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International Cooperation in Protection of Atmospheric Ozone: The Montreal Protocol on Substancese That Deplete the Ozone Layer

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I. INTRODUCTION

On September 14, 1987, in Montreal, Canada, 24 countries signed a landmark Protocol[1] to the Vienna Convention for the Protection of the Ozone Layer,[2] thereby taking a large step toward solution of the global environmental problem posed by the depletion of atmospheric ozone. The importance of this Protocol is two-fold: it serves to reduce the production of pollutants responsible for atmospheric ozone destruction, and it represents a milestone in the field of international environmental cooperation—it is the first time the international community has banded together to eliminate an environmental threat *before* serious damage has occured. As such, the Protocol might help set a precedent for solving other environmental challenges faced by the global community.

By focusing on both these aspects of the Protocol, this article will attempt to provide a thorough analysis of the ozone problem. After a summary of the scientific background of the current threat to atmospheric ozone, the article will discuss the Protocol's historical background, analyze its provisions, and highlight its significance for the field of international environmental law in general. It is hoped that this discussion will serve to demonstrate just how unique and revolutionary the Protocol is, as well as emphasize the scope and severity of the problem of atmospheric ozone depletion.

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1. Montreal Protocol on Substances that Deplete the Ozone Layer, Sept. 16, 1987, *reprinted in* 26 I.L.M. 1541 (1987) [hereinafter Protocol].

2. Vienna Convention for the Protection of the Ozone Layer, March 22, 1985, *reprinted in* 26 I.L.M. 1516 (1987) [hereinafter Vienna Convention].

II. THE PROBLEM OF DEPLETION OF THE OZONE LAYER: AN OVERVIEW

A. *The Chemistry of Atmospheric Ozone*

Ozone is a relatively unstable variety of oxygen consisting of three atoms of that element bonded together to form a molecule; its chemical formula is O3.[3] Ozone is constantly being created in the upper atmosphere by the action of sunlight on diatomic oxygen molecules (O2), and is simultaneously destroyed by a number of complex reactions involving several gaseous elements.[4] The total concentration and vertical distribution of atmospheric ozone is determined by the combined effect of these processes, which may create and remove ozone at different rates and at different altitudes.[5] Atmospheric ozone absorbs short-wave ultraviolet solar radiation, preventing most of it from reaching the Earth's surface.[6] Ozone also absorbs varying amounts of infrared radiation, and is thus an important factor in the maintenence of atmospheric temperature.[7]

Normally, chemical processes in the upper atmosphere produce and destroy ozone at roughly equal rates, maintaining a balance. In recent years, however, scientific studies have shown that this balance is no longer being maintained, and that the ozone layer is suffering a relatively high rate of depletion.[8] More recently, public attention has been focused on the ozone problem by the discovery of a "hole"[9] in the ozone layer over Antarctica, which occurs at certain times of the year and seems to be growing. This is a manifestation of the unique atmospheric conditions which prevail in the Antarctic, and of recently observed trends, which seem to indicate that ozone depletion is occuring more rapidly at higher latitiudes (above 40 degrees north and south) than near the equator.[10]

Scientific studies[11] have linked ozone depletion to a number of chemical agents, some of which occur naturally, but all of which are by-products of industry. These include nitrogen oxides (NO2), nitrous oxide

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3. This discussion of the scientific basis of the ozone problem is derived mainly from *Causes and Effects of Changes in Stratospheric Ozone: Update 1983* [hereinafter *Update 1983*], prepared by the Environmental Studies Board of the National Research Council, and published by the National Academy Press in 1984. For more detailed information on scientific aspects of the ozone problem, *see* the bibliographies in this book and its predecessor, *Causes and Effects of Stratospheric Ozone Reduction: An Update* [hereinafter *An Update*, as well as, *generally*, Whitten & Prasad, *Ozone in the Free Atmosphere* (1985).

4. *Update 1983*, *supra* note 3, at 3.

5. *Id.*, at 50-94.

6. *See* Bruce, *Man's Impact on Earth's Atmosphere*, in 1 J. TITUS, EFFECTS OF CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE 35, 44 (1986).

7. *See* Environmental Assessment of the Vienna Convention for the Protection of the Ozone Layer, *reprinted in* 26 I.L.M. 1524 (1987).

8. *See An Update*, *supra* note 3, at 2.

9. The famous "hole" observed in the ozone layer over the Antarctic in the 1970's and '80's is not a true hole, but is rather an area of seasonal 40-50% thinning in the stratospheric ozone layer. *See* Bruce, *supra* note 6, at 44.

10. *Id.* at 48.

11. *See generally*, *An Update* and *Update 1983*, *supra* note 3.

