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Depletion of the World Ozone Protection True Progress: Looking for a Place Where We Can Stop

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DEPLETION OF THE WORLD OZONE PROTECTION

TRUE PROGRESS: LOOKING FOR A PLACE WHERE WE CAN STOP*

MORAD EGHBAL**

TABLE OF CONTENTS

Let us then speak boldly. The Time for it has come, and it would be strange, if in this age, liberty, like the light, should penetrate everywhere except to the one place where freedom is most natural - the domain of thought.[1]

INTRODUCTION

According to folklore, over 3,000 years ago an ingenious official in Egypt proposed selling air to breathe to make up for the deficit in the state budget. Even though the official had no idea what air really was, he did realize at least that it was indispensable to life, as human beings know it, on the blue planet Earth.

State budget deficits have proven to be seemingly intractable and a steady companion of human "progress" and the development of civilization throughout human history. The chronicles of antiquity do not tell the results of

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*This article which was written in January 1992, resulted from a presentation the author gave as a panelist at the First International Environmental Law Symposium at The Dickinson School of Law, Carlisle, PA, on October 26, 1991. It has been updated to take into account recent developments. Final draft of this article was accepted for publishing in June 1992. The article is dedicated to Niloo Sadjadi whose abiding support and encouragement was a constant fount of joy and motivation , and to Elaheh Eghbal, with the deep hope that she receive her human inheritance enriched, and not impaired, in value and that she learn to enjoy it responsibly with due care and circumspection.

**B.A., George Washington University; M.A., George Washington University; J.D., Howard University; LL.M., McGeorge School of Law, University of the Pacific; Certificates in advanced International Legal Studies from Inns of Court, School of Law, London, UK; Paris Lodron Universität, Salzburg, Austria; and Eötvös-Lorand University, Budapest, Hungary.

that ancient Egyptian official's valiant effort to save the state budget from a crisis by turning the government into a toll collector for an essential human function, breathing, and a natural resource, air, which up to now had not been charged for. Such plans for a modern day sale may well prove insurmountable and a challenge for tax, marketing, and sales specialists. Despite all the efforts to protect the environment, air pollution is steadily increasing.

We need air to live, half a liter each time we breathe, and in the course of a day, over ten thousand liters. We give as little thought to breathing, however, as we do to where the air actually comes from. All around the globe it is available to each living organism all of the time, free of charge, but not free of cost to humans. A steadfast reliance on fossil fuels such as oil and gas has continuously raised the proportion of carbon monoxide in the atmosphere, as have other things such as other combustion processes and using fire to clear large areas for agricultural use. These processes have now reached a new life-threatening level, as the ozone layer, at a height of between 15 and 50 kilometers in the earth's atmosphere is vanishing,[2] for the most part because of man-made pollutants thoughtlessly emitted into the air over a long period of time.

The greatest risk is believed to come from chlorofluorocarbons, which are used as coolants and in aerosol sprays as propellants. For decades, chlorofluorocarbons were the pride of their inventors: non-toxic, chemically stable, inert, easy to use and therefore technically and commercially attractive. These chemically stable gases penetrated the higher layers of the stratosphere and in a chemical reaction separated chlorine atoms in the compound. This process played havoc with the ozone layer. The ozone layer is a gaseous filter protecting the earth from the sun's rays by absorbing below a wavelength of 300 nanometers[3] ultraviolet radiation of the sun which is dangerous for all forms of life. Without the protection of the ozone layer, ultraviolet rays would destroy plant growth, disrupt the world's food chain, lead to genetic transmutations, and increase the occurrence of many forms of cancer.

While human knowledge of the dynamics of the atmosphere and its interaction with the earth's surface is not complete, we now know that there are distinct limits to how much waste, in the form of gases and dust, the atmosphere can absorb. The problem is both an environmental issue and one which concerns Third World development. As most recently reflected in the context of the United Nations' conference held in Rio de Janeiro, Brazil, if this problem is to be resolved comprehensively with workable solutions to be found for all parties involved, then the industrialized nations must begin to view themselves and their respective roles in the development of the globe's natural resources as *paris inter pares* ("equal among equals") and not as *primus inter pares* ("first among equals").[4] The industrialized countries of the world, as major producers of coolants and propellants, have materially contributed to the creation of the problem. Less industrialized countries, as major users of products containing environmentally damaging coolants and propellants in their fervent desire to emulate the industrialized countries in a quest for an ever "higher" standard of living and a drive towards "progress," have become significantly dependent on the flow of chlorofluorocarbon-containing products developed in and exported from industrialized countries.[5] Just as the atmosphere defies our contrived human boundaries of states, a solution to this critical problem must be global in nature and based on international consensus for its remedies, if the industrialized countries' dream is not to turn into the industrializing countries' nightmare.

Despite the purported efforts of the Egyptian official 3,000 years ago to tax breathing, human beings have not had to pay for breathing, at least not yet. But while breathing has been free of charge, there have been inherent underlying costs to *homo sapiens*' voracious, insatiable appetite for what is perceived to be ever higher living standards, development, and greater comfort. Now, Mother Nature reminds us in a compelling way that the careful and fragile balance of natural processes on Earth cannot be tampered with carelessly and without considerable costs. The time for *homo sapiens* to settle accounts and pay up has come.

Because of the complexities of this problem and the limitations of this format, it is not possible to treat the questions surrounding the depletion of the ozone layer exhaustively in this context. This paper attempts, however, to provide a comprehensive outline of the *status quo* accompanied by suggestions of where the answers to the problem of ozone depletion may lie.

This paper is divided into three parts. Part One will give some relevant scientific background to the phenomenon of atmospheric ozone depletion. Although atmospheric ozone depletion, "the greenhouse effect" (the incremental net warming of Earth's atmosphere), and acid rain are interrelated environmental problems, a full treatment of each subject matter would go well beyond the limitations of this paper. Part Two will attempt to give a summary introduction to domestic measures undertaken to combat the problem in the United States. Part Three will attempt to accomplish the same in the area of international law and will also attempt to demonstrate why the problem of atmospheric ozone depletion must be understood in the context of Third World development. With the collapse of the "second" world, which includes the nations of the former Soviet bloc and behind the old Iron Curtain, it is quite uncertain whether this nomenclature still applies. The author, therefore, elected to draw the distinctions between a world which is "industrialized" and a world which is "industrializing", instead of using terminology which is probably dated and inappropriate.

PART I - THE EARTH'S ATMOSPHERE AND THE SCIENTIFIC BACKGROUND OF ATMOSPHERIC OZONE DEPLETION

The Earth's atmosphere consists of a coat of gases approximately 2,000 kilometers in diameter whose density decreases with increasing altitude because of decreasing pressure.[6] Due to this phenomenon, about half of the total mass of the atmosphere is concentrated in the lower five kilometers where there are temperature fluctuations within certain altitude levels. The atmosphere is distinguished by different atmospheric layers: the troposphere, the stratosphere, the mesosphere, and thermosphere.[7]

An ideal Earth atmosphere consists of 78.8% nitrogen; the remaining 21.2% is taken up by small amounts of such gases as argon, methane, xenon, hydrogen, krypton, helium, and traces of other gases and water vapor.[8] The two most significant elements, however, are oxygen with 20.95% and carbon dioxide with only 0.03%. Oxygen is generated by plants (specifically the chlorophyll in the leaves) which absorb carbon dioxide (CO_2) and water and with the help of energy provided in the form of sunlight, transform the compounds into sugar and oxygen. This process is referred to as photosynthesis.[9] Photosynthesis is essential for the maintenance of a delicate oxygen-CO_2 equilibrium in the atmosphere and is equal in importance to oxygen absorption and CO_2 production through decay or burning of organic matter and respiration of animals or human beings.[10]

Considering this delicate balance, it is not surprising then that large amounts of man-made emissions create a significant imbalance and strain the limited capacity of the atmosphere to accommodate gross fluctuations in this balance. Two often quoted and dramatic incidents of air pollution occurred in London, England and in Donora, Pennsylvania. In December 1952, London suffered several days of smog, which is estimated to have caused 4,000 deaths.[11] Four years earlier, in October 1948, 20 persons died in Donora, Pennsylvania, a town near Pittsburgh, and 42.7% of the population fell ill due to three days of fog, inversion, and extreme air pollution.[12]

There may be many ways to define pollution. The one definition generally accepted in international law, according to the International Law Association's Montreal Rules of 1982, is "[a]ny introduction by man, directly or indirectly, of substance or energy into the environment resulting in deleterious effects of such nature as to endanger human health, harm living resources ecosystems, and material property and impair amenities or interfere with other legitimate uses of the environment."[13]

Depletion of Atmospheric Ozone

In 1974, Molina and Rowland first published their understanding of global ozone destruction and indicated that this destruction was due to the emission of certain man-made chemicals into the air.[14] The danger they identified quickly moved into the mainstream of public, political, scientific, and legal discussion, culminating in a level today whereby much of the initial hypothesis may be considered as established after more than a decade of research. The "ozone layer", as a protective sheet, has two vital functions for life on Earth. It plays a major role in the control of the Earth's climate by absorbing some of the ultraviolet radiation of the sun and by providing the heat necessary to maintain the stability of the stratosphere. This protective sheet shields the Earth from the effects of dangerous wavelengths in the solar spectrum as it filters ultraviolet radiation. The stratosphere contains high concentrations of atmospheric ozone (approximately 90%).[15] Ozone builds up when ultraviolet radiation induces photochemical reactions trans-

forming oxygen (O_2) into ozone (O_3), and chemical reactions induced by solar energy reduce ozone into oxygen molecules again. Thus, it can be said that the Earth's ozone layer is the result of an equilibrium in ozone formation and reduction, which can be completely disturbed by human contributions to its depletion.[16]

Concentration of stratospheric ozone above a particular site on Earth varies with geographic location (latitude), temperature, atmospheric circulation, seasons, and amount of solar radiation.[17] In regard to the horizontal distribution of ozone, which is also known "as total column content," the largest concentrations are found between 25-40 km above the Earth's surface, where the ozone layer stretches over about 10 km. This total layer, under terrestrial temperature and pressure conditions, would amount to a thickness of only 0.3 cm of ozone and would have a capacity to absorb damaging UV radiation relatively greater than the capacity of a sheet of metal, equally thick, to absorb visible light.[18]

A Filter for UV-Radiation and Its Depletion

Solar ultraviolet radiation is emitted in different wavelengths which are measured in nanometers (nm = one billionth of a meter). Sunlight is visible to the human eye only in the range of 400-700 nm. Wavelengths shorter than 400 nm are referred to as the ultra-violet part of the spectrum, which is divided into three sub-parts: UV-A (320-400 nm), UV-B (280-320 nm), and UV-C (200-280 nm). While UV-C radiation is completely absorbed, the ozone layer does not filter out UV-A and some of it is reflected back into space by oxygen and nitrogen (N_2) in the atmosphere. UV-B, with potentially negative effects on human health, plant life, and marine organisms, is absorbed by the ozone layer to a large extent.[19] A depletion of the ozone layer would, therefore, expose Earth to an increase in UV-B radiation.

Initially, atmospheric testing and high flying supersonic aircraft were blamed for ozone depletion as they were thought to deposit water vapor and nitrogen oxides (NO_x) directly into the stratosphere. Nothing was found to confirm this theory with respect to supersonic flight and it was eventually disregarded.[20] Currently, prime suspects of ozone depletion are a group of chlorofluorocarbons (CFCs), while methane (CH_4) and nitrogen oxides are a close second, and bromine compounds and halons are a third, but somewhat less significant, group.

CFCs are industrially made chemicals. They were developed in 1930 by the American DuPont de Nemours Company as it searched for a new and safe coolant to replace sulfur dioxide (SO_2), ammonia, or blocks of ice.[21] CFCs find use mostly in a wide variety of consumer goods such as refrigerators and air conditioners (CFC12), propellants in aerosol cans, solvents (CFC113), foam blowing agents (CFC11) in the manufacture of fast food containers, car seats, and related consumer goods. In this variety, CFCs, CFC11 (CCl_3F or Trichlorofluoromethane), and CFC12 (CCl_2F or Dichlorofluoromethane) are more significant as their use increases by 5-7% per year.

A ban on most aerosol can uses in North America and Scandinavia in the late 1970's led to a temporary decline of emissions by 21% between the peak levels of 1974 and 1983. However, this decline was masked by a subsequent increase in other uses of CFCs. The statistics for the years 1976 to 1983 consisted of a 51% decrease in aerosols and a 36% increase in non-aerosol uses. Though both Western and former Soviet bloc countries share in the output of CFCs, Western countries contribute a disproportionately larger share (80%), with 15% coming from the former Soviet bloc countries.[22]

The attractiveness of CFCs for commercial use lies in their characteristics: chemically stable, neutral, low in toxicity, non-flammable, and highly volatile. They appear to be less of a potential health hazard than many other potential substitutes.[23] Chemically inert, neither CFC11 nor CFC12 are readily water soluble, and, therefore, there is no significant oceanic aquatic "sink" for them. Since they are not subject to rainouts, they cannot be removed in the troposphere. Sunlight passing through the troposphere does not decompose them either, and CFCs slowly migrate into the stratosphere in a process which may take decades.[24] The exact mechanism of pollutant transport into the stratosphere is poorly understood.[25]

By comparison, the processes CFC11 and CFC12 undergo once in the stratosphere are fairly well known. CFC11 and CFC12 are exposed to ultraviolet light which breaks them down and releases the chlorine in the compound. Chlorine then acts as a catalyst and reduces ozone in an oxidation cycle to oxygen. A chlorine atom (Cl) then reacts with a single oxygen atom (O), resulting in two molecules of

oxygen and a molecule of chlorine available to repeat the cycle all over again.[26]Based on this process, it is assumed that one chlorine atom can destroy thousands of ozone molecules before the chlorine is removed from the atmosphere. This process takes place very slowly and over a long period of time, with an accompanying buildup of hydrogen chloride (HCl) which sinks down into the troposphere where a flush by precipitation takes place.[27] This means that emissions will not have an impact on the stratosphere until years after their release and will only produce an effect within a certain period of time. In the case of constant CFC12 emissions, atmospheric concentrations would continue to increase for at least 100 years. According to U.S. scientists, a stable level of atmospheric concentrations could only be achieved through an immediate 85% reduction in emissions.[28] CFC emissions are still rising, however, and are expected to continue to do so because industrializing countries are now reaching a stage of increased demand for consumer goods, such as refrigerators, electronic appliances and the like. Thus, far from being under control, emissions seem to be gaining momentum.

