that it is conditioned on the unanimous vote of Council members. In the area of chlorofluorocarbon regulation, the OECD has done little to exercise this rather extensive authority. A comprehensive study of the economic impact of such regulation was initiated by the organization in 1976 and resulted in a published report in January 1978. Significantly, this study concluded that a ban on aerosols in member nations would have a substantial impact if a compliance deadline of six months was set as opposed to a moderate impact if the deadline was extended to thirty months. The OECD has not taken further action on the chlorofluorocarbon issue since this 1978 report. Some suggest that the members of its Environment Committee have decided that other organizations are adequately handling the problem.

Whether or not the United Nations is adequately handling the problem of CFC emissions, specifically, or global environmental con-

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81 Id. Thirty-one of the thirty-four members of the Economic Commission for Europe signed the agreement. Id.
82 Id. at 355-56.
84 See Stein, supra note 79, at 64.
85 Id. at 355-56.
86 See id. supra note 79, at 64.
87 See id.
cerns, generally, is a subject of heated debate. There can be little doubt, however, that the United Nations Environment Programme has stimulated "environmental awareness" since its inception in 1973. The UN’s involvement in environmental activism predates the creation of UNEP by nearly twenty-five years: its first conference dealing with environmental topics, the Scientific Conference on the Conservation and Utilization of Resources, was held in 1949. A more comprehensive conference was called by the United Nations Educational, Scientific, and Cultural Organization in 1968. The primary concern of those attending this Intergovernmental Conference of Experts of the Scientific Basis for the Rational Use and Conservation of the Resources of the Biosphere (the Biosphere Conference) was to bring about "the coordination of national and international research efforts to identify threats to the global environment and to plan resource-management policies to be implemented at all levels of government to help meet these threats." At the conclusion of the Conference, it was reported:

In the place of single-purpose actions in disregard of their associated consequences, both public and private, there is need to substitute planned programs for the management of resources if past degradation of the environment and deterioration of the ecosystem are to be corrected, if the biosphere’s productivity is to be maintained and even enhanced, and if aesthetic appreciation is given opportunity to flower.

Unfortunately, these scientific findings were not translated into

88 See Smith, supra note 80, at 337. The author analyzes the UNEP’s global protection plan and concludes that it “would do well to cease its work and return to the member states the inherent responsibility for determining on their own initiative both the nature of environmental issues and the extent to which action will be taken in order to meet those various environmental matters of concern.” Id. at 337. But see Johnston, supra note 6. This author asserts that the development of international environmental law requires, among other things, a broad geographical diversity which would “ensure that a balance is achieved among the predominant viewpoints and interests reflected in culture, ideology, and economy.” Id. at 279. He further concludes that “it is important that the task [of designing a politically acceptable global conservation or emission control strategy] should be promoted or coordinated by a global body, such as UNEP (official) or the International Union for Conservation of Nature and Natural Resources (IUCN) (unofficial), which is sensitive to the cultural, ideological, and economical interests and viewpoints of different countries, blocs, or regions in the international community.” Id. (citation omitted).

89 See Smith, supra note 80, at 336. Dr. Mostafa K. Tolba, the Executive Director of UNEP, reflecting on the UN’s work on environmental issues from 1972 to 1982, stated that the stimulation of “environmental awareness” was the Programme’s most notable achievement. Id. (citation omitted).

90 See Kay & Jacobson, supra note 70, at 10. The sense of alarm and urgency prevailing at UN conferences held in the 1970s to address global environmental problems was totally absent in 1949. Id.

91 See A. SPRINGER, supra note 2, at 4. Sixty-two nations and a number of international organizations were represented at the Conference, which was held in Paris. Id.

92 Id.

workable environmental protection policies—little attention having been given to the legal or institutional changes that would be required.94

The UN's next major attempt to address the problems facing the global environment, termed "the most significant global event in environmental history,"95 was the United Nations Conference on the Human Environment, held in Stockholm in June 1972. Recognizing the shortcomings of the Biosphere Conference and other international gatherings, those initiating the Stockholm Conference emphasized that positive action plans were necessary if safeguarding the global environment was to become a reality.96 The Conference, which attracted 1,200 delegates representing 113 nations (both developed and undeveloped)97 and at least 400 international agencies,98 had as its theme, "Only One Earth," stressing "the fact that all things, both living and inanimate, among which man dwells are part of a single, interdependent system and that all man has no place to turn if he despoils his own surroundings through thoughtless abuse."99 As a result of the Stockholm Conference, a 26-principle Declaration of the United Nations Conference on the Human Environment was drafted, as was a 109-point Action Plan and a resolution containing recommended institutional arrangements.100

The Stockholm Declaration proclaimed a global desire to preserve and improve the human environment and enunciated rules of conduct to guide efforts toward that goal.101 Principle 21 of that Declaration has been described as "the keystone of the Stockholm initiative."102 This principle declares:

States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damages to the environment of other States or of areas beyond the limits of national jurisdiction.103

94 See A. Springer, supra note 2, at 4.
96 See Smith, supra note 80, at 338.
97 Certainly, one of the Conference’s greatest achievements was persuading the less-developed nations that environmental problems were not confined to industrialized states and convincing those countries that concern for the environment did not necessitate a lesser commitment to development. See Kay & Jacobson, supra note 70, at 11.
98 See Development, supra note 95, at 269-70.
100 See Development, supra note 95, at 270.
101 See Kay & Jacobson, supra note 70, at 11.
102 Smith, supra note 80, at 340.
Analyzing the concept of responsibility as embodied in Principle 21, the OECD Secretariat suggests that it has two constituent elements:

1. The traditional obligation of due diligence to which States have been subject for many years under general international law, and,
2. the determination to develop a policy for the protection of the international environment as a moral necessity, inspired not only by the development of international morality but also by the clearly urgent nature of such joint action.  