(N2O), methane (CH4), carbon dioxide (CO2), and the chlorofluorocarbons (abbreviated as CFCs), which are the worst offenders.[12] CFCs are man-made chemicals used primarily in aerosols and in cooling systems, such as refrigerators and air conditioners. These chemicals are especially harmful to atmospheric ozone because they are not easily destroyed by natural processes in the upper atmosphere, and may remain in the stratosphere, continually breaking down ozone molecules, for 100 years or more.[13] Due to the fact that other agents linked to ozone depletion, such as carbon dioxide and methane, are less persistent, and are produced by natual processes in significant quantities,[14] the Montreal Protocol imposes controls on chemicals in the CFC family only.[15]

B. Environmental Effects of Ozone Depletion

Since atmospheric ozone absorbs short-wave ultraviolet radiation (UV-B radiation),[16] any depletion results in higher levels of these harmful rays penetrating the atmosphere and reaching the Earth's surface.[17] It appears that short-wave ultraviolet radiation has a variety of detrimental effects on animal and plant life, especially on aquatic organisms.[18] Studies show that increased levels of UV-B at the surface may stunt the growth of certain crop types, and may also inhibit plant reproduction.[19]

While a number of studies have attempted to measure the effects of increased UV-B on animals,[20] the majority have focused on humans. UV-B radiation produces a variety of effects in humans, ranging from suntan to skin cancer, according to the amount of exposure and sensitivity of the individual.[21] UV-B has been shown to be causally linked to suppression of

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12. *See Update 1983, supra* note 3, at 5.

13. *Id.*, at 96; *see also* Bruce, *supra* note 6, at 41.

14. Carbon dioxide is, of course, a by-product of animal respriation as well as product of industry. Methane is produced by various decomposition processes. For a more complete discussion of the sources and effects of these and other gases on ozone depletion, *see* Bruce, *supra* note 6, at 41.

15. Annex A to the Montreal Protocol contains a list of chemicals covered by the treaty's controls, these are divided into two groups: chlorofluorocarbons and halons; these two classes are lumped together and abbreviated for convenience's sake throughout this paper as CFCs.

16. *See* Bruce, *supra* note 6, at 44.

17. *Id.* For every one percent depletion in atmospheric ozone, there is a corresponding two percent increase in the amount of UV-B radiation which reaches the earth's surface.

18. The organisms which are affected by increased UV-B radiation are generally those which live at or near the ocean's surface, and include plankton, fish larvae, and larval shrimp and crabs. UV-B appears to disrupt the reproductive viability of these creatures, and may also shorten their lifespans. *See Update 1983, supra* note 3, at 218; Letter of Submittal from the Department of State to the President of the Vienna Convention for the Protection of the Ozone Layer, August 22, 1985, *reprinted in* 26 I.L.M. 1518 (1987).

19. *See Update 1983, supra* note 3, 209-215, *see generally*, Teramura, *Overview of Our Current State of Knowledge of UV Effects on Plants*, in J. TITUS, EFFECTS OF CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE, 65.

20. *Update 1983, supra* note 3, at 191.

21. *See generally*, Emmett, *Health Effects of Ultraviolet Radiation*, J. TITUS, EFFECTS

the human immune system as well as to various types of skin cancer.[22] Since the ozone layer normally prevents a large percentage of UV-B radiation from reaching the Earth's surface, any depletion of atmospheric ozone leads directly to a higher incidence of skin cancer and immune system suppression in humans. While the exact figures are as yet undertermined, it is estimated that for each one percent decrease in the amount of atmospheric ozone there will be a corresponding increase of between two and four percent in the incidence of human skin cancer.[23]

III. INTERNATIONAL RESPONSE TO THE OZONE DEPLETION PROBLEM: THE ROAD TO THE MONTREAL PROTOCOL

The depletion of the stratospheric ozone layer was first noticed by scientists in 1974.[24] Over the next few years, as the scientific community began to realize the potential threat to mankind and the environment posed by this problem, international attention and concern increased.[25] In 1977, in response to this growing concern, the United Nations Environmental Program (UNEP) convened an International Conference on the Ozone Layer, and shortly thereafter established a Coordinating Committee on the Ozone Layer.[26] This committee, composed of representatives from a consortium of international, governmental, and non-governmental organizations, conducted and coordinated research on the depletion of atmospheric ozone, published assessments of the problem, and made recommendations for its solution.[27] Additionally, in 1980, the Governing Council of the United Nations convened a working group to discuss possible international action.[28]

The work of these two groups[29] reached its culmination at a conference in Vienna in March 1985, where twenty-one nations signed the Vienna Convention for the Protection of the Ozone Layer.[30] This document, which the U.S. Senate ratified in 1986,[31] contains no significant substantive provisions regarding reduction of CFCs, but instead sets up a framework for internationally coordinated study of the ozone problem.[32] The

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OF CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE 129 (1985).

22. Emmet, *supra* note 21, at 138; *An Update*, *supra* note 3, at 241.

23. *See* BRUCE, *supra* note 6, at 44.

24. Golubev, *Global Environmental Change: The UNEP Perspective*, in J. TITUS, EFFECTS OF CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE 22 (1985).

25. Benedick, *Global Environmental Change: The International Perspective*, J. TITUS, EFFECTS AND CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE 32 (1985).

26. Golubev, *supra* note 24, at 22.

27. *Id.*

28. Benedick, *supra* note 25, at 32.

29. For an overview of the process which led to the Montreal Protocol, *see* Reports of the Ad Hoc Working Group of Legal and Technical Experts for the Elaboration of a Protocol on Chlorofluorocarbons to the Vienna Convention for the Protection of the Ozone Layer, UNEP Doc. WG.151/L.4, UNEP Doc. WG.167.