Another major factor in regard to ozone depletion is the nitrogen cycle, which is closely related to the chlorine cycle. Nitrous oxide (N_2O) reacts with both chlorine and ozone, with its effects on either cycle depending on the relative amounts of Cl or NO_x present in the stratosphere. Emissions of N_2O have increased globally by roughly 55% over the last 100 years and atmospheric concentrations are also rising. N_2O originates from, among other sources, microbial processes in soil and water, man-made sources such as combustion, and the use of fertilizers.[29]

Another gas which affects atmospheric ozone and whose concentrations have increased by 1.1% per year between 1976 and 1985 is methane. Some of its sources are combustion of natural microbiological processes and industrial processes involving the combustion of natural gas, bio-mass, and coal. While the increase in methane concentrations is not well understood, it is attributed to human activity.[30] Carbon dioxide concentrations in the stratosphere are increasing as well, and are expected to reduce the temperatures in the stratosphere, especially in the upper levels.[31] Both CH_4 and CO_2 are thought to increase the column content of ozone, balancing out some of the CFC or N_2O induced reductions.[32] Ozone depletion is expected to slow down as long as the growth rates of CH_4 and CO_2 are larger than those for CFCs and N_2O.

There are many variables and critical areas of uncertainty which make any predictions as to the speed and the progress of the depletion of the ozone layer very hard. Natural variations in the stratigraphic ozone concentrations make it difficult to determine with certainty the extent to which the depletion of the ozone layer induced by man-made emissions has already taken place.[33] While CFC11 and CFC12 are increasing at 5% to 7% per year (with projections of 3.5% to 5% per year until the year 2000 and 2% thereafter), CO_2 and CH_4 are increasing at about 0.5% and 1%, respectively.[34] Norwegian scientists calculated on the basis of these emission growth data that ozone levels will continue to decrease and that the global average depletion will be 6.5% by the year 2030, with depletion in higher latitudes reaching 6.5% by the same year. Even if chlorine levels are kept constant at 1980 levels, ozone concentration will be on a continuous decline at the rate of about 2% until 2010, with an average of 8% for higher latitudes.[35] The EPA developed a scenario which reached similar conclusions in a reference case and suggested, furthermore, effects for varying levels of NO_x and CH_4.[36] The reference case assumed annual growth rates of 2.5% for CFC11 and CFC12, 1% for methane, 0.5% for CO_2, 0.25% for NO_x, 3.7% for bromine compounds, and 3% and 2.5% for CFC113 and CFC22, respectively. Both studies show that significant changes will have taken place in the ozone layer by the first half of the next decade.[37] Obviously, any such studies contain uncertainties in these calculations to the extent that any modeling is involved. From early studies in 1975 which predicted ozone depletions of 15-20% to present predictions, estimates have been lowered and ozone concentration models appear to be generally 30-50% lower than those actually measured in the stratosphere.[38]

One phenomenon which cannot be satisfactorily explained and does not fit neatly into all the other theories on ozone depletion is the "ozone hole" over Antarctica which has been measured since 1957. Ozone concentrations over Antarctica, observed since 1977, have registered a marked decline. This decline does not in reality represent an actual hole in the ozone layer, but the total column content of ozone in late winter and early spring over Antarctica which has decreased 40% over the last decade.[39]This loss appears to be

balanced by a poleward movement of ozone-rich air in the summer. Experiments conducted in 1977 confirmed the theory that the ozone hole is part of a global trend. It is unclear whether this phenomenon will continue in the future as a global trend or whether it will be limited to the Antarctic as there have emerged equally inexplicable "ozone holes" over Europe.[40]

Yet, most recently released information prepared by participants of the Second Airborne Arctic Stratospheric Expedition (AASE II) indicates the potential for greater ozone depletion than had been previously expected.[41] In northern latitudes, "these findings have increased ... concern that significant ozone loss will occur during any given winter over the Arctic in the next years."[42] In temperate latitudes, "[r]esults from AASE-2[sic], in conjunction with observations taken before the eruption of [Mount] Pinatubo, provide evidence linking mid-latitude winter reductions in ozone to reactions involving chlorine and bromine free radicals. There are strong indications that the injection of volcanic debris will enhance ozone reduction by chlorine and bromine for a few years. The origin of the enhanced layers of ClO at all latitudes are being investigated."[43]

Apart from all the uncertainty, existing studies point to a clear trend in ozone depletion, given the time spans involved and the fact that remedial action is not confined to regions.[44] Ozone depletion is global in nature, with pollutants traveling upwards until they are mixed in the stratosphere where they are distributed evenly and attack the ozone layer. Therefore, any proposed remedy must be binding and uniform and must rely on the co-operation and unified effort of all countries.[45]

Effects of Depletion

With a decreasing ozone layer, more harmful radiation reaches the surface of the Earth. UV-B radiation is estimated to increase by 2% for every 1% decrease in ozone concentration in the atmosphere.[46]

Evidence from extensive laboratory and epidemiological studies suggests a linkage between UV-B radiation and non-melanoma skin cancers in humans,[47] while melanoma skin cancer, a malignant skin cancer which metastasizes and may be fatal, makes up two percent of all skin cancer cases. There has been an increase in the occurrence of non-melanoma skin cancer in higher latitudes where levels of UV-B radiation levels are highest because of a reduced solar zenith angle.[48] Evidence of a link, however, between this type of skin cancer, melanoma skin cancer, and UV-B radiation is not entirely compelling since sunlight may be one of several factors causing melanoma.[49]

Even with emissions remaining constant at 1980 levels, present estimates suggest that 142,000 new cases of skin cancer (6% increase for women, 8% for men for a 2% ozone depletion) will be registered by the year 2050. If CFC emissions rise, there will be an expected corollary rise in the cases of skin cancer to 256,000 (22.5% increase for women, 30% for men for a 7.5% ozone depletion) for the same year. If one can extend this linear argument, then these figures would mean that about 114,000 cases are preventable by cutting down the CFC emissions and the resulting ozone depletion.[50] Another research study concluded that a 1% decrease in ozone would produce a 1.56% increase in annual "carcinogenic radiation" leading to a 2.7% increase in non-melanoma skin cancers.[51]

Numerous experiments have shown that UV-B radiation adversely affects 2/3 of the 200 plant species tested. Crop yields, plant growth, leaf structure, physiological and biological functions, and germination were found to be negatively influenced to varying degrees by UV-B radiation.[52] The few experiments carried out in the field showed plants to be less susceptible to increased UV-B levels, but 90% of the tested plants were crops and very little is known about UV-B impact on the natural ecosystems. For crops, increased UV-B radiation and the accompanying increase in the formation of photochemical oxidants could cause economically significant yield reductions.[53] For an assumed ozone depletion of 7.5% in the year 2025, yield reduction for corn, wheat, soybeans, and cotton are estimated to be, respectively, 1.5%, 1.4%, 2.8%, and 3.3%.[54]

Notwithstanding some of the uncertainties referred to earlier, experiments simulating ozone depletion of 5-25% showed harmful effects on fish, larvae of shellfish, zooplankton, and plants essential to the aquatic food chain. Research has focused on marine habitats, as they are economically more significant than freshwater habitats.[55] Measurements show an impact for solar UV-B radiation down to depths between 5 meters and more in turbid water and more than 20 meters in clear water, where a large portion of aquatic organisms are found.[56]

This phenomenon is related to the fact that photosynthesis, which depends on sunlight, takes place in approximately the upper sunlit 100 meters of the water column which is populated by phytoplankton. Phytoplankton would move to deeper regions with increased UV-B irradiation to reduce exposure, but this move would be accompanied by a reduction in light necessary for photosynthesis and would result in reduced phytoplankton productivity. The most likely effect would not be an overall decrease of net productivity, but changes in species diversity and composition, which would affect the stability of the complex and closely connected aquatic ecosystem.[57]

Two major dangers of ozone depletion for stock and other marine species can also be identified. First, there exists the possibility of genetic mutations if species are exposed to UV-B radiation at early, sensitive stages of their life cycles. Second, there could be a disruption of the food chain for all larger aquatic species, commercial fisheries and, ultimately, the human food supply.

In its causes and effects, the depletion of the ozone layer is strongly connected to another modern, global, environmental concern: changes in the global climate known under the rubric of "the greenhouse effect."[58] The linkage is by the gases which induce ozone destruction and which are also the major greenhouse gases: CO_2 (the most important one), methane, N_2O, CFC11 and CFC12, and tropospheric ozone. The Earth's ambient surface temperature depends on the amount of sunlight which reaches the surface, in relation to amounts reflected back into space. The gases mentioned above have the effect of a screen and retain heat comparable to a greenhouse. With a continued rise in the temperature, global temperature levels could rise about 1.5 degrees centigrade by the middle of the next century,[59] with noticeable changes occurring within the next decade. Such developments would have immense consequences. Climate zones could shift and impair global agriculture and food supplies; sea levels could rise between 60 and 420 feet due to thermal expansion; and glaciers and the polar icecap could melt. Because of the immense impact of CO_2 emissions and the difficulty of controlling them as they occur necessarily in every combustion process, the greenhouse effect may be considered an even more pressing problem than the depletion of the ozone layer.[60] Some scientists consider the global warming trend inevitable and suggest the start of preparations for climatic, geographic and social changes of major proportions.[61]

What are the options, if any?

CFCs play a predominant role in the depletion of the ozone layer and are a prime target for corrective measures. In 1977, 80-90% of the CFC production took place in Organization of Economic Cooperation and Development (OECD) countries. Today, between 21 and 30 countries worldwide are considered producers of CFCs, with the United States in a leadership position.[62] CFC products are sold and find use in about four times as many countries worldwide. Since the remainder of this paper is devoted to possible legal measures to redress the depletion of the world ozone protection, suffice it to make some remarks at this point about the technical possibilities to remedy this process of depletion.

Obviously emission reduction is key, and while an 85% cut in emissions is considered statistically and arithmetically necessary to stabilize atmospheric concentrations, this figure says nothing about the technical and financial feasibility of achieving it. The World Resources Institute ("WRI") suggests that a reduction of CFC11 and CFC12 by one third is possible within five years. This is a short term plan which, if followed, would usher in a phasing out and eventual elimination of damaging CFC emissions in the next 10-20 years globally.[63] WRI proposes four main approaches to CFC emission reduction: reduction of operating losses, recovery and recycling during production and usage, usage of CFCs with shorter atmospheric lifespans, and reduction of processes or products which require CFCs.

This proposal establishes that the first two approaches require improved design of refrigerators, air conditioners, and other appliances using CFCs to prevent leakage of the gas and recycling of any leakage. Improved design could lead to significant reductions, since leakage is an important contributor to CFC emissions.[64] Recycling involves, however, relatively costly processes and may not be fully available in the immediate future. A replacement of CFCs with substitutes would require the use of material which is at the moment significantly more expensive and which requires additional testing to determine toxicity and flammability,[65] although a new device has been developed employing a new approach to air-conditioning by "suck[ing] nearly all water vapor out of the air ... [for] a cooling system that uses ordinary water in place of

ozone-destroying chemicals - and provid[ing] cooling for a small fraction of the energy of conventional systems."[66]

Furthermore, even the use of such substitutes for CFCs, known as hydrochlorofluorocarbons (HCFCs) because of hydrogen being added to the original compound, has become ecologically suspect and environmentally questionable.[67] The report which condensed the findings and recommendations of a three-year project on the causes and consequences of ozone depletion, available technologies to replace ozone-depleting chemicals, and policies to arrest and reverse the damaging processes, concluded that while less ozone-depleting than CFCs, HCFCs contribute far more ozone-depleting chlorine in the short and medium-term than conventional calculations of ozone-depleting potential of CFCs would indicate.[68]

In its conclusion, the report suggested that assuming

> that ozone depletion will be eliminated when chlorine concentrations drop below the level that triggered the Arctic ozone hole in the late seventies (which was the first manifestation of a serious problem of ozone depletion), we see that the Saving-Our-Skins scenario would result in an elimination of ozone depletion between one-and-a-half and four decades earlier than other cases. Further, the peak of chlorine concentration would be reached in 1992 in the Saving-Our-Skins scenario, compared to 1996 for the Accelerated-Full-Compliance scenario, and 2003 for the London-Amendments scenario, declining thereafter.[69]

Non-essential use of CFCs in packaging (aerosols, fast food containers, egg cartons) can be eliminated altogether, which is shown by the responsive action of a major U.S. fast food chain to replace CFC-based containers gradually.[70] Technical solutions cannot, however, be isolated and cannot focus on one particular problem, but must instead approach the problem in a comprehensive manner. To succeed, this approach requires, as a minimal prerequisite on the part of those seeking solutions, both a comprehensive training and background to understand the ramifications of potential solutions as well as a comprehensive professional awareness to implement the solutions uncompromisingly. Such pre-requisites are often found lacking, however, due to a particular training process of those professionals to whom the rest of this world looks for answers and suggestions.

PART II - THE FEDERAL CLEAN AIR ACT - POST-1987; ANY STRATEGY FOR CONTROL OF OZONE AND CARBON MONOXIDE?