The sense of urgency in the Stockholm Declaration is also evident in the recommendations of the Conference's Action Plan. These recommendations fall into three categories: Those concerned with environmental assessment of "EarthWatch," those concentrating on environmental management, and those emphasizing supportive measures. The environmental assessment recommendations provide for the establishment of a number of environmental information systems, including the International Referral System, which is designed to provide information on environmental issues and problems, and the Global Environmental Monitoring System, which monitors global environmental conditions. Environmental management has as its goal "the development of comprehensive planning and environmental enhancement for future generations." The supporting measures, which constitute the third aspect of the Action Plan, have three components: "education, training, and public information; organizational arrangements; and financial and other forms of actions."

While clearly a major step in addressing environmental issues on an international level, the Stockholm Conference "did not live up to its expectations." The possible impact of the Conference was limited from the start, in fact, since only a declaration rather than a binding resolution or treaty could be agreed upon. Political differences among those attending the Conference also weakened its potential to radically affect international environmental law. In this respect, some have suggested that "the Stockholm Conference was 'doomed' to a certain extent from the very beginning, because of the fact that the USSR and most of the Eastern Bloc of Socialist States boycotted the meeting, simply because of the Western Powers' re-

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104 OECD Secretariat, Observations on the International Responsibility of States in Relation to the Protection of the Environment, in Legal Aspects of Transfrontier Pollution 381-82 (OECD ed. 1977). The Secretariat's note thoroughly analyzes these two elements and concludes with an examination of the possible legal implications of the concept of responsibility. Id. at 380-408.
105 See Smith, supra note 80, at 338.
106 Id. at 338-39.
107 Id. at 339.
108 Id. (citation omitted).
109 W. Gormley, supra note 49, at 121.
110 See supra notes 66-68 and accompanying text.
fusal to admit East Germany." Because of this political controversy there was not universal participation in the Stockholm proceedings and thus "a major segment of the world community (and a significant number of U.N. Members) can claim not to be even morally bound to adhere to the principles codified into the Stockholm Declaration." Despite these shortcomings, the Stockholm Conference did draw international attention to the problems facing our global environment and led to the establishment of an institution which has played "a crucial role in the sharpening of global priorities for the development of international environmental law." That institution, the United Nations Environment Programme (UNEP), has been assigned the general role of coordinating the environmental activities of the UN agencies as well as other international organizations, and of stimulating national activities in this area. The UNEP functions primarily as a catalyst rather than as an executory agency. Structurally, the Agency consists of what were originally four separate institutions created to effectuate the Stockholm Action Plan. They were a Governing Council, a fifty-eight member elected body chosen by the General Assembly to serve for three years; a secretariat, now responsible for administration of the UNEP; an Environmental Fund, to which governments contribute on a voluntary basis; and an Environmental Coordination Board, consisting of members from all relevant UN bodies.

In the first decade of its existence, the UNEP sponsored countless projects and cooperative ventures, addressing the gamut of environmental issues. Under the Agency’s auspices, major conferences and symposia have been held on such topics as the world climate, air pollution and air-quality monitoring, ocean pollution, diminishing tropical and rain forest biosystems, global conservation, and overpopulation. In 1976, four years after the UNEP’s inception, the Governing Council identified the problem of ozone deterioration as one of five areas to receive priority treatment. Since 1976, the Agency has sponsored numerous meetings dealing specifically with the ozone problem. One such meeting, the Conference of Pleni-

111 W. GORMLEY, supra note 49, at 121.
112 Id. at 121-22.
113 Johnston, supra note 6, at 257 n.8.
114 See Smith, supra note 80, at 343 (citation omitted).
115 See Development, supra note 95, at 270.
116 Id.; Smith, supra note 80, at 342. For a more detailed discussion of the functions of these four institutions, see Hardy, The United Nations Environment Program, in INTERNATIONAL ENVIRONMENTAL LAW 7-77 (1974).
117 Development, supra note 95, at 277-79.
118 See Stoel, supra note 79, at 64.
119 Id. A meeting of stratospheric ozone experts was convened in Washington, D.C., in 1977 and a World Plan of Action was adopted, citing 21 issues for specific attention.
potentaries on the Protection of the Ozone Layer, was held in Vienna in March 1985. The purpose of this Conference was to prepare a treaty which would impose upon its signatories the obligation to take "appropriate measures . . . to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer." Further discussion of the resultant Vienna Convention and its potential as a solution to the ozone problem appears in the next section.