30. Vienna Convention, *supra* note 2.

31. *Sen. Treaty Doc.* 99-9, ratification deposited Aug. 27, 1986.

32. Vienna Convention, *supra* note 2, arts. 3, 4.

Vienna Convention also provides for transfer of information regarding the problem, promotes regular conferences of the parties, and sets up a secretariat to encourage the adoption of measures to prevent further depletion of the ozone layer.[33] In short, the Convention was designed to foster an atmosphere of international cooperation in order to enable substantive measures to be developed at a later date, if they were found to be necessary. The Convention's effectiveness in reaching this goal is evidenced by the relative ease with which the Montreal Protocol was adopted two years later.

IV. MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

A. Background

As the above discussion of the genesis of the Vienna Convention indicates, the signatories and sponsors of the treaty recognized the probable need for a Protocol to impose substantive controls on the production and consumption of CFCs. In order to assess this need, UNEP arranged for a summarization of the findings of the Coordinating Committee,[34] and sponsored two workshops of the Working Group, in May and September, 1986, in order to assess the need for and outline the form of a Protocol.[35] Among the findings[36] were a number of dire predictions, which indicated that even if immediate action were taken to freeze CFC production and consumption levels ozone depletion would continue for at least one hundred years.[37] It was apparent that the only way to stabilize the stratospheric ozone situation was to mandate deep cuts in global consumption and production of CFC's. The Montreal Protocol was the international community's response to this challenge.

B. Analysis of Substantive Provisions

In order to slow and eventually end the process of atmospheric ozone depletion, the Montreal Protocol imposes a variety of controls on the production, consumption, importation, and export of a number of harmful chemicals, mostly chlorofluorocarbons.[38] The controls are based on 1986 levels of production and consumption of two groups of ozone-depleting chemicals,[39] as calculated according to a formula in Article 3.[40] Parties are

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33. *Id.*, arts. 2,5-7.

34. Golubev, *supra* note 24, at 23.

35. *Id.*

36. For a report of these findings, *see generally* TITUS, supra note 6.

37. *See generally* Hoffman, *The Importance of Knowing Sooner*, J. TITUS, ed., *supra* note 6, at 53.

38. See Annex, *supra* note 9. The controls apply to two groups of chemicals, CFCs and halons. Halons are chemically related to CFCs, and are suspected to have even higher ozone-depleting potential than the more common chlorofluorocarbons.

39. *Id.*

40. Protocol, *supra* note 1, art. 3. This formula assigns a numerical factor to each con-

required[41] to limit production and consumption of the specified CFCs and halons to 1986 levels by the beginning of the second six month period following the entry into force of the Protocol.[42] Article 2 of the Protocol limits production and consumption of the controlled chemicals to 80%[43] of 1986 levels for a five-year period beginning on July 1, 1993, and further imposes a limit of 50%[44] of 1986 levels as of July 1, 1998.

Taking into account the special circumstances of several of the parties, Article 2 of the Protocol provides for a number of variations on and exceptions to the general controls described above. Article 2(6), for example, allows the Soviet Union to complete CFC production facilities provided for in its most recent five year plan, and to have any additional production from such facilities counted as part of 1986 production and consumption levels for purposes of the Protocol.[45] Article 2(7) allows the member states of the European Community, once they have all individually ratified the Protocol, to apportion production and consumption of the controlled chemicals among the member states in such a way that consumption or production may exceed the prescribed limits in one or more states, so long as the Community *taken as a whole* meets the general requirements of Article 2.[46] A similar provision[47] allows small producers of CFCs to cooperate to apportion production between themselves, provided that overall combined production of these states does not exceed the control levels.

The major exception to the Article 2 controls applies to developing

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trolled substance according to its ozone-depleting potential. Using these factors, a party computes its 1986 production and consumption levels, arriving at a numerical figure. While the party's consumption and production of the controlled substances may not normally exceed this figure, the party may, subject to the limitations of the Protocol, substitute larger amounts of CFCs with a lower rating for smaller amounts of CFCs with a higher rating. A party's total production of controlled substances may thus conceivably increase under the Protocol, although this increased production will consist of substances with a lower ozone-depleting potential.

41. Protocol, *supra* note 1, art. 2(1), 2(2).

42. *Id.*, at art. 16. Article 16 provides that the Protocol shall enter into force on January 1, 1989, so long as at least 11 signatories have ratified it. Otherwise, it becomes effective 90 days after this ratification is accomplished.

43. *Id.*, at art. 2(3). Developed countries are allowed to exceed their 80% production limits by up to 10% if this excess production is required for the advancement of developing countries.

44. *Id.*, at art. 2(4). This section provides a 15% overproduction exception at this stage, under the same conditions described.

45. This concession was apparently necessary to obtain the acceptance of the Protocol by the Soviet Union and other planned economies, who wished to be allowed to complete potentially proscribed CFC production facilities in the planning or construction stages. *See* [Reference File] INT'L ENVT. REP. (BNA) 531 (Oct. 14, 1987).