The year 1987 in the field of environmental law could be looked back upon as a repetition of the debate of earlier years with regard to the Clean Air Act.[71] The discussion was hampered by indecision due to insufficient information about the scope, cause, and effects of the problem and by setting air quality standards which cannot be attained. Much later, the standards had to be recognized as unrealistic and unattainable. This dilemma had its roots in the fact that Congress, as a collective, appeared to lack the requisite scientific background and knowledge to comprehend the significance of remedies they proposed and passed on, and the lack of background accentuated their susceptibility to the wiles of differing interest groups. While a host of issues were being discussed in the Clean Air debate which are critical to the United States Environmental Protection Agency (EPA), the business sector, state and local regulatory programs, and public-interest groups,[72] the one topic of interest to this paper was developments occurring in late-1987 on the issue of continued non-attainment of the National Ambient Air Quality Standards (NAAQS) for ozone and carbon monoxide.[73]

The latest date explicitly mentioned in the Clean Air Act for attainment of the ozone and carbon monoxide NAAQS was December 31, 1987. Between 1970, when the Act was originally enacted, and 1987, various areas of the country had undergone several rounds of planning aimed at insuring compliance with existing NAAQS for ozone and carbon monoxide. These rounds resulted in State Implementation Plan (SIP) proceedings pursuant to Section 110 of the Act.[74] These proceedings culminated in the adoption of a variety of emission control requirements for those pollutants which are believed to be the cause of the violations. For the most part, however, state adoption of emission control requirements intended to ensure compliance with these NAAQS failed to produce full compliance in most areas surrounding major, national metropolitan centers.[75] One environmental law expert, however, has observed that "attainment has been achieved

an overwhelming portion of the time (typically greater than 99%) almost everywhere for almost everyone."[76] Depending on the particular circumstances surrounding the state SIP submission to the EPA and the actions of the EPA in approving or disapproving the same for a given locale, a locale may be subject to bans on new source construction[77] or cutoff of federal funding for air pollution control programs, highway construction, and construction of publicly owned sewage treatment works.[78]

Faced with the fact that the overwhelming majority of the major population centers in the country would not be in compliance with the NAAQS for ozone, and at least 65 locales would have failed to attain the NAAQS for carbon monoxide by the end of 1987, the EPA, on November 24, 1987, published a proposed notice entitled "State Implementation Plans; Approval of Post-1987 Ozone and Carbon Monoxide Plan Revisions for Areas Not Attaining the National Ambient Air Quality Standard."[79] The notice described the agency's proposed views on how it intended to interpret the Act in its efforts to bring about attainment. It also set forth the rationale for the interpretation and specific steps the EPA planned to take, both short-term and long-term, in an effort to achieve attainment of these standards. The Senate Public Works and Environment Committee had reported a bill calling for the adoption of a variety of comprehensive amendments to the Act,[80] but during late 1987 it became clear that final Congressional approval of amendments by both the House and the Senate would not take place by year end. The urgency of the problem required concerted action and would not tolerate further postponement.

Thus, in the course of the Congressional deliberations on a continuing budget resolution[81] and on continuing federal appropriations for fiscal 1988, an amendment was adopted to delay the imposition of federal Clean Air Act sanctions until August 31, 1988 for locales that are in violation of the ozone and carbon monoxide NAAQS. The amendment kept in place, however, any sanctions which the EPA had previously imposed on a locale for failure to comply with either of these NAAQS. The extension of time was intended to furnish sufficient time in 1988 for Congress to adopt amendments to the Clean Air Act before recess for Labor Day. The extension became effective when the President signed Public Law 100-202 on December 21, 1987.

After more than fifteen years of a variety of federal emission controls, it is now clear that the respective NAAQS for ozone and carbon monoxide will not be attained at all times and in all places.[82] This has led one Congressional leader to make the statement that "an estimated one hundred million Americans live in areas where the air fails to meet the health-based standards of the Clean Air Act."[83] This statement stands in stark contrast to remarks made recently by the President of the United States and the Administrator of the United States Environmental Protection Agency at the United Nations Conference on the Environment and Development (UNCED) in Rio de Janeiro,[84] exhorting the recent, but spotty environmental record of the United States as a world standard to emulate.

Representatives from public interest lobbying groups insist that there are a host of sensible control measures, for example, fuel volatility limits, on-board refueling controls, conversion to a different fuel,[85] imposition of more intensive car-pooling requirements, and imposition of emission reductions which can be specified and imposed to bring about immediately better ambient air quality.[86] On the other side, leaders of industry and their representatives are quick to point out that substantial progress has been made in attaining ozone and carbon monoxide standards during the period since 1970.[87] In a weakened economy and an uncertain labor market, it appears that industry has the upper hand for now in this unproductive tug of war because the EPA most recently announced "that it will not tighten the standard for urban ozone"[88] and acknowledged that its ruling "did not incorporate the latest research on health effects that has prompted calls by many experts for more stringent ozone limits."[89] The decision "was based only on those documents which have been reviewed by EPA's Clean Air Scientific Advisory Committee (CASAC), a group of independent scientific and technical experts. These documents evaluated health and environmental effects information available up to early 1989. EPA concluded that these documents did not provide a sufficient basis for revising the standard at this time,"[90] estimating that it "may take up to two to three years to review fully new studies and include them in a 'criteria' document, the scientific report on which a revision would be based."[91]

The November 24, 1987, Federal Register contains a seventy-seven page proposed regulatory regime which solicited comments

on the EPA's proposed final policy for a program to address the likelihood that a substantial number of major population centers in the United States will not attain the separate NAAQS established for ozone and carbon monoxide. The deadline for EPA's receipt of comments on this proposed "Policy Statement" and Appendices,[92] which imposes some tens of billions of dollars of direct costs on at least 100 million Americans, was January 25, 1988. EPA readily admits that these costs do not address the "potentially substantial social costs associated with extensive carpooling, inconvenience associated with reformulated consumer products, [and the] inconvenience associated with relocation of major volatile organic compounds such as refineries."[93] A question which has not been asked persistently enough, if it has been asked at all, and which goes on begging to be answered thoroughly and with circumspection is 'from an overall public health and welfare standpoint, what exactly is the public's gain when tens to hundreds of billions of dollars have been spent, often by encumbering the welfare of yet-unborn generations under a yoke of additional debt, and dislocations and societal disruption has followed?'

The announcement of EPA's Post-1987 Control Strategy on November 17, 1987 generated considerable criticism.[94] When comments were filed in late January 1988, the strategy was roundly criticized for imposing a number of non-productive, burdensome planning requirements which resulted in limited local and state regulatory resources being devoted to paperwork exercises.[95]

For instance, in the policy announcement, EPA states its intent to use the air quality data for the most recent three year period in which data are available. EPA anticipated, however, having 1985-87 ozone data available for use when the final Post-1987 Control Strategy notice was published.[96] The proposed policy also requires that all areas that have not monitored attainment of the ozone standard for the last two years must begin to develop new SIP programs to attain such standards. This, of course, means that areas which developed and implemented plans for attainment by the end of 1987 would be subjected to SIP calls and pressed for further emission reductions, and so on, even though control measures implemented subsequent to 1984 may have brought about attainment of the standard.

Another requirement of the EPA's proposed Post-1987 Control Strategy was that all ozone non-attainment areas must perform photo-chemical dispersion modeling to predict the amount of ozone precursor emission reduction that will be necessary to achieve the ozone NAAQS, even though the agency recognizes past efforts.[97] This sort of modeling generally is considered necessary to plan properly the requisite regulatory control actions. An excess in availability of reasonable emission controls is not the current situation and is not the problem being addressed in the proposed Post-1987 Control Strategy. The data gathering and analysis which will be required to fulfill this will be an enormously time-consuming and expensive task. Furthermore, in most instances, the input data required for the modeling is insufficient to compare accurately differential control benefits. Even with adequate input data, the accuracy of the predicted model result is only within, at least, 30% of the actual ozone levels monitored.

Numerous other non-productive requirements are contained in the EPA Post-1987 Control Strategy, and the policy also sets forth a variety of non-productive EPA oversight obligations for program implementation. It is beyond the scope of this paper to mention them all in detail, but the net effect appears to be the development of a structure which ensures a continued adversarial relationship between state and federal agency programs,[98] as opposed to a productive partnership relationship for air quality improvement which is supposedly one of the cornerstones of the Act.

Additional shortcomings of this regulatory process include the lack of any definitive programs for the development of workable solutions to problems which are identified as in need of attention for emission reduction, the notion that environmental problems are amenable to an analytical approach, known as "Comparative Risk Assessment",[99] and the failure of the EPA to provide technical guidance for the effectiveness of certain control requirements, their practicability, and costs of implementation. It appears that the elaborate, time-consuming and expensive planning and reporting procedures, coupled with the federal agency's failure to produce meaningful scientific and economic control requirements, will result in a Post-1987 Control Strategy which will be hamstrung by few, if any, actual drastic reductions in pollutant levels.[100]

In fact, on June 25, 1992, the Bush administration issued a rule giving manufacturers broad authority to increase substantially the amount of hazardous pollutants that they may emit into the atmosphere beginning in the mid-1990's.[101] For industrial regions, such increases could total millions of extra pounds of pollutants in the air every year if a number of chemical plants and manufacturers take advantage of the waiver at once.[102]

The ruling laid bare not only the tensions within an administration that proclaimed itself to be in favor of environmentally effective and ecologically responsive regulation, but took an opportunity to gut an important cornerstone of the Clean Air Act.[103]It also displayed glaringly the fragmentation of competing branches of government when the House Appropriations Committee of Congress eliminated funding for the administration's Council on Competitiveness, which played a central role in the White House's management of the law,[104] and the President threatened to retaliate by vetoing the Treasury, Postal Service, and General Government appropriations bill if Congress included the competitiveness council funding cut.[105] This incident is reminiscent of Guido Calabresi's and Philip Bobbitt's argument that "disguise, temporizing [and] deception" are a normal and necessary means of dealing with "tragic choices" if "society must confront suffering without being willing to discard its values every time it cannot uphold them."[106]

In considering this question, most troublesome is the appearance that Congress does not seem to have either the time or the requisite scientific understanding to analyze the problem properly, let alone propose workable solutions. Despite these shortcomings which were also stated earlier, Congress has presumed, by virtue of exercising its legislative powers, that it can dictate an ozone standard to be achieved in all places and at all times.[107]

Arguendo, this goal could be achieved, perhaps instantly, should this society be willing and determined to eliminate refined petroleum products, eliminate the production of petrochemical products, eliminate the use of gasoline and diesel powered automotive engines, natural gas driven turbines and furnaces, and dictate a halt to many other activities which make up part of everyday American life.[108] A considerable number of metropolitan areas which currently exceed the NAAQS for ozone could then record ambient ozone readings below the NAAQS with the achievement of these goals.[109]

Utopian as such a drastic step may sound, it would also affect virtually all the other areas with excessive carbon monoxide NAAQS, which would comply with the standard. From a point of science, however, it is not credible to state conclusively that all areas of the country would register full compliance with the ozone NAAQS at all times. When then could compliance with the law be achieved?

This question of compliance can be answered in one of three ways: whenever *homo sapiens* figures out a way to pull one over on Mother Nature; whenever the noncompliant communities have been shut down; and when the scientific community of "experts" fully understands the regional ozone formation problem. We can then identify and eliminate those emissions which actually contribute to the problem.

PART III - THE INTERNATIONAL AGENDA

Earlier, it was mentioned that the main characteristics of the ozone layer depletion are its global feature in cause, effect and necessity of action, the time lags and uncertainties involved, and the potential irreversibility of the damage. The global feature of atmospheric ozone depletion can be viewed in light of a good neighborliness concept,[110] which evolves from a concept of a neighborhood, but on our global village finds application in this context as well.[111] From the viewpoint of a victim state and its territorial integrity, it is irrelevant whether the harmful emissions originated in a neighboring state or crossed several national boundaries.[112]

It must be kept in mind that modern industrial activities have far-reaching effects which transcend national borders[113] and delineate a broader, new concept of neighborhood. Neighboring interests in the uses of air are no longer confined, if they ever were, to directly adjacent states, but extend far beyond and go as far as the effects of such uses do. A broadened scope and the characteristics of atmospheric ozone depletion, however, display some difficulties with respect to the requirements and application of this principle, as they oblige states either to take all due care and circumspection to prevent transboundary contributions to the depletion of atmospheric ozone or to undertake reasonable steps to remedy the problem. The

difficulties appear in any requirement of significant injury or clear and convincing evidence. In spite of all the scientific uncertainties which accompany this particular problem and which have been outlined earlier, the concept of good neighborliness need not be dismissed summarily.

Existing technology makes it possible to determine transboundary contributions of atmospheric pollutants and to provide overall emissions and deposition patterns. While it may be impossible to trace specific sources, the results can be proportionately attributed to different states.[114] Although a lack of specific source-receptor information and databases precludes specific duties, this concept of a good neighbor gives rise to a general state obligation to take reasonable preventive steps and remedies where a state "exports" pollutants contributing to the depletion of atmospheric ozone.[115]

Following this line of thought would lead to a transformation of this idea to a general duty of states to behave in an environmentally responsible manner vis-á-vis their own populace and other states.[116] In this context, a duty to cooperate will be most relevant to joint monitoring, consultations, and enforcement with the aim of curbing global emissions and improving the environmental quality. As will become clear from the following comments, most states are willing to participate in and contribute to this idea, if for no other reason than self-interest.

Although the principle of state responsibility and lawsuits for breaches of environmental safety in domestic courts are available in theory, neither appears promising in practice to tackle the problem. One hindrance is the clear cause and effect relationship and its attendant difficulty in assessing the contributions of a single nation to the problem. Equally difficult and complex is attributing specific effects either to CFCs or other emissions of a particular country causing depletion. It is noteworthy, however, that it was through the domestic courts of the United States that the EPA was obliged to focus resources and attention on the protection of the ozone layer.[117] It can be said that existing rules of international environmental law provide only broad guidelines according to which measures against further atmospheric ozone layer depletion are to be taken. The fact is that the problem calls for immediate and precise action which the slowly evolving rules of international law do not supply and for which the traditional juridical approach of remedy by way of litigation is, in and of itself, not adequate. What international environmental law lacks then is a global planning, coordinating, and preventive dimension, also responsive to international human rights law in the context of the protection of indigenous peoples and the environment[118] which is binding and enforceable. This may well be an anathema to legal process, inasmuch as the process in a national legal context is issue-specific and gravamen-driven and in the international context would have to tread upon what has up to now been considered squarely in the domain of sovereignty.