In addition to sponsoring symposia and conventions addressing specific environmental concerns, the UNEP held a special meeting in 1982 designed to assess the condition of the world environment since 1972, to examine the successes and failures of the UNEP during that period, and to formulate a future response. The Nairobi Session of a Special Character (SSC) was attended by delegates from 105 governments, more than thirty-five intergovernmental organizations and UN agencies, and by persons representing more than 100 international and other nongovernmental organizations. These representatives noted the negative trend of the global environment in the 1972 to 1982 decade, but concluded that the UNEP had been reasonably effective in light of the tremendous limitations on it in terms of the time and money at the Agency's disposal. "While there was considerable pressure from several developing nations to expand the primary role of UNEP from that of catalyst to one of active implementer and financier of country-specific projects, the SSC did not recommend such a departure from the traditional role of the agency."
Those representing developing nations at the Nairobi SSC not only lobbied for an expanded role for the UNEP, but also ardently supported ecological planning and protection.\textsuperscript{126} This activism on the part of developing nations is in striking contrast to their position at the Stockholm Convention ten years earlier. Indian Prime Minister Indira Gandhi well expressed the view of these countries in 1972:

The rich countries look upon development as the cause of environmental destruction, but to us it is one of the primary means of improving the environment of living . . . . How can we speak to those who live in villages and in slums about keeping oceans, rivers, and air clean when their own lives are contaminated at the source?\textsuperscript{127}

By 1982, at least some developing nations recognized the inseparability of development and environmental protection and the necessity of some long-range restraint on exploitation of the environment.\textsuperscript{128} The Indonesian Minister of Development, accordingly, observed:

The feeling is strong in my country and in Asia that there must be harmony between development and enhancement of the environment. There is no question that the political will to do this exists. I am in Nairobi looking for the skill and technology that will enable us to do it.\textsuperscript{129}

Unfortunately, the "political will" to bring about this harmony had apparently diminished in those representing developed nations at the SSC. Many (including the United States) who had strongly advocated reform and pollution abatement at Stockholm were viewed at Nairobi as having "reduc[ed] their commitment to [UNEP] and other cooperative efforts to cope with the environmental problems."\textsuperscript{130}

\section*{IV. Ozone Depletion as an International Legal Problem}

\subsection*{A. In General}

The preceding discussion has highlighted the development of international environmental law, focusing on the role of regional and international organizations in that evolution. This discussion is in-

\textsuperscript{126} \textit{Id.} at 281.
\textsuperscript{127} \textit{Id.}
\textsuperscript{128} Some developing nations recognized the need to protect the global environment from the adverse impacts of social and economic development as early as 1975 when work was begun on the World Charter for Nature, under the sponsorship of 34 developing nations. See Wood, \textit{The United Nations World Charter for Nature: The Developing Nations' Initiative to Establish Protections for the Environment}, 12 \textit{Ecology L.Q.} 977, 978 (1985). The major theme of the Charter is enunciated in its Preamble: "Lasting benefits from nature depend upon the maintenance of essential ecological process and life support systems, and upon the diversity of life forms, which are jeopardized through excessive exploitation and habitat destruction by man." World Charter for Nature, G.A. Res. 7, 36 U.N. GAOR Supp. (no. 51) at 17, U.N. Doc. A/51 (1982). The preamble concludes by citing the need for efforts to protect nature at all levels—"national and international, individual and collective, private and public." \textit{Id.}
\textsuperscript{129} Development, \textit{supra} note 95, at 281.
\textsuperscript{130} \textit{Id.} at 280.
tended not only to provide a framework for considering the legal aspects of the ozone depletion problem, but also to convey a sense of the limitations inherent in the international environmental law model. Having laid this foundation, the problem of ozone depletion can now be properly addressed as a problem for international policymakers.

That ozone depletion is an international problem is abundantly clear. Chlorofluorocarbon emissions in Europe can sweep across Asia and the Pacific and begin attacking the ozone layer above the California coast within a month.\textsuperscript{131} Furthermore, the damage now being inflicted on the stratospheric ozone layer is the cumulative effect of CFC emissions throughout the world.\textsuperscript{132} Because these emissions result in damage to a \textit{res communis}, "an area beyond the limits of national jurisdiction that exists as the common property of all states,"\textsuperscript{133} (e.g., the high seas, Antarctica and outer space), ozone deterioration may be seen as a form of international pollution. Although not ordinarily applicable to the stratosphere, since a state has control over its superadjacent airspace the application of \textit{res communis} is valid "because the nature of the problem is essentially the same. The cumulative effect of many locally generated pollutants (i.e., the use of aerosol sprays) may damage shared interests in the protection of human health, resources, and ecosystems."\textsuperscript{134}

As has been noted, ozone depletion has been recognized by a number of prominent regional and international organizations as an international problem.\textsuperscript{135} The work of the UNEP has been especially significant in this respect, with the Vienna Convention representing the main product of that activity.\textsuperscript{136} A significant feature of the Vienna Conference was its anticipatory approach to the problem of ozone depletion: "[T]he mere possibility of a 'chlorine catastrophe' was accepted as a sufficient reason to act."\textsuperscript{137} "This was a landmark event: it was the first time that the international community acted in concert on an environmental issue before there was substantial damage to the environment and health—in effect, acting together in anticipation of potential problems."\textsuperscript{138}