46. The Eurpopean Community as a whole is bound by the Protocol, although the individual member states must also ratify it. For a discussion of the special circumstances of the EEC vis-a-vis the Protocol, *see* 10 INT'L ENVT. REP. 531 (Oct. 14, 1987).

47. Protocol, *supra* note 1, art. 2(5).

countries,[48] as is outlined in the provisions of Article 5. The drafters of the Protocol recognized[49] the special requirements of these countries for CFC use,[50] and Article 5 thus entitles developing countries to delay compliance with the controls of Article 2 by ten years, so long as per capita consumption of the controlled substances does not exceed 0.3 Kg per annum.[51]

For ten years following the entry into force of the Protocol developing countries party to the Protocol will have the opportunity to increase their production of CFCs and halons in order to enhance economic development.[52] As an additional aid to development, Article 2 also allows developed nations, covered in full by the controls, to exceed production limits by up to 10%, so long as this excess production is used to "satisfy the basic domestic needs" of the developing nation parties.[53]

Apart from direct controls on important sources of ozone depletion, the Montreal Protocol also attempts indirectly to bring about a global reduction in production of these harmful substances. It does this by imposing import and export restrictions on the parties to the Protocol.[54] First, all parties are required to ban the import of controlled substances from non-party states within one year after entry into force of the Protocol.[55] This provision seems intended to curtail production of controlled substances in non-party countries by eliminating a large percentage of the export market for these producers. This may indirectly provide an incentive for CFC-producing countries to become a party to the Protocol, in order to regain a wider market for their products.

Further requirements of Article 4 include a ban on the importation from non-party nations of products *containing* CFCs or halons, to come into effect within 4 years from the entry into force of the Protocol.[56] Article 4(4) goes even further, providing for the possibility of a ban on the import from non-party nations of goods *produced with the aid of controlled substances*, but not actually containing them.

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48. "Developing Country" is never defined for purposes of the Protocol—an omission which could conceivably cause problems in the future.

49. *See* Protocol, *supra* note 1, Preamble.

50. Most developing countries are located in tropical or subtropical regions, and the "special requirements" mentioned in the Protocol refer to the need for refrigeration equipment in these regions. CFCs are utilized as coolants in refrigerators and air conditioners. *See* Golubev, *Global Environmental Change: The UNEP Perspective*, in J. TITUS, *supra* note 6, at 21.

51. Protocol, *supra* note 1, art. 5(1).

52. *Id.* at art. 5(1). Unlike developed countries party to the Protocol, the basis for controls in the developing countries will not be 1986 production and consumption levels, but rather the average level of consumption and production over the three-year period 1995-1997, or 0.3 Kgs per capita.

53. Protocol, *supra* note 1, art. 2(1)-(4).

54. *Id.*, at art. 4.

55. *Id.*, at art. 4(1).

56. *Id.*, at art. 4(3).

The Protocol takes a more liberal stance in regard to export of controlled substances and related goods from party states to non-party states. While developing countries are flatly prohibited.[57] from exporting controlled substances and related goods to non-party countries, there is apparently no prohibition whatsoever on such exports when they involve a developed nation and a non-party. While developed parties are prohibited from granting to non-parties any sort of economic assistance that might "facilitate the production" of controlled substances,[58] they are nevertheless not prohibited from exporting technology for producing and utilizing CFCs and halons; they are only discouraged from doing so.[59] In keeping with the spirit of the Protocol, party states are in no way prohibited or discouraged from exporting" . . . products, equipment, plants or technology that improve the containment, recovery, recycling, or destruction of controlled substances, promote the development of alternative substances, or otherwise contribute to the reduction of the emissions of controlled substances."[60]

Cognizant of the possibility of new developments in scientific knowledge of the relationship between man's activities and the depletion of atmospheric ozone, the drafters of the Protocol included several provisions designed to ensure that the controls contained in the document are coordinated with the latest research developments. The agreement provides that the parties shall research and exchange information on the ozone problem,[61] provide each other with technical and scientific information to facilitate the goals of the Protocol,[62] and hold regular meetings to discuss and assess its implementation.[63] Perhaps most importantly, Article 6 provides for quadrennial meetings of party representatives and scientific experts to assess the efficacy of the Protocol's controls in the light of current information. On the basis of conclusions reached at these meetings, controls will be adjusted according to the procedure outlined in Articles 2 and 9. These controls are designed to promote flexibility, in the hopes that the Protocol will not become quickly outdated.

V. THE MONTREAL PROTOCOL'S PLACE IN THE INTERNATIONAL ENVIRONMENTAL LAW TRADITION

A. Historical Overview of Transfrontier Pollution Law

In order to fully appreciate the Montreal Protocol, it may be helpful to look at the development of international environmental law, specifically that area of law dealing with state responsibility for transfrontier pollution. The unique nature of the Protocol can be fully appreciated

57. *Id.*, at art. 4(2).
58. *Id.*, at art. 4(5).
59. *Id.*, at art. 4(6).
60. *Id.*, at art. 4(7).
61. *Id.*, at art. 9.
62. *Id.*, at art. 10.
63. *Id.*, at art. 11.

only through contrast with its precursors, without which it could not have come into existence. It is hoped that a brief overview of transnational evironmental law will help to put the Protocol in its proper perspective.