It must also not be forgotten that many of the traditional legal principles, from a perspective of less industrialized countries, are considered tools of the industrialized nations to maintain their dominant position in relation to poorer nations and to continue a *status quo* of dependency. Proposed remedies are looked upon with suspicion and interpreted in a way which avoid what may be considered unjustified restrictions on sovereign resource use,[119] as the following passage illustrates:

> The underdeveloped countries have finally realized the inescapable relationship which links their economic backwardness to the political and economic domination they are subjected to. They have become clearly aware that the abstract political sovereignty obtained during the first stage of their independence could give them no power over the reality of their underdevelopment. ... Formal and fictitious sovereignty was bound to remain an institutional mirage so long as there was not a modern conception of sovereignty incorporating the dimension of economic independence. ... With this end in view, the principle of economic independence, invested with a crucial new legal function, and thus raised to the rank of a principle of modern international law, must in particular be reflected in the rights of peoples and states to dispose of their own natural resources. In the prohibition of all forms of illegitimate interference on their economic affairs, and in the banning from international economic affairs of force and all other forms of constraint. ... [120]

> When they treat the claim for the permanent sovereignty of states and nation over their own natural wealth as mere logomachy, traditional lawyers are singularly failing to understand the real facts about how the third world countries have been dispossessed of their sovereignty for the benefit of foreign economic côteries.[121] ... Under traditional international law, there was no remedy against these situations since imperialism was careful to avoid direct and open violation of political aspects of sovereignty, limiting itself to undermining its economic bases. Thus, disembodied and formal political sovereignty, ... has historically protected the interests of foreign states at the expense of the national interests of the underdeveloped countries.[122]

Global Responses: Is There a Potential For Remedies?

Publication of Molina and Rowland's theory[123] on ozone depletion in 1974 precipitated a panoply of scientific and legal measures in various countries.[124] The United States National Academy of Sciences (NAS) reviewed the theory and has monitored its implications since 1976.[125] NAS has concluded that, in spite of uncertainties, regulatory measures were required, absent many significant changes in scientific findings. The NAS study led to an aerosol ban in 1978/79 and was accompanied by restrictions on non-essential uses of CFCs as propellants.[126] Canada, Sweden, and Norway adopted similar measures in 1978, 1979, and 1981 respectively.[127] The European Economic Community (EEC) followed a more hesitant approach, which was reflected in a 1980 council decision suggesting a voluntary 30% further reduction from the 1976 level by the end of 1981, pending additional research.[128] The decision was confirmed by a 1982 decision calling for increased cooperation in the development of viable substitutes.[129] In 1983, the EEC concluded, however, that the latest scientific findings warranted no additional measures.[130] With all its accompanying controversy, early research undertaken to explore the dimensions of the problem illuminated one point clearly: because of its size and far-reaching impact, individual domestic measures would generate more costs than benefits.[131]

United Nations' (UN) involvement in the search for possible remedies started early, when experts from a variety of organizations, governmental and non-governmental, were invited to a conference in Washington, DC in March 1977.[132] In order to facilitate its coordinating functions for an action plan, a Coordinating Committee on the Ozone Layer (CCOL) was established, which consisted of representatives of the United Nations bodies and specialized agencies, international, regional, intergovernmental, and non-governmental organizations, and scientific institutions to concentrate on coordinating, initiating and reviewing relevant research.[133]

In April 1980, the CCOL recognized the need for further global cooperation on the ozone layer problem[134] and called upon governments of those countries with particularly high CFC11 and CFC12 use to reduce the use of these substances and to limit increases in production capacity. In May 1981, CCOL's activities went beyond coordination of research and took on a more active role in putting together a global framework convention for the protection of the atmospheric ozone layer.[135]

It had become apparent that the United Nations Environmental Program (UNEP) was prepared not to confine its involvement to general discussion and to symposia. At the *Ad hoc* Meeting of Senior Government Officials Expert in Environmental Law, held in Montevideo in Autumn 1981, which was strongly supportive of the UNEP's coordinating work in science and its plans to provide a global convention on the problem, the protection of atmospheric ozone was a central subject.[136] The consensus was to develop guidelines, principles, and agreements towards curbing activities which deplete, or are likely to deplete, the ozone layer. In January 1982, work towards a framework convention proceeded in Stockholm at a meeting of the *Ad hoc* Working Group of Legal and Technical Experts,[137] which held four sessions of seven meetings each during the following three years. With assistance from UNEP's secretariat, the working group prepared and revised drafts for a convention and considered possible annexes and institutional structures.[138] In its communications, the working group included member countries and requested their comments on several control plans and on a second draft protocol on measures to control, reduce, and limit CFC emissions.[139]

General provisions of the convention on the subject of cooperation, information exchange, monitoring, and research were

hardly as controversial as the actual approach to control measures. The watershed was to be found between a single-option approach favored mainly by the EEC on the one side, and a multi-option approach supported by the United States, Canada, and Scandinavian countries. The EEC wanted a general limitation on the production capacity on the grounds that a cap would prevent emissions from increasing beyond a critical value.[140] Compared with the current production, the suggested cap was so high that irreparable damage to the ozone layer would have resulted before the cap came into effect.[141] A multi-option approach, on the other hand, favored different variations in a gradual phase-out of CFC emissions,[142] together with a protocol to the convention calling for an 80% reduction of CFC use of aerosol sprays within eight years after the convention had come into force.[143] Naturally, this approach would require little other action from those countries which had already put such bans into place and would not address CFC uses in air conditioners, a practice which was much more acute in North America than it was in Europe.[144] As the differences could not be reconciled, the working group prepared a fifth revised draft convention with accompanying technical annexes, which was finalized, adopted, and signed by twenty states and the EEC at the Conference of Plenipotentiaries on the Protection of the Ozone Layer, in Vienna on March 18, 1985.[145]

The Vienna Convention for the Protection of the Ozone Layer

Taking notice of the potentially harmful impact of an ozone layer depletion on human health and the environment and the need for additional research, the preamble of the Convention emphasized that all activities have to take the particular needs of developing (i.e. industrializing) countries into account. Thus, the Convention provides only a framework which can serve as a basis for cooperation and the development of future obligations.[146]

Articles 2 through 5 contain the general obligations of the Convention. Article 1(1) defines the ozone layer "...as the layer of atmospheric ozone above the planetary boundary layer," and covers, therefore, not only the stratospheric ozone layer, but also the total atmospheric ozone layer and accounts for possible risk arising from changes of ozone distribution in the atmosphere with a column content remaining the same. Though the parties are not obligated to act in a particular manner to prevent ozone depletion, Article 2(1) states that they

> ... shall take appropriate measures in accordance with the provisions of this Convention and of those protocols in force to which they are party 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.

Article 2(1) is not all inclusive, as it is aimed at activities which have an adverse effect. "Adverse effects" is defined in Article 1(2) as:"...changes in the physical environment or biota, including changes in climate, which have significant deleterious effects on human health or on the composition, resilience and productivity of natural and managed ecosystems, or on materials useful to mankind."

The parties' international obligation is significantly limited as they have to act in accordance with the means at their disposal and their capabilities, but they are free to adopt measures more stringent than those required under Article 2(3) of the Convention. An unqualified obligation to cooperate, consistent with Article 2(2), would probably have kept many industrializing countries from signing it.[147]

Expanded scientific cooperation and information exchange in research, monitoring, and assessment are covered by Articles 3, 4, and 5 of the Convention. Article 3(1) lists different areas for the initiation of and cooperation in the conduct of research and scientific assessment, which is also described in greater detail in the Annex to the Convention. This article contains a list of ozone depleting substances as well. Article 3(2) calls for the promotion and establishment of joint or complementary programs to observe systematically the condition of the ozone layer and determine related parameters. This Article dovetails with the requirement of Article 3(3) obligating the parties to cooperate in ensuring regular and timely collection, validation, and transmission of the results through a network of world data centers.

While the obligation contained in Article 3 addresses cooperation in the above-mentioned areas, Article 4(1) contains an obligation not as compelling. Parties to the convention are

only required to "facilitate and encourage exchange of scientific, technical, socio-economic, commercial, and legal information ..." relevant to the Convention, such information to be furnished to bodies acceptable to the parties. Any information which is regarded as confidential by the supplying party must be protected accordingly, and Annex II, which elaborates on Article 4 of the Convention, requires that such exchange "be consistent with national laws, regulations, and practices regarding patents, trade secrets, and protection of confidential and proprietary information."

Article 6 of the convention established the Conference of the Parties to convene no later than one year after the entry into force of the Convention.[148] Central to the conference's function are:

> (1) its power to adopt programs for research, scientific cooperation, information exchange, transfer of technology, and the like;
> (2) its ability to consider and adopt amendments to the Convention and its Annexes as well as to any protocol;
> (3) its power to establish subsidiary bodies deemed necessary for the implementation of the convention; and
> (4) its maintenance of connections with other competent international organizations to seek their services or to invite them to attend meetings of the conference.[149]

In criticizing the tenor of the Convention for lack of conciseness, one writer suggested that parties unwilling to agree to an addition to or a change of the Convention may also attempt to prevent the assessment of all efforts to bring about a consensus.[150] It would then be difficult to determine what majority would be required to make this assessment.

The uncertainty in this criticism is further laid open if one reads Article 10(2) together with Article 9(2) to (4) of the Convention. Article 10(2)(a) indicates that a consensus procedure is applicable to the adoption of annexes, while Article 10(2)(b) requires parties to submit a written notification, should they wish to opt out of an annex. Article 10 could be read in one of three ways.

First, Article 10 strengthens Article 9 since it requires notice in writing by those who oppose a new annex. Such notification is to be given within six months by at least one-fourth or one-third of the parties. It appears entirely conceivable to opt out of an annex after approval by three-fourths or two-thirds of the parties.

A second interpretation would be that Article 10(2) broadens the scope of Article 9 of the Convention because an annex can become effective even if it is supported by less than the majorities required under Article 9. Though this interpretation follows Article 10(2)(b), it would contradict Article 10(2)(c) of the Convention which refers to Article 9(2) and 9(4) on the question of required majorities.

Thus, the third interpretation of Article 10 of the Convention would be consistent with the second, except for the fact that even with parties opting out within six months, any majorities required by Article 9 must remain in tact. If this in fact applies, Article 10(2) leaves it unclear.

The Convention was also criticized for a lack of mandatory dispute settlement procedure.[151] Article 11(1) and (2) requires the parties only to "seek solution by negotiation," or to seek the assistance of a third party, where an agreement cannot be reached. This provision does not foreclose the parties from declaring themselves subject to compulsory dispute settlement by arbitration or the International Court of Justice in the event negotiations or meditation fail. When the Final Act of the Conference of Plenipotentiaries was adopted, sixteen states declared their regret at the absence of a mandatory dispute settlement process and recommended to all other signatories to declare themselves bound under Article 11(3).[152]

Montreal Protocol

The differences between the multi-option proposal and the single-option one, described *supra*, created difficulties in taking specific steps towards a reduction of CFCs.[153] Even within these two groups, there existed disagreement as to both scientific assessment of the problem and ozone depletion rates[154] which complicated negotiations.[155] Ultimately, the entire group broke up at its first working session in December 1986 without agreement having been reached on three major issues: an actual reduction formula, inclusion of a trade ban, and consideration of the needs of industrializing countries.[156]

Disagreement over the reduction formula

centered not only around choosing one option approach over the other, but also focused on what the control measures should be directed at. The EEC wanted the adoption of production control measures only, on the grounds that it would be the simplest way for implementation[157] and the best safeguard for the ozone layer since "what was not produced, could not be emitted."[158] Another group wanted to see both production and emission addressed together[159] on the grounds that production control by itself would exclude countries which did not produce CFCs. A third group wanted to approach the matter from both production and consumption, with consumption being understood as production plus imports less exports.[160] Embracing all these approaches was the question of which substances were to be included. While the EEC and Japan wanted to include only CFC11 and CFC12 at first, the United States wanted to see all CFCs and fully halogenated substances included.[161]

The question of whether any control measures ultimately accepted should be accompanied by trade restrictions or bans in the area of CFC exports by non-party countries was a point of contention. Trade bans or restrictions would be needed in order to make it unattractive for CFC producing countries or potential future producers to circumvent the protocol in their eager quest for market shares abandoned by countries who were party to the protocol. The discussion considered the compatibility of such measures in the context of international rules of trade.[162] The contemplated trade measure would be compatible with the General Agreement on Tariffs and Trade (GATT) as long as it fell within Article XX(b), which allowed trade controls in the context of the protection of human, animal, or plant life or health.[163] Where one GATT member complained against another, it was up to the GATT parties to determine whether a trade sanction under the convention fell under Article XX of the GATT.[164] So that conflict between GATT and the Convention would be avoided, the *Ad Hoc* Group on Trade Issues developed a proposal that trade measures against non-parties not apply if the non-party demonstrated full compliance with the control approach.[165]

The global nature of the problem to be addressed required a protocol applicable to as many countries as possible and needed to include industrializing countries which would have potentially increasing production and consumption of CFCs. This step required a delicate balance between encouraging less industrialized countries to take part in ozone protection measures and granting them a right to benefit from the use of CFCs.[166] In considering regulation, representatives of less industrialized countries wanted to see particular attention to three points. First, the industrializing Third World produced and used only small amounts of the total quantities of CFCs and could not be considered the cause of the problem. Second, industrializing countries should be allowed some increase in their share of CFC emissions, since they had previously not claimed their share.[167] Lastly, industrializing countries needed support during a transition phase to new technologies and substances so that they could fully live up to their obligation under the protocol.[168]

Efforts to find a viable compromise equitable to all interests finally led to the Montreal Protocol on Substances That Deplete the Ozone Layer, which was signed by 24 states and the EEC on September 16, 1987,[169] together with a Resolution on the Montreal Protocol, a Resolution on the Exchange of Technical Information and a Resolution on the Reporting of Data.[170] A possible breakdown threatened the negotiations when the United States and the former Soviet Union each introduced completely new aspects and precipitated various changes in the preceding draft protocols, particularly the 6th and 7th Revised Draft Protocols.[171] While it was always clear that CFCs11, 12, 113 and 114 should be covered, it was not entirely obvious whether an agreement could be reached on CFC115 and halons 1211 and 1301. The latter are frequently used in fire extinguishers, and although forty more times CFCs are released into the atmosphere, the halons' ozone depletion potential is eight times higher.[172] The protocol's key provision is its Article 2, which in comparison to its draft predecessors, has grown in length and detail and applies to both production and consumption and aims at a 50% emission reduction by 1999. Between July 1, 1989 and June 30, 1999 the parties are to report data for the purpose of compliance control.[173] The interests of less industrialized countries were considered, when the consumption formula was allowed to reflect a rise of production above the 1986 level by 10%, but the consumption levels remained binding.