\textsuperscript{131} Brodeur, \textit{supra} note 3, at 80.
\textsuperscript{132} \textit{Id.} "CFCs have a long lifetime in the atmosphere—unlike many other gases, they are not readily broken down and removed from the atmosphere. Rather, they build up; they accumulate." Benedick, \textit{Protecting the Ozone Layer}, \textit{Dep't of St. Bull.} 63 (April 1985) [hereinafter \textit{Protecting the Ozone}].
\textsuperscript{133} A. Springer, \textit{supra} note 2, at 14.
\textsuperscript{134} \textit{Id.}
\textsuperscript{135} See \textit{supra} notes 79, 86, 87, 118-21, and accompanying text.
\textsuperscript{136} "Vienna Convention" refers to the treaty which was adopted and opened for signature on March 22, 1985, while "Vienna Conference" refers to the meeting which culminated in that treaty.
\textsuperscript{137} Johnston, \textit{supra} note 6, at 271.
\textsuperscript{138} Benedick, \textit{International Cooperation to Protect the Ozone Layer}, \textit{Dep't of St. Bull.} 58 (June 1986) (address made by Richard E. Benedick, Deputy Assistant Secretary for
Although a "landmark event," the Vienna Conference did not achieve all of its goals. A major objective of the delegates was to reach an agreement on the provisions of a draft protocol on chlorofluorocarbons. Two distinct control strategies were proposed: One, sponsored by Norway, Finland, Sweden, Switzerland, Canada, and the United States, called for an international aerosol ban protocol and the other, offered by the European Economic Community, recommended a thirty percent reduction in aerosol use and a limit on future CFC production capacity. No consensus was reached as to the appropriate strategy, but the delegates did agree on a resolution asking UNEP to convene a series of international workshops "to continue work on a protocol that addresses both short and long term strategies to control equitably global production emissions and uses of CFCs, taking into account the particular situation of developing countries as well as updated scientific and economic research." Furthermore, the delegates authorized UNEP to "convene a Diplomatic Conference, if possible in 1987, for the purpose of adopting such a protocol."

Despite their inability to agree on any global control measures as to the production and use of CFCs, those attending the Vienna Conference did meet their minimal objective by adopting the Vienna Convention for the Protection of the Ozone Layer. The Convention, which consists of twenty-one articles and two annexes, "creates a framework for international cooperation on research, monitoring, and information exchange concerning the ozone layer." More specifically, the Vienna Convention imposes an obligation on its signatories to take "appropriate measures . . . to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer." By "appropriate measures," the drafters suggest at least four kinds of commitments:

(a) to cooperate 'by means of systematic observations, research and information exchange . . .';
(b) to adopt 'appropriate legislative or administrative measures and cooperate in harmonizing appropriate policies to control, limit,
reduce or prevent harmful activities under their jurisdiction or control . . . ;’
(c) to cooperate in the ‘formulation of agreed [implementation] measures, procedures and standards . . . ’; and
(d) to cooperate with ‘competent international bodies’ for purposes of implementation.144

The Convention also contains a dispute resolution provision, but the provision does not expressly obligate conflicting parties to resort to arbitration or litigation before the International Court of Justice where a settlement is not reached through negotiation or mediation.145

Forty-three governments were represented at the Vienna Conference in March 1985. By June 1986, twenty-six of those countries and the EEC had become signatories to the convention.146 The mere signing of the Convention, however, does not give it any legally binding effect: only after twenty nations have ratified it will the Convention become international law.147 As of January 1987, six of the signatory countries had deposited their ratifications with the UN; Canada and the Soviet Union took that step in June 1986 and the United States in August of that year.148 Ambassador John D. Negroponte, Assistant Secretary for Oceans and International Environmental and Scientific Affairs, predicted in March 1986 that the Convention would enter into force “perhaps within the next two years.”149 If and when the requisite twenty nations do ratify the Convention, it will still only impose an obligation to work cooperatively to research, monitor, and exchange information concerning the ozone layer. As the Convention now exists, it does not provide for controls on the manufacture or use of CFCs.

B. Complicating Factors

The failure of the Vienna Convention to reach an international agreement calling for reduction in CFC production and use graphically illustrates a number of factors which make the ozone depletion problem such a difficult one to solve. First, because ozone depletion has been linked with CFC emissions, the problem involves economic and not just environmental concerns. Eight years after the EPA im-

144 id. art. 2(2), quoted in Johnston, supra note 6, at 273.
145 id. art. 11(3), quoted in Johnston, supra note 6, at 273.
146 UNEP/GC.13/16, supra note 120; International Cooperation, supra note 138, at 60 (statement by Ambassador John D. Negroponte, Assistant Secretary for Oceans and International Environment and Scientific Affairs, before the Senate Foreign Relations Committee on March 18, 1986—advocating ratification of the Convention).
148 This information was gathered from the “Current Actions” section of the Department of State Bulletin from April 1985 to January 1987.
149 International Cooperation, supra note 138, at 59.
posed its ban on aerosol uses of CFCs, five U.S. companies were still selling an estimated $750 million worth of CFC products annually.\textsuperscript{150} Clearly, CFC producers have a vested interest in keeping their products on the market. To this end, a group of producers and industrial users of CFCs formed the Alliance for Responsible CFC Policy in the summer of 1980 and have ardently lobbied to prevent regulation of the chemicals.\textsuperscript{151} From an economic standpoint, there remain two major obstacles to such regulation: “First, adequate substitutes, which do exist for aerosol propellants, have not been developed for other [CFC] uses, which account for approximately 45 percent of total [CFC] production . . . . Second, a rapid move to substitutes, where they do exist, entails significant economic cost to industries presently dependent on [chlorofluorocarbons].”\textsuperscript{152} Well aware of the burden additional CFC regulation would place on their economies, both factions of the Vienna protocol supported controls which basically mirrored what they already had in place.\textsuperscript{153}