International attempts to control transfrontier air and water pollution are relatively recent phenomena; indeed, they seem to be unique to the latter half of the Twentieth Century.[64] There are, however, a few early cases which seem to have initiated the trend toward an internationally-accepted, customary body of law in this area: the Trail Smelter case[65] and the Corfu Channel Case.[66] The opinion in the latter recognized ". . .every state's obligation not to allow knowingly its territory to be used contrary to the rights of other states."[67] The Trail Smelter case, concerned specifically with an incident of transfrontier air pollution, contains a more authoritative statement: "No state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the property or persons therein. . ."[68]

For more than two decades, the narrow decisions discussed above were virtually the only authority available for cases involving transfrontier pollution.[69] With the increasing awareness of environmental concerns that characterized the Sixties and Seventies came the realization that pollution does not stop at national frontiers, and that any real solution to the problem could only be reached through international efforts.[70] Out of this realization came the first multilateral declaration on state responsibility for transfrontier pollution, the Stockholm Declaration, which provides:[71]

Principle 21

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

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64. *See generally*: V. NANDA, WORLD CLIMATE CHANGE: THE ROLE OF INTERNATIONAL LAW AND INSTIUTIONS, (ed. Ved P. Nanda 1983); Hoffman, *State Responsibility in International Law and Transboundary Pollution Injuries*, 25 INT'L & COMP. L. Q. 509 (1976); J. SCHNEIDER, WORLD PUBLIC ORDER OF THE ENVIRONMENT: TOWARDS AN INTERNATIONAL ECOLOGICAL LAW AND ORGANIZATION, (1979).

65. Trail Smelter Arbitration (U.S. v. Can.), 3 R. Int'l Arb. Awards 1905 (1941).

66. Corfu Channel Case (Alb. v. U.K.), [1949] I.C.J. 4.

67. *Id.* at 22.

68. Trail Smelter, *supra* note 65, at 1965.

69. *See* Bankes & Saunders, *Acid Rain: Multilateral and Bilateral Approaches to Transboundary Pollution Under International Law*, 33 U. NEW BRUNSWICK L. REV. 155 (1985).

70. *See generally*, Bleicher, *An Overview of International Environmental Regulation*, 2 ECOLOGY L. Q. 1 (1972).

71. Declaration of the United Nations Conference on the Human Environment, U.N. Doc. A/CONF. 48/14 & Corr. 1 (1972), *reprinted in* 11 I.L.M. 1416 (1972) [hereinafter Stockholm Declaration].

States or of other areas beyond the limits of national jurisdiction.

Principle 22

States shall cooperate to develop further the international law regarding liability and compensation for the victims of pollution and other environmental damage caused by activities within the jurisdiction and control of such States to areas beyond their jurisdiction.

It must be noted that the Stockholm Declaration states general principles only; it has not proved strong enough to be relied upon in most cases.[72] Commentators have interpreted the above principles to allow imposition of liability on a state for transboundary pollution only where there has been a serious injury, and where a direct causal chaim linking the pollution to the injury can be discerned.[73] The above Principles are thus of limited applicability as regards cases of injury caused by transboundary pollution of an uncertain origin, as with the effects of acid rain.[74] This is especially true where a complex causal chain is involved, as it is where problems caused by ozone depletion are concerned. Despite its shortfalls, the Stockholm Declaration nevertheless remains the only widely-accepted statement of transnational environmental principles, although efforts to devise a more comprehensive body of substantive law have had some success in some specialized areas, notably transnational water pollution.[75]

While the body of substantive law regarding transnational pollution is very limited in extent, there has been a rapid expansion of internationally-accepted procedural norms applicable to the field, norms which are at least tacitly adopted in the Montreal Protocol. Some procedural obligations owed by one state to another have been included in bilateral and multilateral treaties so often that they now enjoy the status of customary norms of international law. For example, it is well-accepted that a state has the duty to notify other states of its activities which may have extraterritorial effects.[76] This duty was made specifically applicable to cases of transfrontier pollution in the Athens Resolution of the Institute of International Law.[77]

An extension of the duty to notify is the duty of states to exchange information. When one state plans a project that may cause harmful ef-

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72. Bankes & Saunders, *supra* note 69, at 163.

73. *Id.*

74. *See, e.g.*, A. ALTSHULLER & G. MCBEAN, SECOND REPORT OF THE UNITED STATES-CANADA RESEARCH CONSULTATION GROUP ON THE LONG-RANGE TRANSPORT OF AIR POLLUTANTS, 6-11 (Nov. 1980).

75. *See, e.g.*, Helsinki Rules of the Uses of Waters of International Rivers, *Report of the Fifty-Second Conference of the International Law Association Held at Helsinki*, (1969); Resolution on the Utilization of Non-Maritime International Waters (except for Navigation), adopted by the Institute of International Law at its session in Salzburg, Sept. 4-13, 1961, *reprinted in* 49 *Annuaire de l'Institut de Droit International* Tome II 381; and Bourne, *International Law and Pollution of International Rivers and Lakes*, 6 U. BRITISH COLUMBIA L. REV. 115 (1971).