The Montreal Protocol has undergone one revision, known as the London Amendments (agreed to in June 1990 and not

yet ratified by most signatory countries),[174] and it is expected to be revised once more in November 1992. At the Second Meeting of the Parties to the Protocol in London, the United States participated in the adoption by consensus of a package of extensive adjustments and amendments to the Montreal Protocol.[175] The adjustments call for a phaseout of CFCs and, except for essential uses, halons, by the year 2000. Previously, parties were obliged only to reduce consumption of CFCs by 50 percent by the year 2000 and to freeze consumption of halons in 1992. These adjustments entered into force for all parties on March 7, 1991, six months after the circulation of the depository.

For purposes of ratification, the package of amendments to the Protocol was legally designated as a single amendment. The principal features of the amendment involve the addition of new controlled substances and the establishment of a multilateral fund to assist industrializing countries in complying with the Protocol's control measure obligations. In regard to new controlled substances, the amendment calls for the phaseout of carbon tetrachloride and CFCs not already covered by the Protocol by the year 2000 and for the phaseout of methyl chloroform by the year 2005.

The multilateral fund was established to help meet agreed incremental costs incurred by a number of participating industrializing countries in observing their obligations under the Protocol and to finance "clearinghouse functions" such as identifying industrializing country needs, facilitating technical assistance, and providing information and training.[176] The financial mechanism is financed by voluntary contributions from participating industrialized countries based on the UN scale of assessment with the U.S. contribution capped at 25 percent. Initially capitalized at $160 million for the first three years, the fund was envisioned to grow to $200 million in 1992 with China's accession to the Protocol.[177]

Bilateral assistance may continue up to 20% of a party's overall contribution. The unilateral fund is administered through three "implementing agencies": the United Nations Environmental Program (UNEP) which assists in promoting the objectives of the Protocol and operates the technical clearinghouse,[178] the United Nations Development Program (UNDP) which performs feasibility and pre-investment studies, and the World Bank which provides the actual financing for approved projects. Technology transfer concerns were addressed in that parties were to take every step practicable to assure that the best available, environmentally safe substitutes and related technologies are expeditiously transferred to industrializing countries.

The UNCED Conference in Rio de Janeiro, Brazil[179]

From June 3 to 14, 1992, after more than two years of preparations, the United Nations Conference on Environment and Development (UNCED), commonly known as the Earth Summit,[180] was convened in Rio de Janeiro, Brazil. Scheduled to coincide with World Environment Day (June 5), the Earth Summit also marked the twentieth anniversary of the United Nations Conference on the Human Environment, which had been held in Stockholm in June 1972.

The Stockholm Conference produced a set of principles for the ecologically sound management of the planet and led to the creation of the United Nations Environment Programme (UNEP) as a main catalyst for international cooperation on environmental issues.[181] It was also the forum at which world leaders and most others first discussed development in terms of its environmental sustainability and economic progressiveness. The Conference was intended to meet the needs of the present, without compromising the ability of future generations to meet their needs.

Yet, in the following years little was done in practical terms to integrate the environmental dimension or the idea of sustainable practices into policies and plans for economic development. All the same, from the human vantage point we realized that the global environment was continuing to deteriorate, and the economic and social status quo between industrialized and industrializing countries had become untenable with a continuing and widening gap between the two.

In 1987, the UN World Commission on Environment and Development revived the concept of sustainable development in a publication widely known as the Brundtland Report, named after Ms. Gro Harlem Brundtland, Prime Minister of Norway, who had chaired the Commission.[182] The landmark report documented in compelling terms a need for sustainable development both in industrialized and industrializing countries and

reflected very different starting points and impediments for countries which decide to undertake the journey to industrialization.

On December 22, 1989, the United Nations General Assembly adopted Resolution 44/228 which called for a global meeting on environment and development issues.[183] The Conference, the Assembly said, "should elaborate strategies and measures to halt and reverse the effects of environmental degradation in the context of increased national and international efforts to promote sustainable and environmentally sound development in all countries."[184] It is noteworthy that the resolution spoke of development, and not industrialization, a dichotomy which is reflected in the juxtaposition of the two words "environment" and "development" in the title of the Earth Summit.

In the context of this dichotomy, "development" could be ascribed to the realm of the industrialized countries, and "environment" to that of the industrializing nations. Yet, such an argument would ignore the point that the key to the conference lies in the conjunctive. Despite the fact that the conference did not address specific issues of ozone depletion in seeking anew a compromise on issues of global importance to *homo sapiens* and in developing a forum and *modus operandi* for dialog to lay the groundwork in concerted action being taken by the participants to remedy the perceived problems, the Earth Summit confronted a formidable agenda, as it addressed:

- protection of the atmosphere (use of energy, climate change, depletion of the ozone layer, transboundary air pollution);
- protection of land resources (deforestation, desertification, soil loss, and drought);
- conservation of biological diversity;
- protection of freshwater resources;
- protection of oceans, seas and coastal areas, and the rational use and development of their living resources;
- environmentally sound management of biotechnology, hazardous wastes, and toxic chemicals;
- prevention of illegal traffic in toxic products and wastes;
- improvement in the quality of life and human health;
- improvement in the quality and working conditions of the poor by eradicating poverty and stopping environmental degradation.[185]

Related to this agenda were patterns of development which may be considered to cause stress to the environment, such as poverty in industrializing countries, levels of economic growth, unsustainable patterns of consumption, and demographic pressures and their impact on aspects of trade and investment in an international economy. Despite the fact that the Earth Summit received world-wide support and was attended by an extraordinary number of heads of state, the focus of the conference which brought it almost equally keen attention was the position of the President of the United States; both with his administration's ambivalence preceding the start of the conference that he attend and then shortly before the conference convened, in an apparent about-face, the fact that the president joined other heads of state in Rio. This vacillation reached the level of near embarrassment when the United States became the only country not to sign the Convention on Biological Diversity which set regulations for the conservation and sustainable use of fauna and flora. As an apparent pretext for this position, it was claimed that the financial mechanisms for implementing the treaty were unclear and would endanger the U.S. biotechnology industry.[186] While it was supposed that the texts of the conventions and the corresponding chapters of Agenda 21 should be equivalent, there was no binding obligation for them to be identical.

It was on this specific feature that the United States based its objections to two paragraphs in the chapter on biological diversity. One of these paragraphs states that the world's countries should share equally the benefit derived from the research on and development of genetic and biological resources.

The other paragraph lays down the right of countries which still have a diversity of flora and fauna (i.e. the industrializing and non-industrialized countries) to have access to biotechnology and the trade in products derived from such resources. Thus, the position of one of the representatives of the industrialized world becomes emblematic for the real and conceptual obstacles which face the industrializing world should it elect to embark

on a path to improve the quality of life for those who live in its midst.

True Progress:
Looking for a Place Where We Can Stop

Difficulties in reaching a compromise in matters concerning the depletion of the world's ozone layer must be seen in light of significant, perhaps compelling, national interests which give rise to official positions.[187] The United States has presented its positions in international discussions with remarkable urgency, agility, and persistence because, *inter alia*, the attitude of the CFC producing industry changed markedly in 1986. In September 1986, the Alliance for Responsible CFC Policy, which represented over 500 U.S. CFC producers, called for expanded voluntary conservation and increased research. The Alliance now supports a freeze on emission levels.[188] Industry requires greater clarity on the question of timeframes and the full scope of measures, in order to be able to adapt to them. But industrial considerations alone had not inspired the U.S. call for fast and effective action, since U.S. CFC producers almost exclusively supply the domestic market.

The EPA was sued in a U.S. court by the Natural Resources Defense Council (NRDC)[189] on the claim that the EPA had not fulfilled its duties under Section 157(b) of the Clean Air Act.[190] The plaintiff demanded that a schedule be established for a decision on the control of CFCs. The United States District Court for the District of Columbia ordered the implementation of a schedule which, among other things, required the EPA to propose new CFC regulations by May 1, 1987, and to issue final regulations by November 1, 1987. In May 1987, the NRDC and the EPA agreed on an eight-month extension of these deadlines until December 31, 1987 and August 1, 1988, respectively. The United States District Court for the District of Columbia was asked to approve these deadlines.[191] This pressure on the EPA to define and implement domestic standards corresponds to the quick response of the United States to determine them internationally, as well.[192]

Notwithstanding any criticism of the Convention for its broad terms, one would have to recognize the amazingly responsive follow-up the Montreal protocol provided. Although some suggest that because of the foreseeable increase in CFC use in industrializing nations the actual reductions will not even amount to 35%,[193] the Convention represents an acceptable compromise and a beginning, in light of the still uncertain predictions with regard to actual depletion potentials.

With respect to the less industrialized countries' participation in the protocol, the possibility of requesting technical assistance and support is of particular significance. A major step towards implementation and compliance could be made by the less industrialized world if the industrialized parties to the protocol responded to such requests not only with granting technical assistance but also financing and took into account that the less industrialized countries have little part in the causation of the CFC problem. The Convention, the Montreal Protocol, and its London Amendments represent a significant step in the evolution of international environmental law from a system of inadequate, patchwork response towards a preventive *modus operandi* of managing common resources.

Without a requisite financial commitment, however, on the part of those who derived heretofore the greatest commercial and economic benefit from the production and sale of CFC-containing products which is commensurate to the commercial benefits derived, the capacity to implement required steps towards such a preventive *modus operandi* may be found to be seriously flawed, even if the will is there to develop and design a comprehensive plan to redress the present dilemma.[194]

One Man's Breath, Another's Death:
Is the industrialized brother's dream turning into a sibling's nightmare?

The question of ozone layer depletion is fundamentally a resource distribution and resource management question which goes to the heart of Humankind's ability to survive on the blue planet Earth. In an absolute sense, however, ozone depletion will probably have little effect on the continuation of the existence of this planet, as this planet has throughout its history seen many crises, undergone many dramatic changes of every kind, and will probably continue to do so in the future.

The problem of atmospheric ozone depletion then forces Humankind to take a long, hard look at itself and to recognize that which binds us all as a species and that which is the fountain of Humans' continuing presence on this planet - our shared communality.[195]

Democratic systems of government take pride in having as a central feature of their structure their constituents' right to choose and to choose freely. But the ecological spending spree the human species has been on for almost a century and a half, if continued, will have foreclosed virtually any kind of choice for us and for future generations, as we let our existential myopia and our cultural bias paint us into a corner from which there is no escape for *homo sapiens.*

At an ecological conference in Morelia, Mexico, the Swedish writer Agneta Pleijel is said to have begun her talk with the question "[i]s man a part of nature or excluded from it?"[196] Vassily Aksyonov continues this line of inquiry as follows:

> In fact, the philosopher was inclined to write about nature in its most terrifying manifestation, such as one that was observed on Java by German naturalist-explorer Franz Junghuhn in the early 19th century: By night, giant turtles came out of the sea to lay their eggs on the dunes. As they reached their destination, they were attacked by wild dogs that ripped and ate the turtles' legs and tails. Crocodiles, meanwhile, attacked the dogs, killing some of them and joining the feast. The turtles were still alive, but couldn't move, and the objective of the predators was to turn them upside down to deprive them of their shells. Then a new actor - the tiger - came out of the wings.
>
> This dreadful story, repeated and repeated, naturally, gave Schopenhauer an illustration for his philosophy. The will to live and the will to give birth - the fate of the turtle - create an image of biological life as a meaningless vicious cycle. Schopenhauer also said that human beings have the only power that might oppose that fearful process; this power he called "compassion."[197]

Though the hour has advanced, it is not too late, if, as a species, *homo sapiens* can show through its conduct that it understands freedom to choose in the context of restraint and compassionate self-control. Only then can there be a realistic chance for survival as a species and perhaps even an opportunity to achieve real prosperity among ourselves. To the extent the law fails to take notice of these elements and incorporate them, it has turned into the handmaiden of specialized group interests, at the expense of some measure of global welfare, and is helping rearrange furniture on a sinking ship. Should the law rise to the occasion, however, it may well set a precedent by replacing the current, self-destructive trend in managing global resources at a level of repetitious, incoherent homogeneity based on nationalistic impulses and ethnic rivalries, with an enlightened approach towards a sustained level of transnational, coherent heterogeneity and diversity.

EPILOGUE

The North-South dialogue between the rich, "developed" and the poor, "less industrialized" countries has yet to produce the hoped-for results.[198] Some twelve years ago, the Report of the Brandt Commission stated this succinctly:

> The North-South dialogue is not only an essential task in itself: it is also a wider call for action. It can make global action more probable by demonstrating that countries and continents can overcome their differences and resolve the contradictions between their self-interest and their joint interests. Now that both North and South are increasingly aware of their inter-dependence, they need to revitalize the dialogue to achieve specific goals, in a spirit of partnership and mutual interest rather than of inequality and charity. The dialogue must aim to give every society a full opportunity to develop as it wishes and satisfy the essential needs of its people at an acceptable pace; and to create a dynamic world in which every country can achieve its own development, each respecting the other and respecting also the imperatives of a shared planet.[199]

The depletion of the ozone is the most recent crisis the world economy has experienced since 1970, the effects of which were felt more severely in the least developed (i.e. least industrialized) countries, up to now, generally more vulnerable to fluctuations in the world economy. Notwithstanding this series of grave crises, the less industrialized world is gradually evolving its own, significant sphere of influence.[200] Because this evolution has yet

to take on its own characteristics and particular focus, the real danger exists that the "developing," i.e. industrializing, world will attempt to emulate the "developed," i.e. industrialized, world, as it sets goals and defines strategies to achieve them.[201] Such a development may well lead to a repetition of mistakes made by those "developed" countries in their own evolution, which has had such exacerbating consequences on the world's economy and ecology. In the context of the span of a human lifetime and the beneficial use of the world's resources, a repetition may well prove to be untenable for an already fragile international environment.