Economics is an important aspect of the ozone depletion problem not only because of the friction between environmentalists and industrialists over the issue of controls, but also because of the conflicting views of developed and developing countries as to the priority to be given the problem. As indicated in the previous discussion of the Stockholm and Nairobi Conferences, developing nations originally viewed concerns for the environment and economic development as separate and incompatible.\textsuperscript{154} By 1982, when the Nairobi Conference convened, there was some recognition by developing nations that these two concepts are inseparable.\textsuperscript{155} Present tangible problems, however, continue to take priority over future intangible ones. This is especially true in developing countries where the present tangible needs are often for basic food, shelter, and clothing. Accordingly, the Bangladesh representative attending the 1977 meeting of the UNEP Governing Council expressed concern over the Council’s preoccupation with the ozone issue.\textsuperscript{156} A report of that meeting noted:

Bangladesh reminded the Governing Council of the real priorities as seen by a poor nation with repeated natural disasters such as floods and tidal waves. To us, said the Bangladesh representative, the controversy over harm caused to the ozone layer by spray products is simply not relevant. Increasing soil productivity, coping with natural disasters and meeting basic human shelter needs are the areas in which the country should concentrate.\textsuperscript{157}

\textsuperscript{150} Hoppe, supra note 10, at 110.
\textsuperscript{151} Brodeur, supra note 3, at 77.
\textsuperscript{152} A. SPRINGER, supra note 2, at 23.
\textsuperscript{153} See International Cooperation, supra note 138, at 58.
\textsuperscript{154} See supra notes 126-29 and accompanying text.
\textsuperscript{155} See supra notes 128-29 and accompanying text.
\textsuperscript{156} See A. SPRINGER, supra note 2, at 23.
\textsuperscript{157} Id. at 23-24.
While that statement was made ten years ago, the current tangible needs of Bangladesh and other developing countries, unfortunately, have not drastically changed.

A second aspect of the ozone depletion problem that makes it especially hard to confront and which has prevented broad controls on CFCs is the scientific uncertainty pervading the issue. Chlorofluorocarbon producers have repeatedly pointed to this uncertainty as justification for not ceasing their manufacture of the chemicals. Governments, too, have cited the scientific uncertainties in atmospheric chemistry as a major reason for not taking a strong stance in terms of controls on CFC production and use. For instance, in the late 1970s, England and France "expressed considerable skepticism about the extent of the hazard; they conceded that Rowland and Molina's ozone-depletion hypothesis might be correct, but they advocated a wait-and-see approach, claiming that there were too many uncertainties in atmospheric chemistry to warrant regulation of an important industry." Even in the light of the Antarctica findings, these two countries have retained such a posture and continue to ardently oppose any controls on CFCs that might result in unemployment or harm their international trade position.

Those advocating either strict cutbacks or total bans on CFC production have not claimed to be absolutely certain that there will be catastrophic damage to the ozone if such production goes unchecked, but they have challenged the level of certainty which industry has demanded. Professor Rowland derided DuPont particularly for this reason:

Back in 1974, an official of the du Pont Company told a congressional subcommittee that if credible evidence should be developed to show that [CFCs] posed a hazard to human health du Pont would stop manufacturing them. These days, the [CFC] industry appears to have decided that it does not intend to consider any evidence credible as long as there is the slightest doubt about the validity of any part of the ozone-depletion hypothesis.

If stricter regulations must be preceded by such "credible evidence," it is doubtful that they will be adopted for some time. As Ambassador Richard Benedick observed: "[D]ue to the nature of the science and our capacity for stratospheric measurement, the uncertainties are likely to remain for many years." Benedick has therefore concluded: "We must soberly ask ourselves: what are the consequences

158 Brodeur, supra note 3, at 75.
159 See Chlorine Found, supra note 21, at C7, col. 2.
160 Brodeur, supra note 3, at 83. The veracity of Professor Rowland's claim was apparently confirmed by Dr. Elwood P. Blanchard, a vice president of E.I. du Pont de Nemours and Co., during a House subcommittee meeting in March 1987. Dr. Blanchard insisted that "no unequivocal trends of ozone depletion have yet been verified" and that "the changes noted in Antarctica cannot be extrapolated to the rest of the world." Chlorine Found, supra note 21, at C7, col. 1 (emphasis added).
161 Protecting the Ozone, supra note 132, at 63.
of delay if we insist on 100% certainty and fail to take action now?"162

At least one other major factor can be identified as a hindrance to a Vienna Protocol to control CFC production and use—state sovereignty. This concept is memorialized in article 2(7) of the United Nations Charter and represents a basic tenet of international law.163 One writer has suggested that because international law accords to States such a high degree of control over human activity within their boundaries, it appears to be incompatible with effective protection of the biosphere.164 Others contend that "national sovereignty" and "freedom of the seas," "permit a state 'to degrade its own territory . . . [and] to inflict injury on areas of the planet outside national territory virtually without limit,' subject only to fragmented and primitive values of international responsibility."165 More specifically, state sovereignty has been described as "an underlying 'roadblock' to international cooperation, and even an anti-thesis to a law of cooperation."166 Because international cooperation is the keystone of the Vienna Convention for the Protection of the Ozone Layer, its success and the success of future work on the protocol depends on the extent to which individual nations forego their sovereign rights and take concerted action to preserve and protect their common environmental heritage. The six nations which have ratified the Vienna Convention have at least taken a step towards that end.