76. *See* Bankes & Saunders, *supra* note 69, at 164.

77. Athens Resolution of the Institute of International Law, art. VII.

fects in neighboring states, it is not enough just to notify those states of the project; sufficient information about the project must accompany the notice to enable the neighbor country to make a valid assessment of the possible damage.[78] While the status of this duty as a rule of international environmental law is only firmly established in the area of water law, recent developments have confirmed that the duty may be extended to cases involving transfrontier air pollution.[79] It has been suggested that the duty to exchange information also includes the setting up of joint monitoring and research stations by the affected countries.[80] Evidence of the broad acceptance of these and similar duties can be gleaned from the fact that they are explicitly included in many recent international treaties involving transfrontier pollution.[81]

International support has been growing for yet another procedural duty—the duty of a state planning a project with possible extraterritorial effects to consult and negotiate with other states which might be affected.[82] This duty implies that the state which might be affected by transfrontier pollution should be allowed to suggest possible alternatives to the prospective polluter, and negotiate a mutually acceptable solution to the problem.[83] This duty cannot be said to be an accepted norm of customary international law, however. While international lawyers tend to agree that the duty to consult and negotiate *should* be a customary norm, and some support for it can be found in the opinions of the International Court of Justice,[84] the principle has binding effect only when it is included in treaties,[85] such as the Montreal Protocol.

Having examined the substantive and procedural antecedents of the Montreal Protocol, it may also be helpful to look at two relevant predecessors of that treaty, in order to fully appreciate the Protocol's significant innovations. These include the Geneva Convention on Long-Range Transboundary Air Pollution[86] (more conveniently known as the ECE

78. UNEP Draft Principles of Conduct in the Field of the Environment for the Guidance of States in the Conservation and Harmonious Utilization of Resources Shared by Two or More States (1978), *reprinted in* 17 I.L.M. 1097.

79. *See* OECD Recommendation on Principles Concerning Transfrontier Pollution, Nov. 14, 1974, *reproduced in* Ruster & Simma, *International Protection of the Environment*, vol. 1.

80. *Id.*

81. *See*, Convention on Long-Range Transboundary Air Pollution ("E.C.E. Convention), Geneva, Nov. 13, 1979, *reprinted in* 18 I.L.M. 1442; Vienna Convention, *supra* note 2; Montreal Protocol, *supra* note 1.

82. *See* Bourne, *Procedure in the Development of International Drainage Basins: the Duty to Consult and Negotiate* (1972), 10 CANADIAN YEARBOOK INT'L L. 212.

83. *See* OECD Recommendation, *supra* note 79; Athens Resolution *supra* note 77.

84. Bankes & Saunders, *supra* note 69, at 168.

85. It should be noted that neither the Vienna Convention nor the Montreal Protocol recognize this duty to negotiate, although consultation between the parties is required. This is no doubt due to the fact that these documents are meant to prevent problems associated with ozone depletion, not remedy them after they have occured.

86. E.C.E. Convention, *supra*, note 81.

Convention) and the previously mentioned Vienna Convention for the Protection of the Ozone Layer.[87] Both of these treaties are multilateral efforts to come to grips with transboundary pollution of the atmosphere, and both are almost exclusively procedural in nature. The ECE Convention is primarily concerned with the study and exchange of information about acid rain and other transnational effects of air pollution.[88] Its only substantive provision is a vague exhortation that the parties "gradually reduce and prevent air pollution including long-range transboundary air pollution."[89] Similarly, the Vienna Convention requires only that the parties promise to cooperate in the exchange of information and research on the ozone problem, and "Promote. . .the harmonization of appropriate policies, strategies and measures for minimizing the release of substances causing or likely to cause modification of the ozone layer. . ."[90] These two treaties, while admirable efforts to increase international awareness and knowledge about the serious problem of transnational pollution, are unlike the Montreal Protocol in that they have little or no effect on the solution of the problem itself.

B. Significance of the Montreal Protocol

The text of the Montreal Protocol, upon close examination, can be seen to incorporate virtually all of the law concerning transboundary pollution, both procedural and substantive, which has attained customary status over the past few decades, and also adopts major porvisions of the treaties mentioned above. The Protocol is written in the spirit of the maxim *sic utere tuo ut alienum non laedas*;"[91] that is, a state may use its own property freely only so long as such use does not cause harm to other states or their citizens. The depletion of the atmospheric ozone layer harms the citizens of all countries; therefore producers of harmful substances such as CFCs and halons are obligated to alleviate the threat to human health posed by their activities. The Protocol's provisions thus follow the lead of earlier treaties in the field by ensuring that parties will be bound to perform their procedural dutues of information exchange,[92] cooperation, and consultation with one another in order to avert the potential harm of ozone depletion.