Dumitru Ceausu of the U.N. Sub-Commission on Prevention of Discrimination and Protection of Minorities considered the possibilities in the following manner:

> The new international economic order should be with the participation of all States. **It should be accepted without being imposed.** The existing order was designed to maintain the majority of countries in economic weakness and military powerlessness by excluding the developing countries from the decision-making process. The new order would therefore have to be established with the support of those who held economic and political power, through negotiation, dialogue and persuasion; otherwise, it would be brought about by a world crisis or, worse still, by a world war.[202]

The interdependence of countries and the need for respect for and promotion of a safe environment in the context of fundamental freedoms as an essential component of international economic relations is being recognized even by individuals who are not convinced of the need for a new international order. Louis Henkin concedes that by the end of the century we will have a different order:

> I cannot foresee the outcome of dialogue and eventual negotiation, and, in fact, there is not likely to be an 'outcome', only a series of continuing developments and changes over years and decades. One can say that with some confidence, however, that although the developed world holds most of the cards today, the influence of numbers, of rhetoric, of ideas whose time have come - if slowly - will be strongly felt in the politics of economics; and the international economic order at the end of the century, if not new, will be substantially different from what we know today.[203]

We find this argument echoed differently, yet in a familiar chord struck in the thoughts and comments of United States Senator Albert Gore, who pointed out that:

> [a]lthough other chemicals have contributed to the ozone depletion crisis, the principal damage has been done by chlorofluorocarbons (CFCs). The fact that CFCs have been produced for fewer than 60 years and yet have had such a sweeping impact should make us consider how many of the other 20,000 chemical compounds introduced each year may, when mass-produced, cause other significant changes in the environment. Very few are extensively tested for environmental impact before they are used - although, ironically, CFCs were. It was their benign chemical stability in the lower atmosphere that enabled them to float slowly, unimpeded, to where ultraviolet rays finally sliced them into corrosive pieces. ...
>
> In the past, it was safe to assume that nothing we could do would have any lasting effect on the global environment. But it is precisely that assumption which must now be discarded so that we can think strategically about our new relationship to Earth. ...
>
> Marginal adjustments in ongoing programs, moderate improvements in laws and regulations, rhetoric offered in lieu of genuine change - these are all forms of appeasement, designed to satisfy the public's desire to believe that wrenching transformation of society will not be necessary. The Neville Chamberlains of this crisis carry not umbrellas but "floppy hats and sunglasses" - the palliative allegedly suggested by a former secretary of the interior as an appropriate response to the increased ultraviolet radiation caused by the thinning of the ozone layer.
>
> What is needed is a plan - call it a

> Global Marshall Plan for the environment - that combines large-scale, long-term, carefully targeted financial aid to developing nations; massive efforts to design and then transfer to poor nations the new technologies needed for sustained economic progress, a world-wide program to stabilize world population and binding commitments by the industrial nations to accelerate their transition to an environmentally responsible pattern of life.[204]

Whether one believes or questions these tenets, out of self-interest lacking foresight major industrialized countries have thus far failed to understand fully the global importance and immense significance of the call of the less industrialized countries. This ethno-centric myopia of "developed" countries may carry with it far-reaching and serious consequences for a well-understood and defined communality of nations as the world tumbles and teeters at the brink of unprecedented crisis and catastrophes. Such an apocalyptic state of world affairs would be an existential threat to the thin veneer of civilization, self-rule, self-determination, and democracy as we know it. Most importantly, in the case of *Earth v. Man* there can be no winners, only losers. Professor Delgado suggests that the Public Trust Approach is "unlikely to succeed, because the trustee will share the same values we hold, ... [and] will construe our trust instructions against a background of the same cultural assumptions, values, and meanings that we hold, and that render us poor defenders of the thing in question."[205] But this argument ignores the point that for Humankind to assume the role of a trustee, Humankind would do well to develop a comprehensive and non-anthropocentric approach to the management and stewardship of global resources.[206]

Perhaps a beginning could be made by starting a global dialogue on a regular and continuing basis, without regard to the contrived human boundaries of states, about not only the "promising approaches to humanity's relationship with the natural world" which Professor Delgado suggests "have not been developed,"[207] but also the three he mentions[208] and others not treated extensively in his article, such as "deep ecology, .. religion-based environmental ethics, and Kenneth Boudling's (and others') 'spaceship earth' approach,"[209] as well as others he does not mention.[210]

Only when *homo sapiens* evolves to act in a non-anthropocentric manner as the guardian-trustee and steward of the Earth's resources to turn this natural inheritance over to the next generation enriched and not impaired in value will we, as a species, have a chance for surviving despite ourselves on the blue planet Earth.[211]

ENDNOTES

1. Translated from VICTOR HUGO, MANIFEST FOR THE ROMANTIC MOVEMENT IN FRANCE (1827) (emphasis added).

2. Mario J. Molina and F.S. Rowland, "*Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom Catalyzed Destruction of Ozone*," 249 NATURE 810 (June 1974).

3. A nanometer is one one-billionth part of a meter. THE OXFORD ENGLISH DICTIONARY, Vol. X at 209 (2d. ed. 1989).

4. *But see* Statement of President George Bush, Office of the Press Secretary, Rio de Janeiro, Brazil, Friday, June 12, 1992, 3:00 p.m. A.S.T. at 2 and 3; 28 WEEKLY COMP. OF PRES. DOCS. 1043 (June 22, 1992); Remarks by The President In Address to the United Nations Conference on Environment and Development, Assembly Hall, Riocentro Conference Center, Rio de Janeiro, Brazil, June 12, 1992; Press Briefing by Environmental Protection Agency Administrator William K. Reilly, Sheraton Rio Hotel, Rio de Janeiro, June 12, 1992.

5. "*Third World Demand for CFCs Raises Worries*," WASHINGTON POST at A18 (March 14, 1989).

6. *See* P.J. FRASER, "*Structure and Constituents of the Atmosphere*," BELGRADE CONFERENCE ON THE ILA PROCEEDINGS (1980) (Summarizing the structure of the Earth's atmopshere).

7. THE NEW ENCYCLOPÆDIA BRITTANICA, Vol. 14 at 311 (15th ed. 1986).

8. *See* W.T. SPROULL, AIR POLLUTION AND ITS CONTROL 13 (1970): 78.08% nitrogen, 20.95% oxygen.

9. *Id.* at 14.

10. J.E. KRIER AND R.B. STEWART, ENVIRONMENTAL LAW AND POLICY 3 (2nd ed. 1978).

11. SUBCOMMITTEE ON ACID RAIN OF THE CANADIAN HOUSE STANDING COMMITTEE ON FISHERIES AND FORESTRY, *Still Waters: The Chilling Reality of Acid Rain*, REPORT OF THE CANADIAN HOUSE OF COMMONS at 63 (1981).

12. KRIER AND STEWART, *supra* note 10, at 8.

13. *See* INTERNATIONAL LAW ASSOCIATION (ILA), RULES OF INTERNATIONAL LAW APPLICABLE TO TRANSFRONTIER POLLUTION, REPORT OF THE 60TH CONFERENCE AT 159 (Montreal 1982) *reprinted in* (1983) 10 ENVIRONMENTAL POLICY AND LAW at 27.

14. Molina and Rowland, *supra* note 2, at 810.

15. *Id.*

16. I.S. Isaksen and F. Stordal, "*The Influence of Man on the Ozone Layer: Readjusting the Estimates*," 10 AMBIO 9, at 10 (1980); R.T. Watson, "*Atmospheric Ozone*," *in* EPA and UNEP, eds., EFFECTS AND CHANGES IN STRATOSPHERIC OZONE AND GLOBAL CLIMATE, Vol. 1; OVERVIEW OF SCIENCE AND ISSUES RELATED TO THE PROTECTION OF THE OZONE LAYER at 69 [hereinafter "OVERVIEW"] (EPA) (James G. Titus ed., August 1986).

17. J.E. Frederick, "*The Ultraviolet Radiation Environment of the Biosphere*," *in* OVERVIEW, *supra* note 16, at 121-28.

18. Molina and Rowland, *supra* note 2; F. J. Evans, "*Ozone, Our Invisible Shield*," BRIDGES at 18-22 (May/June 1985).

19. Frederick, *supra* note 17, at 121-22; E.A. Emmet, "*Health Effects of Ultraviolet Radiation*," *in* OVERVIEW, *supra* note 16, at 129.

20. OECD, *Fluorocarbons: An Assessment of Worldwide Production, Use and Environmental Issues* at 3 (Paris 1976); A. Kiss, "*Du nouveau dans l'air: des 'pluies acides' à la 'couche d'ozone'*," 31 ANNUAIRE FRANÇAIS DU DROIT INTERNATIONAL 820 (1985).

21. Michael Keating, "*Canada Key Player in Ozone Talks*," THE [TORONTO] GLOBE AND MAIL at A6 (February 21, 1987).

22. M.K. TOLBA, "*Facing A Distant Threat*," STATEMENT TO THE OPENING SESSION OF THE CONFERENCE OF PLENIPOTENTIARIES ON THE PROTECTION OF THE OZONE LAYER (Vienna) at 4 (March 18, 1985); Michael Keating, "*Ozone Depletion Raising Risk of Skin Cancer, Scientists Say*," THE [TORONTO] GLOBE AND MAIL at A1 (December 9, 1986).

23. OVERVIEW, *supra* note 16, at 1.

24. Isaksen and Stordal, *supra* note 16, at 9-10; Molina and Rowland, *supra* note 2, at 811-12.

25. *See* I. Anderson, "*Is Darwin the Origin of Ozone Depletion?*" NEW SCIENTIST at 26 (8 January 1987) (One recent theory about pollutant transport in the atmopshere).

26. Caul and Stordal, "*Ozone Perturbations due to Increases in N_2O, CH_4 and Chlorocarbons: Two Dimensional Time-Dependent Calculations*," *in* OVERVIEW, *supra* note 16, at 108.

27. S.R. Seidel and T.G. Titus, "*Overview of the Effects of Changing the Atmosphere*," *in* OVERVIEW, *supra* note 16, at 4.

28. T.S. Hoffman, "*The Importance of Knowing Sooner*," *in* OVERVIEW, *supra* note 16, at 54-56.

29. Caul and Stordal, *supra* note 26, at 15.

30. *Id.* at 88.

31. *Id.* at 71.

32. Watson, *supra* note 16, at 71.

33. Caul and Stordal, *supra* note 26, at 96.

34. *Id.* at 86, 88, 89.

35. Caul and Stordal, *supra* note 26, at 96; Seidel and Titus, *supra* note 27, at 4.

36. Anonymous (EPA), *supra* note 16, at 6.

37. Caul and Stordal, *supra* note 26, at 96 (point to possibility of a 5% depletion at middle and high latitudes).

38. Watson, *supra* note 16, at 79.

39. A.F. Tuck, "*Depletion of Antarctica Ozone*," 321 NATURE 729 (19 June 1986); H. Rademacher, FRANKFURTER ALLGEMEINE ZEITUNG 9-10 (October 5, 1987).

40. *Id.*

41. "*Interim Findings: Second Arctic Stratospheric Expedition (AASE-II)*," NASA Headquarters, 3 February 1992.

42. *Id.* at 2.

43. *Id.* at 3. *"Northern Hemisphere Dodged Ozone Hole Last Winter,"* WASH. POST at A1, May 1, 1992; *"The Ozone Vanishes,"* TIME at 60 (February 17, 1992); *"Ozone Depletion Tied to Infectious Diseases,"* WASH. POST at A10 (February 8, 1992); *"U.S. May Seek to Hasten Action to Protect Ozone,"* WASH. POST at A3 (February 6, 1992); *"Ozone-Hole Conditions Spreading,"* WASH. POST at A1 (February 4, 1992); *"Ozone Study Predicts Increase In Cataract, Skin Cancer Risks,"* WASH. POST at A3 (November 16, 1991); *"First Summer Thinning Found in U.S. Ozone Layer,"* WASH. POST at A3 (October 23, 1991); *"'WINDOW IN THE SKY' WORRIES ESKIMOS,"* WASH. POST at A12 (March 31, 1992).

44. *See* Joel A. Mintz, *"Keeping Pandora's Box Shut: A Critical Assessment of the Montreal Protocol on Substances That Deplete The Ozone Layer,"* 20 INTER-AMERICAN L.REV. 565 at 571 (1989) (Discussing some critical developments since the signing of the Montreal Protocol). R.L. McKenzie and G. Seckmeyer, *"Increased ultraviolet radiation in New Zealand (45°S) relative to Germany (48°N),"* 359 NATURE 135 (September 10, 1992) (About hemispheric differences in ultraviolet intensities, following recent analyses of global ozone measurements confirming that ozone reduction are not confined to the Antarctic, but now extend to mid-latitudes in both hemispheres, to show that in New Zealand summer of 1990-91 biologically weighted ultraviolet irradiences were nearly a factor of two greater than those in the summer of similar northern latitudes in Germany)

45. David D. Caron, *"Protection of the Stratospheric Ozone Layer and the Structure of International Environmental Lawmaking,"* 14 HASTINGS INT'L. & COMP. L. REV. 755, 772-76 (1991).

46. OECD, *supra* note 20, at 8.

47. *See* Emmett, *supra* note 19, at 136-40 (Details of the evidence from extensive laboratory and epidemiological studies suggest a linkage between UV-B radiation and non-melnoma skin cancers in humans).

48. Frederick, *supra* note 17, at 124-28.

49. Emmett, *supra* note 47, at 140; Evans, *supra* note 18, at 20.

50. D. J. Dudeck and M. Oppenheimer, *"The Implications of Health and Environmental Effects of Policy,"* *in* OVERVIEW, *supra* note 16, at 368-70.

51. Gert Kelfkens, *Et Al.*, *"Ozone Depletion and Increase in Annual Carcinogenic Ultraviolet Dose,"* PHOTOCHEMISTRY AND PHOTOBIOLOGY, vol. 52, no. 4 at 819-23.

52. A.H. Termura, "*Overview of Our Current State of Knowledge of UV Effects on Plants*," *in* OVERVIEW, *supra* note 16, at 165-73.