V. The Search for an International Legal Solution

Based on the foregoing discussion, it should be apparent that the problem of ozone depletion is one of the more difficult issues facing international policymakers in the 1980s.167 As has been

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162 Id. Apparently, the data compiled by the U.S. Nimbus-7 satellite and the increased focus on the "Antarctica Ozone Hole" has led major CFC producers to begin taking the threat of ozone deterioration more seriously. In September 1986, the Alliance for a Responsible CFC Policy suggested that the United States set a "reasonable" limit on future growth of global CFC production. "'On the basis of current information, we believe that large future increases in CFCs would be unacceptable to future generations,' declared Richard C. Barnett, the alliance's chairman and a vice-president at York International, a producer of air conditioners." Hoppe, supra note 10, at 110. The Alliance's notion of what constitutes a "reasonable" limit, however, is not clear.

163 See W. Gormley, supra note 49, at 58.
164 See A. Springer, supra note 2, at 31.
166 See W. Gormley, supra note 49, at 58.
167 Bob Watson, an atmospheric chemist with NASA's Earth Sciences Division in Washington, D.C., observed in 1985: "I feel sorry for policy makers because they have to try to make international policy just as predictions about damage to the ozone layer are changing substantially—every time there's been an assessment report, the numbers change." Mathewson, supra note 1, at 166. While advanced technology has helped stabilize predictions, Watson's point—that policy makers in this area are not in an enviable position—is still valid because of the complexities of the problem.
noted, efforts have been made on national, regional, and international levels to deal with a perceived basis of the problem—CFC emissions. The remainder of this paper will be devoted to a critique of those efforts, focusing on both governmental and nongovernmental response to this significant environmental issue.

A. Governmental Responses

Governmental responses to the ozone depletion dilemma have been initiated on basically three levels—unilateral (or national), regional (or multinational), and international (or global). Each of these approaches has its merits, and efforts on all three levels have been successful to some extent in dealing with the ozone problem. The current status of CFC controls, however, suggests that there is still significant work to be done at all levels of government. Moreover, while there are strong advocates for each of these approaches, few would contend that a complete solution lies in any single one of them.

Individual nations, rather than transnational organizations, were the first to recognize the CFC problem and the first to begin scientific and economic assessments and eventually regulation of the chemicals.  

The United States has taken the forefront in this regard beginning with the imposition of a ban on the production and shipment of CFCs for nonessential uses back in 1978, and continuing to date with the efforts of the 99th Congress to pass legislation that would freeze production of the chemicals at current production levels and that would halt the importation of products containing or made with CFCs. Canada, Finland, Norway, and Sweden have also taken unilateral action to reduce CFC emissions.

As a response to international environmental concerns, unilateral state action has both its advantages and disadvantages. At least five advantages can be noted:

[(1)] The promptness with which state power and sanctions can be effectively brought to bear against conduct or activities threatening environmental injury[;] . . . [(2)] action by one state may furnish precedents and experiences upon which other states can usefully draw[;] . . . [(3)] in certain circumstances [unilateral action may] have a wide ranging and even global beneficial environmental impact, far exceeding any immediate effect within the acting state’s territory or on its nationals[;] . . . [(4)] it may help to promote the development of relevant international environmental agreements[;] . . . [and

168 See Stoel, supra note 79, at 65. Stoel suggests that this fact “reflects the truism that this remains a world of sovereign nation-states.” Id.
169 Worldwide Pact, supra note 37, at 14, col. 2.
170 Mathewson, supra note 1, at 165.
171 The term “unilateral state action” is referred to in a broad sense as “any action which a state takes solely on its own, independent of any express cooperative arrangements with any other state or international institution.” Bilder, The Role of Unilateral State Action in Preventing International Environmental Injury, 14 Vand. J. Trans’l L. 53 (1981).
unilateral state action may have a desirable impact on the evolution of progressive customary international norms concerning environmental protection.\textsuperscript{172}

With the exception of the third advantage cited above,\textsuperscript{173} the action taken by the United States on the ozone issue has evidenced these benefits. First, the present lack of international controls on the manufacture and use of CFCs confirms that had the United States waited for an international consensus on even a limited ban, it would still be waiting. Second, at least four nations followed the United States’ example by imposing bans on various phases of the CFC industry.\textsuperscript{174} Third, U.S. leadership both in terms of CFC controls and in terms of ozone research has no doubt played an important role in “the development of relevant international environmental agreements,” such as the Vienna Convention, and has been instrumental in the progress towards a protocol calling for global cutbacks on CFC production.\textsuperscript{175}

In contrast to the advantages of unilateral state action delineated above, there are a number of possible disadvantages of such action as well. These disadvantages include:

1. Unilateral action ... tends to discourage the growth of international order based upon mutual accommodation, cooperation, and international law; ... 2. such action may create international tensions and conflicts; ... 3. it may be inherently limited in its efficiency and effectiveness; ... 4. unilateral environmental action may be disproportionate interference with international trade and other transnational activities in terms of the practical needs and goals of environmental control; ... 5. and (5) such action may involve substantial competitive risks for acting states.\textsuperscript{176}

To a large extent, these disadvantages are also exemplified in the U.S. response to the ozone problem. For example, tension has developed between the United States and those nations which have not acted either unilaterally or internationally to control CFCs. This tension is evidenced by the fingerpointing by members of the U.S. Congress who have charged that the European Community, Japan, and the Soviet Union have been “dragging their feet on an international agreement to protect the ozone shield in order to serve their

\textsuperscript{172} Id. at 79-83. The author explains more fully why these are advantages.
\textsuperscript{173} A major disincentive to strict ozone controls is the fact that the benefits, if any, of the 1978 cutbacks have not been scientifically proven. The difficulty, and perhaps impossibility, of attaining such proof can be explained by at least two factors: (1) worldwide aerosol and non-aerosol uses of CFCs has increased since 1978, despite the ban, Mathewson, \textit{supra} note 1, at 165; and (2) scientists believe that chlorine may build up to a critical point after which ozone deterioration may be rapid and precipitous and irreversible through short-term human actions, \textit{Protecting the Ozone Layer, supra} note 132, at 63.
\textsuperscript{174} See \textit{supra} note 169 and accompanying text. See also Stoel, \textit{supra} note 79, at 59-60.
\textsuperscript{175} See \textit{supra} notes 139-41 and accompanying text. “The United States, both as a government and through the private sector, is the leading contributor to world scientific knowledge on the ozone layer and the impacts of potential depletion.” \textit{International Cooperation, supra} note 138, at 60.
\textsuperscript{176} Bilder, \textit{supra} note 171, at 83-86.
own narrow economic self-interest." Furthermore, if U.S. unilateral environmental action on the ozone issue takes the form of a ban on all imports of products containing or made with CFCs, as has been proposed, such action would necessarily result in interference with international trade and other transnational activities to a degree that arguably outweighs the practical needs and goals of CFC control. A third disadvantage of taking unilateral action on the ozone problem would be exemplified if the above-mentioned Congressional proposal were to become effective—those companies currently producing CFCs in this country might move their factories to countries with more lenient, or nonexistent, controls. Such a pattern could result in a substantial economic loss to the United States and parallel gain to those countries allowing the production of chlorofluorocarbons.

The observation that unilateral environmental action "may be inherently limited in its efficiency and effectiveness," not only highlights a disadvantage of that approach but also indicates an advantage of regional or international responses to environmental concerns. At least in terms of seeking more certainty as the science of the stratospheric ozone layer and its implications for the quality of life in the troposphere, the broader, cooperative efforts of nations will undoubtedly foster a greater understanding. The drafters of the Vienna Convention emphasized this need for cooperation, imposing on the Convention's signatories the obligation to take "appropriate measures...to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer." In article 2, section 2 of the Convention, these "appropriate measures" are defined in terms of four kinds of cooperative commitments, including cooperation "by means of systematic observations, research and information exchange."

While cooperation is the key to the success of regional or international efforts to confront the ozone problem, it has also been its stumbling block. As has been noted, a major tenet of international law is state sovereignty, a concept often at odds with the notion of international cooperation. To the extent that concerns for national economic welfare have taken precedence over concerns for the global environment, state sovereignty has hindered effective transna-

177 Worldwide Pact, supra note 37, at 14, col. 1.
178 Id. at 14, col. 2.
179 The "argument" is one that has been, and no doubt will continue to be, made by those profiting from the CFC industry.
180 Bilder, supra note 171, at 84.
181 Vienna Convention, supra note 121, art. 2(1).
182 Id. art. 2(2). For a listing of these four types of commitments, see supra note 144 and accompanying text.
183 See supra notes 168-66 and accompanying text.
tional responses to the problem of ozone depletion. Because regional institutions such as the EEC and the OECD are, to some extent, economic institutions, they have the potential to play an important role in addressing the ozone dilemma. By demanding CFC controls by all of their Member States, these two bodies can lessen the possibility of at least one disadvantage of unilateral action—invoking “substantial competitive risks for acting states.” Admittedly, such risks will still exist but to a lesser extent where there is regional commitment to a particular action because Member States, at least, will be on parity.

International organizations, because of their broader approach, are in a position to more efficiently and effectively confront global environmental problems than are regional organizations. However, while cooperation among Member States has been a major hurdle for regional organizations attempting to deal with the ozone problem, it has been virtually a wall at the international level. The Vienna Convention is the most effective response to date by an international institution, the UNEP, yet it has only been ratified by six of the requisite twenty nations for it to become international law. If and when the Convention does attain the force of law, however, it will do little more than impose on its signatories the obligation to cooperate in their research efforts, to harmonize control policies, to establish measures, procedures and standards, and to cooperate in the implementation of such policies. Unless agreement can be reached on an international CFC control protocol, as was attempted at the Vienna Conference, the Convention itself will be ineffective as a regulatory tool.