Along with the more traditional provisions just listed, the Montreal Protocol binds the parties to a number of unique requirements. It is these which make the Protocol a true landmark in international environmental law. First and foremost, the treaty is unique in that it imposes controls on

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87. *See* Vienna Convention, *supra* note 2.

88. *See* Bankes & Saunders, *supra* note 69, at 171-179 for commentary on the ECE Convention V(1).

89. E.C.E. Convention, *supra* note 81, art. 2.

90. Vienna Convention, *supra* note 2, art. 6(4)(c).

91. *See* BLACK'S LAW DICTIONARY (5th Ed.), at 1238 for a complete explication of the phrase.

92. Montreal Protocol, art. 9.

polluters *before* the pollution has caused major damage.[93] Prior treaties have always come into being after the environmental damage had taken place, and were designed to either repair or alleviate that damage.[94]

While scientific evidence clearly shows substantial stratospheric ozone depletion in recent years, it has not yet been conclusively shown that this depletion has caused damage such as increases in the occurence of human skin cancer.[95] The rates of incidence of several kinds of skin cancer are on the rise, but it is by no means certain that this is due to the increase in UV-B which accompanies ozone depletion.[96] The increases may have been caused by other factors, such as changes in lifestyle (more time spent in the sun, for example), or added exposure to other carcinogens.[97] It will probably be several years before a definate causal link can be conclusively established between CFC use and increased skin cancer, and it is likely to take even longer for the effects of ozone depletion to be readily noticeable, in the way that effects from acid rain are noticeable in Central Europe or Eastern North America. Nevertheless, it was not impossible to obtain the international consensus necessary for the drafting and acceptance of the Montreal Protocol.

A second aspect of the ozone situation which makes it surprising that the Protocol ever came into being is the fact that it is almost impossible to pinpoint the source of chemicals which break down atmospheric ozone.[98] The body of law concerning transboundary pollution grew up in response primarily to water and air pollution. Since it is relatively easy to determine the source of these types of pollution, it is correspondingly easy to apportion blame.[99] Once the source is determined, international pressure may be applied to the perpetrator, often resulting in a negotiated solution to the problem. It is, however, virtually impossible to pinpoint the sources of the chemicals which cause ozone depletion; CFCs and halons are used all over the globe, and the worst damage to the stratospheric ozone layer seems to be occuring over the one place on Earth where we can be almost certain that no CFCs are being produced—Antarctica. Since there is no definitive way to trace the cause of ozone depletion to its source, there is no way to apportion blame and liability for the damage caused by increased UV-B radiation.[100] There is therefore likely to be considerable less pressure on CFC-producing states to alleviate the problem than, for example, on states which pollute the

93. *See* Benedick, *Global Environmental Change: the International Perspective*, in 1 TITUS, EFFECTS OF CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE 31, 32 (1986).

94. *See* E.C.E. Convention, *supra* note 81, and Helsinki Rules, *supra* note 75.

95. *Update 1983*, *supra* note 3, at 10, 169.

96. *See Update 1983*, *supra* note 3, at 168-191.

97. *Id.* Cancer rates in general have been rising, and it is difficult to determine whether the increased incidence of skin cancer is due to ozone depletion or merely part of this overall trend.

98. *Id.*, at 15.

99. *See* Bankes & Saunders, *supra* note 69, at 163.

100. *Id.*

water supply of another nation. This being the case, it seems amazing that the Montreal Protocol came into existence at all, especially when one considers the stringent controls contained in its provisions.

The strength and thoroughness of the substantive controls imposed by the Protocol constitute the third unique aspect of this treaty. As was described above, the provisions of the Protocol commit the parties to a 50% reduction in production of several substances which are suspected to be involved in ozone-layer depletion, and impose as well as strict controls on the import and export of controlled substances and related technologies between parties and non-parties.[101] Such controls are unprecedented in the field of international environmental law; even treaties drafted in response to obvious and well-understood transfrontier pollution problems do not impose on parties controls which are nearly as strict and far-reaching.[102] As noted above, previous treaties were limited primarily to procedural provisions; the Montreal Protocol incorporates these *and* strong substantive provisions.

Yet another unique characteristic of the Protocol is its amenability to revision and amendment. Indeed, the document's procedural provisions are designed to ensure that its substantive provisions continue to reflect the latest developments in scientific study of the ozone layer.[103] The scientific community is engaged in ongoing research regarding the dynamics of ozone depletion and its effect on humans and the environment in general, and it may be years or decades before definitive conclusions can be reached. Realizing that the controls imposed in Article 2 were based on scientific knowledge likely to change,[104] the drafters of the Protocol incorporated a mechanism allowing Article 2 controls to be altered to reflect new data on ozone depletion. This mechanism is outlined in Article 6 and Article 2(10), which provide for periodic review of the adequacy of Protocol controls in light of the latest scientific data, in order to ensure that controls continue to reflect environmental needs.

VI. IMPLICATIONS OF THE MONTREAL PROTOCOL

The above discussion serves to establish the unique place the Montreal Protocol holds in the field of international environmental law: it represents a huge leap forward from previous efforts made to counteract transboundary pollution. That being the case, the Protocol may well have a strong influence on further developments in the international environmental field. The Protocol could be looked to as a precedent in the solution of several other environmental problems of worldwide scope.