53. Dudeck and Oppenheimer, *supra* note 50, at 371-74.

54. *Id.*

55. R. C. Worrest, "*The Effects of Solar UV-B Radiation on Aquatic Systems: An Overview*," *in* OVERVIEW, *supra* note 16, at 175-91.

56. *Id.*

57. *Id.*

58. *See* ENVIRONMENT CANADA, ATMOSPHERIC ENVIRONMENT SERVICE, ANNUAL REPORT 1985: UNDERSTANDING CO_2 AND CLIMATE (hereinafter "UNDERSTANDING CLIMATE"); SANDRA POSTEL, "*Altering The Earth's Chemistry: Assessing the Risks*," WORLDWATCH PAPER 71 (July 1986).

59. J. Hansen Et Al., "*The Greenhouse Effect: Projections of Global Climate Change*," *in* OVERVIEW, *supra* note 16, at 213. (In Washington, DC the number of days per year on which the maximum daily temperature exceeds 38°C (100°F) increases from about 1 to 12, the number of days exceeding 32°C (90°F) from about 35 to about 85 days in the middle of the next century).

60. Paul J. Crutzen and Georgii S. Golitsyn, "*Linkages Between Global Warming, Ozone Depletion, Acid Deposition and Other Aspects of Global Environmental Change*," *in* CONFRONTING CLIMATE CHANGE: RISKS, IMPLICATIONS AND RESPONSES 15 (Irving M. Mintzer ed., 1992). *But see* M.E. Raymo and W.F. Ruddiman, *"Tectonic forcing of late Cenozoic Climate,"* 359 NATURE 117 (September 10, 1992) (For a discussion of how tectonically driven increases in chemical weathering may have resulted in a decrease of atmospheric CO_2 concentration over the past 40 million years).

61. UNDERSTANDING CLIMATE, *supra* note 58.

62. R. J. Engelman, "*A Look at Some Issues Before an Ozone Convention*," 8 ENVIRONMENTAL POLICY AND LAW 51, 53 (1983); OECD, ECONOMIC AND ECOLOGICAL INTERDEPENDENCE 15 (Paris 1982).

63. "*Study Recommends Steps to Protect Ozone Layer*," N.Y. TIMES, November 30, 1986; A. S. Miller and I. M. Mintzer, "*The Sky Is the Limit: Strategies for Protecting the Ozone Layer*," WORLD RESOURCES INSTITUTE RESEARCH REPORT #3 16 (November 1986).

64. *Id.*

65. *See* duPont, *Fluorocarbons/Ozone - Alternatives for Fully Halogenated Chlorofluorocarbons: The duPont Development Program*, DUPONT UPDATE, March 1987 (The lengthy screening process of alternatives).

66. "*Staying Cool and Saving the Ozone*," THE N. Y. TIMES at D1 (June 22, 1992).

67. Dr. Arjun Makhijani et al., "*'Saving Our Skins,' The Causes and Consequences of Ozone Layer Depletion and Policies for its Restoration and Protection*," INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH, Washington, DC, Report of February 19, 1992.

68. *Id.* at 16-17.

69. *Id.* at 33. *See also* "*U.S. to end CFC Production 4 Years Earlier Than Planned*," WASHINGTON POST at A2 (February 12, 1992).

70. Debra MacKenzie, "High Noon for Ozone in Montreal," NEW SCIENTIST at 24 (3 September 1987).

71. 42 U.S.C. §§ 7401-7671 (Supp. 1992).

72. Craig N. Oren, "*The Clean Air Act Amendments of 1990: A Bridge to The Future?*," 21 ENVTL. L. 1817, 1823-25 (1991). *See also* Henry A. Waxman, "*An Overview of the Clean Air Act Amendments of 1990*," 21 ENVTL. L. 1721 (1991).

73. The NAAQS for ozone is 0.12 parts per million (ppm) concentration for one hour. 40 C.F.R. §50.9 (1987). On December 14, 1987, EPA analysts recommended to the Clean Air Scientific Advisory Board Committee (CASAC) that the one-hour standard be set between 0.08 and 0.12 ppm per hour. Although there appears to be some disagreement within CASAC membership about the need to tighten the standard, it has been reported that CASAC "has strongly recommended that EPA move to a more stringent primary ozone standard." INSIDE EPA, Vol. 8, No. 51, December 18, 1987. This matter was continued to the next CASAC meeting in 1988. Current Developments, 18 ENV.REP. 1965 (BNA) (Jan. 1, 1988). The NAAQS for carbon monoxide is 9.0 ppm concentration for an eight hour period. 40 C.F.R. §50.8 (1987).

74. 42 U.S.C. § 7410 (Supp. 1987).

75. For a discussion of why the problems of enforcement are not rectified in the 1990 amendments to the Clean Air Act and why regulation alone has seldom proven sufficient to accomplish a statutory purpose, often requiring affected parties to resort to litigation, see Timothy Talkington, "*Interstate Air Pollution Abatement and the Clean Air Act Amendments of 1990: Balancing Interests*," 62 U. COLO. L. REV. 957 (1991).

76. 13 EPA JOURNAL, No. 8 at 24 (October 1987).

77. 42. U.S.C. § 7503(a)(4) (Supp. 1987).

78. 42 U.S.C. § 7506(c) (Supp. 1987), "Sanctions."

79. 52 Fed.Reg. 45043-45122 (November 24, 1987) (hereinafter referred to as "*EPA Post-1987 Control Strategy*").

80. S.1894 (S. Report No. 100-231) (November 20, 1987).

81. H.J.Res. 395 (Conference Report and Pub.L. 100-202) (December 22, 1987).

82. *See* Ronald H. Rosenberg, "*Cooperative Failure: An Analysis of Intergovernmental Relationships and the Rroblem of Air Quality Non-Attainment*," 1990 ANN. SURV. AM. L. 13, 13-15 (1990).

83. 12 EPA JOURNAL, No. 8 at 22 (October 1987).

84. *See supra* note 4.

85. "*New Jersey Faces Pressure To Allow Use of Gasohol*," NEW YORK TIMES at 26 (May 25, 1992).

86. *Current Developments*, 17 Ener.Rep. 2119 (BNA) (April 17, 1987); EPA JOURNAL, *supra* note 76.

87. *See* American Petroleum Institute, Testimony before the Subcommittee on Environmental Protection, Committee on Environment and Public Works, U.S. Senate, June 16, 1987.

88. *"EPA Won't Tighten Urban Ozone Standard, Latest Health Data Not Considered in Decision, Agency Concedes,"* WASH. POST at A1 (August 4, 1992); *"U.S. Rejects Demands to Tighten Limits on Ozone in Smoggy Cities,"* N. Y. TIMES at A9 (August 1992); EPA PRESS RELEASE, UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, OFFICE OF COMMUNICATIONS, EDUCATION, AND PUBLIC AFFAIRS (A-107) (August 3, 1992).

89. WASH. POST, *supra* note 88, at A1.

90. EPA PRESS RELEASE, *supra* note 88, at 1.

91. *Id.*

92. 52 Fed.Reg. 45083-45122 (November 24, 1987).

93. 52 Fed.Reg. 45046, col. 1 (November 24, 1987).

94. *Current Developments*, 18 ENV. REP. 1756 (BNA) (Nov. 20, 1987).

95. *See* 52 Fed.Reg. 45054-45058 and Appendices to the proposed EPA Post-1987 Control Strategy (November 24, 1987).

96. 52 Fed.Reg. 45054 (November 24, 1987).

97. 52 Fed.Reg. 45058 (November 24, 1987).

98. For two examples of how this unproductive adversarial relationship plays itself out in litigation, see Environmental Defense Fund v. Thomas, 18 ENVTL. L. REP. 21394 (S.D.N.Y. 1988) (The court, J. Richey, held that the EPA was not required under the Clean Air Act to revise the national ambient air quality standards for sulfur dioxide, ruling first that the Clean Air Act §109(d) does not impose a nondiscretionary duty on EPA to issue revised standards, then holding that EPA was not required by §109(a)(2) to issue simultaneously new sulfur dioxide standards when it issued revised air quality criteria); Natural Resources Defense Council v. Thomas, 689 F.SUPP. 246 (S.D.N.Y. 1988) (The court, J. Haight, held that the federal district court did not have jurisdiction under the Clean Air Act to require the EPA to exercise a discretionary duty under the Clean Air Act, nor under the Mandamus Act, nor on the basis of unreasonable delay in action by the EPA).

99. U.S. EPA, UNFINISHED BUSINESS: A COMPARATIVE ASSESSMENT OF ENVIRONMENTAL PROBLEMS (1987). For a brief description of the "comparative risk" approach, see Christine Gregoire, *"A Washington Innovation: Environment 2010,"* 22 ENVTL. L. 301, 303-4, (1991). In the related case of the EPA promulgating final emission standards for several benzene and radionuclide categories, for a brief introduction to the EPA's manner of choosing a hybrid approach that had all the elements of its most flexible proposal, but was ostensibly constrained by the single-risk measures, see Janet L. McQuaid, *"Risk Assessment of Hazardous Air Pollutants Under the EPA's Final Benzene Rules and the Clean Air Act Amendments of 1990,"* 70 TEXAS L.REV. 427, 439-41 (1991).

100. *See* Coalition Against Columbus Center v. City of New York, 967 F2d. 764, (2nd Cir. 1992) (New York City had not repudiated or failed to fulfill its commitment to assure that mitigating measures were implemented to meet the statutory deadline imposed for complying with NAAQS for carbon monoxide standards under the Clean Air Act in connection with a project to replace existing buildings and an underground parking garage with a new garage and residential, office, and retail buildings. While the city's progress was not as rapid as possible, there was no triable issue of fact as to compliance).

101. *See "Industries Gaining Broad Flexibility on Air Pollution,"* N. Y. TIMES at A1 (June 26, 1992); *"EPA Proposes Sale of Rights To Pollute Air,"* WASH. POST at A3 (October 30, 1991); Title VI of the Clean Air Act, §§ 607, 616.

102. *See "Industries Gaining Broad Flexibility on Air Pollution,"* N. Y. TIMES at A16 (June 26, 1992).

103. *"EPA Eases Final Rules On Industrial Pollution,"* WASH. POST at A1 (June 26, 1992).

104. "[The Council] interpreted the Clean Air Act of 1990 to mean that the public has no right to review a company's plan to increase air pollution above permitted levels." *"Battle Looms for Quayle, Who Ended Rules, and Gore, Who Wrote the Book,"* THE N. Y. TIMES at A6 (July 11, 1992).

105. THE N. Y. TIMES, *supra* note 102, at A16.

106. PHILIP BOBBITT AND GUIDO CALABRESI, TRAGIC CHOICES 26 (1978).

107. For a detailed discussion focusing on examples drawn, *inter alia*, from the Clean Air Act, whose protective provisions appear, in form, tailored to the goals of Congress, but in practice agency action under them falls far short of the stated congressional intent, see Alyson C. Flournoy, *"Legislating Inaction: Asking the Wrong Questions In Protective Environmental Decisionmaking,"* 15 HARV. ENVTL. L. REV. 327 (1991).

108. "What were the root causes of our environmental crisis? With astounding consistency, citizens all around [the State of] Washington identified four key issues they felt were at the base of our environmental problems. Their concerns included uncontrolled growth, a failure of values, consumptive lifestyles, and a lack of environmental awareness and education." Christine Gregoire, *"A Washington Innovation: Environment 2010,"* 22 ENVTL. L. 301, 306 (1991).

109. *See "L.A. Ozone Levels Hit Record Low,"* WASH. POST at A3 (January 1, 1992).

110. The international community's concern over global issues of environmental protection is reflected, for example, in the 1972 Declaration of the United Nations Conference on the Human Environment in Stockholm, which maintained, *inter alia*, that states have the sovereign right to **exploit** their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other states or areas beyond the limits of national jurisdiction. DECLARATION OF THE UNITED NATIONS CONFERENCE ON THE HUMAN ENVIRONMENT, PRINCIPLE 21 (1972).

111. Peter Finkle and Douglas M. Johnston, "*Acid Precipitation in North America: A Case for Transboundary Cooperation*," 14 VAND. J. TRANSNAT'L L. 787, 819 (1981).

112. P. M. Dupuy, "*Limites matérielles des pollutions tolérées*," in: LES PROBLEMES JURIDIQUES POSÉS PAR LES POLLUTIONS TRANSFRONTIERES, Colloquium, Saarbrücken, (Berlin: Schmidt Verlag 1984) at 351 (May 13-15, 1982).

113. For an attempt to explore the limits of traditional doctrines and the possibilities for new paradigms of transboundary liability, see Sanford E. Gaines, "*Taking Responsibility for Transboundary Environmental Effects*," 14 HASTINGS INT'L. & COMP. L. REV. 781 (1991).

114. Gunther Handl, "*Binational Uses of Transboundary Air Resources: The International Entitlement Issue Reconsidered*," 26 NAT. RESOURCES J. 405, 440 (Summer 1986).

115. *Id.*

116. However, for a detailed, critical discussion of Parfit's Paradox and the question of how we can owe a duty to future persons if the very act of discharging that duty may wipe out the very individuals to whom allegedly that duty is owed, see Anthony D'Amato, "*Agora: What Obligation Does Our Generation Owe to the Next? An Approach to Global Environment Responsibility*," 84 AM. J. INT'L. L. 190 (1990).

117. Michie v. Great Lakes Steel, 495 F.2d 213 (6th Cir. 1974); Ohio v. Wyand Chemical Corporation, 401 U.S. 493 (1971); *See also*, The State of Georgia v. Tennessee Copper Company, 206 U.S. 230, 238 (1907), J. Holmes:

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

118. William A. Shutkin, "*International Human Rights Law and the Earth: The Protection of Indigenous Peoples and the Environment*," 31 VA. J. INT'L. L. 479 at 488-493 (1991).

119. *See generally*, David Barrans, "*Promoting International Environmental Protections through Foreign Debt Exchange Transactions*," 24 CORNELL INT'L. L. J. 65 (1991).

120. M. BEDJAOUI, TOWARDS A NEW INTERNATIONAL ECONOMIC ORDER 86-7 (1979).

121. *Id.* at 99.

122. *Id.* at 152-53.