B. Nongovernmental Responses

While governments, acting unilaterally, regionally, and internationally, should continue to contribute to the effort to solve the ozone problem, they cannot do it alone. As Ambassador Benedick suggested, “[n]ew coalitions must be forged, involving citizens’ groups, academic and research institutions, legislators, multilateral

184 A possible solution to this problem is to set up a system of financial assistance to those countries which cannot afford to burden their industries with emissions regulations. See Lutz, supra note 51, at 198.
185 See supra notes 77-87 and accompanying text.
186 Bilder, supra note 171, at 86.
187 See supra note 148 and accompanying text. It has taken two years for these six nations to obtain the approval of their respective governments.
188 See Vienna Convention, supra note 121, art. 2(2).
189 See supra notes 139-41 and accompanying text.
190 Significantly, Ambassador Negroponte, in urging the Senate Foreign Relations Committee to support the Vienna Convention, observed: “It does not commit the United States to additional regulatory undertakings . . . . We have determined that the convention does not have any significant environmental impact and is, in fact, expected to be beneficial to the United States.” International Cooperation, supra note 138, at 59.
organizations, and private industry."  

In some form, all of these types of coalitions have been forged in response to the ozone depletion concern. In the United States, for instance, environmental groups such as the Natural Resources Defense Council (NRDC) and Friends of the Earth have been particularly active in addressing the ozone problem. A senior staff member of the NRDC, David Doniger, recommends an eighty percent cut in worldwide production of CFCs within five years and the complete phaseout of the chemicals in ten years. Doniger asserts: "The environmental prospects are, without any exaggeration, disastrous, and 10 years is a practical period for industry to develop safe alternatives." Those representing Friends of the Earth, though probably in support of government-enforced bans of CFC production, have taken a different approach to the ozone dilemma. They recently announced a consumer campaign designed to alert the public about styrofoam packaging and other commonly used products that contain chemicals (CFCs) which harm the ozone layer.

The work of Friends of the Earth and the NRDC in bringing the problem of ozone depletion before the public is an important non-governmental response to this issue, but clearly the greatest potential for dealing with the chlorofluorocarbon connection lies with the CFC industry itself. As multinational corporations (MNCs), those who manufacture these chemicals or who use them for industrial purposes are in a position to substantially influence the world community, especially the international business world. For instance, if DuPont, the world's largest producer of CFCs, voluntarily began to cut back on production of the chemicals and to put more energy into finding viable alternatives to CFCs, such action would have a tremendous impact on other chemical companies. In recent months, there has apparently been some recognition by the industry that some control measures, though short of total bans, may be needed. In September 1986, the Alliance for a Responsible CFC Policy suggested that the United States set a "reasonable" limit on the future growth of global CFC production.
VI. Conclusion

The recent responses by governmental and nongovernmental groups to solve the problem of ozone depletion clearly evidence the breadth of that problem. Addressing this dilemma is a difficult task for policymakers at all levels of government because of such complicating factors as the scientific uncertainty which pervades atmospheric chemistry, the economic, social and political realities of the modern world, and the foundational tenet of international law which recognizes the sovereign power of individual States over the peoples and activities within their jurisdiction. Satellite transmissions indicating at least 0.5 percent depletion in the ozone layer per year globally and forty to fifty percent deterioration over Antarctica every autumn suggest that these challenges must be met and overcome. The threat to human health and the health of all biosystems on Earth from the resultant increase in ultraviolet radiation is too grave to continue with a wait-and-see approach.

Because chlorofluorocarbon emissions have been linked with some certainty to the destruction of the stratospheric ozone layer, the logical first step in implementing a plan to protect the ozone is by imposing restrictions on the manufacture and use of these chemicals. To this end, the United States and several other countries have placed bans on the manufacturing of CFCs for aerosol uses. Despite these actions, CFC use is on the rise throughout the world, indicating that more drastic measures need to be taken. On a unilateral level, the U.S. Congress is now debating over whether to pass legislation that would freeze production of the chemicals at current production levels and that would halt the importation of products containing or made with CFCs. This proposed legislation should be supported even though the anticipated benefits may not be scientifically measurable or provable for some time. Regionally, there have been few significant efforts to confront the ozone dilemma. Organizations such as the EEC and OECD should not expect the UNEP to solve the problem alone, and given their economic orientation, they are especially well qualified to initiate controls on a transnational level.

On an international level, the Vienna Convention marks the most significant attempt to deal with the ozone problem. Without the inclusion of the hotly-debated protocol calling for CFC controls, however, the Convention will have little, if any, regulatory effect. Sincere efforts must be made to agree on a meaningful protocol demanding significant cutbacks in CFC production and use. The Convention, because of its emphasis on cooperative research efforts among signatory nations, does have value within itself and should be ratified by those nations genuinely concerned about the ozone depletion problem.
In conclusion, the problem of ozone depletion is clearly one of international dimensions and one that should be addressed on an international level. This does not mean that unilateral and regional attempts to confront the problem are of no use. On the contrary, these efforts very often provide examples of the types of controls which can be reasonably achieved. Unilateral and regional approaches, however, should not be viewed as an end in themselves, but rather as a means to an end—international cooperation to preserve and protect the ozone layer. Cooperation really is the bottom line.

Wendy J. Simpson