One such problem, Global air pollution and its product, acid rain, comes immediately to mind. Although it tends to be easier to pinpoint

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101. *See* text accompanying notes 38 through 63.
102. *See*, Vienna Convention, *supra* note 2; E.C.E. Convention, *supra* note 81.
103. Montreal Protocol, Preamble.
104. Montreal Protocol, Annex A.

the source of air pollution than to determine the origin of ozone-depleting substances, acid rain caused by air pollution also tends to cause its ill effects at great distances from its source. This makes it difficult to assess fault and apportion blame, especially in places like Europe, where many countries produce pollutants in a relatively small area.[105] Numerous attempts have been made among small groups of countries to solve this and similar problems, with only a limited amount of success.[106]

Nevertheless, it would seem likely that really significant gains such as those arising from a comprehensive treaty like the Montreal Protocol cannot be expected from a number of uncoordinated controls on pollutants: the European Community has made admirable efforts to reduce sulfur dioxide and nitrogen oxide emissions, yet a major source of these components of European acid rain is pollution in Eastern Europe, where no controls exist.[107] Also, regional efforts tend to get bogged down in unrelated political differences, as is illustrated by the interminable struggle between Canada and the United States for a workable agreement to alleviate the North American acid rain problem.[108]

The fact remains that compared to stratospheric ozone depletion the mechanics of acid rain damage are relatively well-understood, and this damage is easily observed by anyone who visits the forests of eastern North America or Central Europe. It can be hoped, therefore, that global support can be obtained for a worldwide treaty to control acid rain in the same way that the Montreal Protocol controls substances which cause the less obvious damage accompanying ozone depletion.

There are a number of other environmental problems of global concern which might prove amenable to multilateral solutions modelled on the Montreal Protocol. These include the pressing problem of nuclear waste disposal, and growing concerns over the pollution of Earth's orbital space by old satellites, discarded boosters, and other types of "space junk."[109] The Protocol demonstrates that a far-reaching, comprehensive agreement to eliminate an environmental threat can be attained before the threat becomes a reality. This treaty also shows that political differences need not be a stumbling block to finding a solution to a problem which is of concern to all.[110] It seems probable that future multilateral efforts to solve international environmental problems will be influenced by the Protocol; it is to be hoped that they are as successful.

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105. *See generally* Cleutinx, *European Community Air Pollution Abatement Policy*, 17 U. TOLEDO L. REV. 113 (1985).

106. *Id.*, at 116-119.

107. *Id.*, at 116.

108. *See generally*, Harris, *Canadian Positions, Proposals, and the Diplomatic Dilemma: Acid Rain and Emerging International Norms*, 17 U. TOLEDO L. REV. 121 (1985).

109. *See generally*, Goedhuis, *Some Recent Trends in the Interpretation and Implementation of the Rules of International Space Law*, 19 COLUM. J. TRANSNAT'L L. 213 (1981).

110. *See* N.Y. Times, Sept. 17, 1987, at A1, col. .

VII. EVALUATION AND ASSESSMENT OF THE PROTOCOL

In order to assess the value and efficacy of the Montreal Protocol, it is necessary to look at both the likely effect of its provisions as well as the overall value of the agreement. As should be evident from the preceding discussion of various individual provisions, the drafters of the Protocol deserve to be applauded for the thorough, almost visionary nature of the agreement, which goes so far beyond any previous attempt to control a serious global environmental problem. There is little doubt that the Protocol will serve to reduce consumption and production of CFCs and halons, but whether this will be enough to halt the depletion of the ozone layer remains to be seen.[111] The Protocol could have gone farther in some respects, such as prohibiting the developed state parties from exporting controlled substances and related technology to non-parties, and by imposing sanctions on parties found in non-compliance with the control provisions. Nevertheless, in the final analysis the controls imposed by the Protocol are all that environmentalists could reasonable hope for, and go far beyond what could have been expected in the light of prior attempts to come to grips with global pollution.

Looking at the Montreal Protocol as a whole, it is difficult to come up with any major criticisms. Not only does the treaty serve admirable to promote the goals of CFC and halon reduction, but it also stands as a milestone in the field of international environmental law. It represents the first time the world community has put aside its differences to face a global threat before that threat's effects become widespread and obvious, and in a manner which guarantees that cooperative efforts will continue to reflect the latest scientific developments. It is to be hoped that this agreement will not stand as an isolated example of worldwide cooperation, but instead will serve as a paradigm for future agreements on other threats and problems faced by the world community, environmental or otherwise.

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111. Judging from some studies, the controls contained in the Montreal Protocol are likely to be inadequate to halt the depletion of the ozone layer. Some projections indicate that immediate cuts on the order of 85% are required to accomplish this goal. *See* Hoffman, *The Importance of Knowing Sooner*, in TITUS *supra* note 6, at 53. It is to be hoped that as studies continue to show the necessity for more stringent controls, the parties to the Protocol will respond to the findings by using the document's amendment process to bring controls into line with the latest scientific assessments.