123. Molina and Rowland, *supra* note 2.

124. Molina and Rowland, *supra* note 2; Sylvia Williams, "*A Historical Background on the Chlorofluorocarbon Ozone Depletion Theory and Its Legal Implications*," *in* TRANSBOUNDARY AIR POLLUTION at 268-69 (Flinterman et al. eds.) (hereinafter *"History"*); *See also*, Wendy J. Simpson, "*The problem of ozone depletion - is there an international legal solution?*," 12 N.C. J. INT'L. L. & COM. REG. 433 (Summer 1987).

125. Williams, *History*, *supra* note 124, at 270-72.

126. *See* I. Luge, "*Das Ozonproblem und der Versuch einer völkerrechtlichen Lösung*," NATUR UND RECHT 16, 17 (1985).

127. *See* Williams, *History, supra* note 124, at 270-71.

128. For a discussion of international protective strategies and implications, see Patrick Turley, "*Ozone Depletion: International Protective Strategies and Implications*," 12 UALR L.J. 301 (1989-90).

129. *See* OJC 90 of 3.4.1980; Bull. EC-3-1980, point 2, 1.54; OJC 329 of 25.11.1982; *see also* Bull. EC-6-1982, point 2, 1.83.

130. UMWELT, "*Nationale und Internationale Massnahmen zur Beschränkung von FCKW*," at 120 (1987).

131. *See* W. E. MOOZ, ET AL., ECONOMIC IMPLICATION OF REGULATING CHLOROFLUOROCARBON EMISSIONS FROM NON-AEROSOL APPLICATIONS (June 1980).

132. *See* I. Rummel-Bulska, "*The Protection of the Ozone Layer under the Global Framework Convention*," (hereinafter "*Global Framework*") *in* TRANSBOUNDARY AIR POLLUTION *supra* note 24, at 281. (Flinterman et al. eds.).

133. *Id.* at 281-82.

134. Governing Council decision 8/7B of April 29, 1980; *See also* UNEP, "*Final Report of the Ad Hoc Working Group of Legal and Technical Experts for the Elaboration of a Global Framework Convention for the Protection of the Ozone Layer*," UNEP/IG.53/4 at 1 (28 January 1985).

135. Governing Council decision 9/13B of May 26, 1981, *supra* note 134, at 2.

136. *See* Rummel-Bulska, *Global Framework*, *supra* note 132, at 283.

137. *See* UNEP/IG.53/4, *supra* note 134, at 2.

138. *Id.*

139. Rummel-Bulska, *Global Framework*, *supra* note 132, at 285.

140. *See* UNEP/IG.53/4, *supra* note 134, Annex II at 4, 6 (single-option approach can be found in the 4th Revised Draft Protocol on Chlorofluorocarbons (UNEP/IG.53/4, Annex III) as Alternative 2 of Article II).

141. On U.S. position, see summary in UNEP/IG.53/4, *supra*, note 134, Annex III at 3.

142. *See* Alternative 1 of Article II, 4th Revised Draft Protocol on Chlorofluorocarbons, UNEP/IG.53/4, *supra* note 134, at Annex III.

143. P. Szell, "*The Vienna Convention for the Protection of the Ozone Layer*," 36 INT'L DIG. HEALTH LEGIS. 839, 841 (1985).

144. For EEC position, see UNEP/IG.53/4, ANNEX II at 4, 6. *See also* UMWELT, *supra* note 130, at 121.

145. *Vienna Convention for the Protection of the Ozone Layer*, March 27, 1985, UNEP/IG.53/5 (9 April 1985) (hereinafter "*Vienna Convention*") *reprinted in* 14 ENVL. POL. & L. at 71 (1985); *See also* Norman Letalik, "*Vienna Convention for the Protection of the Ozone Layer 1985*," 1 INT'L INSIGHTS 88, 89-90 (Fall 1985).

146. *See* Kiss, *supra* note 20, at 821.

147. *Cf.* Winifried Lang, "*Luft und Ozon - Schutzobjekte des Völkerrechts*," 46 ZEITSCHRIFT FÜR AUSLÄNDISCHES RECHT UND VÖLKERRECHT 261, 272 (1986).

148. UNEP/IG.53/2/Corr.1 (11 January 1985).

149. *Id.*

150. Luge, *supra* note 126, at 19.

151. Letalik, *supra* note 145, at 90, 91.

152. *See* UNEP/IG.53/5, *supra* note 145, at ¶1.

153. Dale S. Bryk, "*The Montreal Protocol and Recent Developments to Protect the Ozone Layer*," 15 HARV. ENVTL. L. REV. 275, 291-97 (1991).

154. *Cf.* M. TOLBA, "*Nowhere to Hide*," *Statement to the Ad Hoc Working Group of Legal and Technical Experts for the Preparation of A Protocol on CFCs to the Vienna Convention for the Protection of the Ozone Layer*, (Vienna Group) - Third Session, Geneva at 1 (April 27, 1987); Report for the First Session, UNEP/WG.151/L.4 (15 January 1987).

155. Throughout the negotiations, however, the U.S. Congress was proceeding on a parallel track with domestic legislative proposals designed to protect the stratospheric ozone layer. For an explanation, from a Senate staffer's view, of the impetus for unilateral action by the United States and various provisions of the Clean Air Act's new Title VI, see Steven J. Shimberg, "*Stratospheric Ozone and Climate Protection: Domestic Legislation and the International Process*," 21 ENVTL. L. 2175 (1991).

156. *Id.*; *See also* Jeffrey J. Renzulli, "*The Regulation of Ozone-Depleting Chemicals in the European Community*," 14 B. C. INT'L. & COMP. L. REV. 345, 354-58 (1991); James T.B. Tripp, "*The UNEP Montreal Protocol: industrialized and developing countries sharing the responsibility for protecting the stratospheric ozone layer*," 20 N.Y.U. J. INT'L L. & POL. 733 (Spring 1988).

157. UNEP/WG.167/2 at 11 (March 4, 1987).

158. UNEP/WG.172/2 at 5 (May 8, 1987).

159. UNEP/WG.167/2 at 11 (March 4, 1987).

160. Swedish proposal, UNEP/WG.172/CRP.3, April 27, 1987.

161. UNEP/WG.172/2 at 5 (May 8, 1987); UNEP/WG.167/2 at 9, 10 (March 4, 1987).

162. UNEP/WG.167/2 at 22 (March 4, 1987).

163. UNEP/WG.172/2, *supra* note 158, at 18.

164. *Id.*

165. UNEP/WG.167/2 at 22 (March 4, 1987).

166. *Id.* at 13, 27. The Montreal Protocol defined industrialized countries as those nations which used more than 0.3 kilograms of CFCs per person in 1986 and which do not come under the provisions of Article 5.

167. India's representative is said to have made a comment that the issue was "a rich man's problem [requiring a] rich man's solution," and that on account of the greediness of developed (i.e. industrialized] countries, they were being asked to curtail their modernization [i.e. industrialization]. The basis for this position was that India had bought from U.S. companies (Pennwalt and Allied Chemical) CFC-producing technology prior to the start of negotiations and would have considerable quantities of CFCs for export. R. BENEDICK, OZONE DIPLOMACY 100-01 (1991).

168. *Id.* at 28. *See also* UNEP/WG.172/2, *supra* note 158, at 6.

169. *See* UNEP, *Final Act, Montreal Protocol on Substances that Deplete the Ozone Layer* (hereinafter "*Montreal Protocol*").

170. *Id. See also* Gerald A. Hapka, "*The Montreal Protocol: A Review of Global Environmental Action*," 9-FALL DEL. L. 27 (1991) (For a brief summary of the protocol's features).

171. *See* D. MacKenzie, "*High Noon for Ozone in Montreal*," NEW SCIENTIST at 24 (September 3, 1987); 6th Revised Draft Protocol, UNEP/WG.172/2, Annex I; 7th Revised Draft Protocol, UNEP/IG.93/3 and Rev.1.

172. *Id.*

173. *See Montreal Protocol*, *supra* note 169, Article One for definitions of "Consumption" and "Production" (September 16, 1987).

174. For the 1990 London Amendments, see *Report of the Second Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer*, U.N. Environmental Programme, U.N. Doc. EP/OzL.Pro.2/3 (1990). *See also*, J.G. Starke, "*The London Ministerial Meeting, 27-29 June 1990 on the ozone layer and global climatic change*," 64 AUSTRALIAN L. J. 736 (November 1990); Joel A. Mintz, "*Progress toward a healthy sky: an assessment of the London amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer*," 16 YALE J. INT'L L. 345 (Summer 1991).

175. *See* Elizabeth P. Barratt-Brown, "*Building a Monitoring and Compliance Regime Under the Montreal Protocol*," 16 YALE J. INT'L. L. 519, 532-42 (1991).

176. *See* Jason M. Patlis, "*The multilateral fund of the Montreal Protocol: a prototype for financial mechanisms in protecting the global environment*," 25 CORNELL INT'L L. J. 181 (Winter 1992).

177. *See* Bryk, *supra* note 153, at 287, 291-95; *See also* Pamela Wexler, "*Protecting the Global Atmosphere: Beyond the Montreal Protocol*," 14 MD. J. INT'L. L. & TRADE 1 (1990) (Discussing the concerns of India and China).

178. For a discussion of the institutional and political reasons for UNEP's failure to meet its goals and expectations raised, see Mark Allan Gray, "*The United Nations Environmental Programme: An Assessment*," 20 ENVTL. L. 291 (1990).

179. At the time of preparation of this article, final drafts of the signed protocols and official documents are not available to the author and official reference numbers will not yet be assigned until the General Assembly convenes in September 1992.

180. UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT, PRESS SUMMARY OF AGENDA 21, Introduction, Rio de Janeiro, Brazil, 3-14 June 1992.

181. *Id.*

182. U.N. WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT REPORT, OUR COMMON FUTURE.

183. UNGA Res./44/228, 22 December 1989.

184. *Id.*

185. United Nations Conference on Environment and Development, Doc. UN/DPI/1228 (May 1992), PRESS SUMMARY OF AGENDA 21, Introduction, Rio de Janeiro, Brazil at 2-7, 10, 12, 18, 20, 23, 24-28, and 40 (3-14 June 1992).

186. For a representative sampling of the evolution of the U.S. stance, as reported in the press, see *"Global Warming Pact Talks to Resume,"* WASH. POST at A3 (February 18, 1992); *"'Earth Summit' Negotiations At U.N. Collapse,"* WASH. POST at A24 (April 4, 1992); *"U.S. Unlikely to Budge at U.N. Global Warming Talks,"* WASH. POST at A4 (April 12, 1992); *"U.N. Advances on 'Greenhouse' Gases Pact,"* WASH. POST at A15 (May 8, 1992); *"U.S. View Prevails on Emissions,"* WASH. POST at A1 (May 9, 1992); *"As Earth Summit Nears, Consensus Still Lacking on Global Warming's Cause,"* WASH. POST at A1 (May 31, 1992); *"Bush Offers Plan to Save Forests,"* THE N. Y. TIMES at A1 (June 2, 1992); *"White House Snubs U.S. Envoy's Plea to Sign Rio Treaty,"* THE N. Y. TIMES at A1 (June 5, 1992); *"National Interests Preside at Rio,"* WASH. POST at A28 (June 7, 1992); *"U.S. Stance Under Fire At Summit," Id.* at A27; *"President Affirms Biodiversity Stance,"* WASH. POST at A1 (June 8, 1992); *"Bonn Pushes Tough Stand On Warming, U.S. Puts Pressure on 3 Allies to Drop 2nd Stiff Initiative,"* WASH. POST at A1 (June 9, 1992); *"Earth Summit Creeps Toward Compromises,"* WASH. POST at A25 (June 12, 1992); *"President, In Rio, Defends His Stand On Environment,"* THE N. Y. TIMES at A1 (June 13, 1992); *"Ecology, the Economy and Bush,"* THE N. Y. TIMES 4 at D1 (June 14, 1992); *"Storm in Rio: Morning After,"* THE N. Y. TIMES at 1 (June 15, 1992); *"Rio Organizer Says Summit Fell Short,"* WASH. POST at A1 (June 15, 1992).

187. Robert W. Hahn and Albert M. McGartland, "*The Political Economy of Instrument Choice: An Examination of the U.S. Role in Implementing the Montreal Protocol*," 83 NW. U. L. REV. 592 at 605-09 (1989).

188. ALLIANCE FOR RESPONSIBLE CFC POLICY, POLICY STATEMENT OF SEPTEMBER 16, 1986, K.J. Fray, Executive Director, Alliance for Responsible CFC Policy, Statement of April 29, 1987 (Geneva).

189. National Resources Council v. Thomas, 1987 WL 11428 (D.D.C.) (No. 84-3587, May 19, 1987). But for an example of how the limitations of the litigation process coupled with a limited interpretation by the court of the intent of the legislation can serve to defeat the legislation's purpose, see Natural Resources Defense Council v. Thomas, 705 F. Supp. 1 (D.D.C. 1988) (The environmental group moved to enforce a previous order of the court which established a time table for implementation of state and federal plans to control airborne pollution, and the court, J. Green, held that the EPA was entitled to extend the deadline for approval of implementation plans).

190. 42 U.S.C. §7401-7671.

191. TOXIC MATERIALS NEWS at 154 (May 20, 1987).

192. "*Stratospheric Protection Act of 1987*," Congressional Record - Senate, s.570,S2282-2288 (February 19, 1987). "*Stratospheric Ozone and Climate Protection Act*," Congressional Record - Senate, s.571,SS2288-2292 (February 19, 1987).

193. Michael Keating, "*International Pact near Completion on Curbing Ozone Killing*," THE [TORONTO] GLOBE AND MAIL at A8 (September 15, 1987).

194. *See* "*World Bank Warns on Environment*," N. Y. TIMES at D2 (May 18, 1992).

195. For an example of opposing groups working for a viable economic model, see "*Seeking the Key To 'Sustainable Development'*," WASH. POST at H1 (May 31, 1992). For an example of how villagers, in their struggle against poverty, have steadily destroyed their portion of one of the world's most fragile ecological systems, the forest of the Himalayan chain, despite a $30 million reforestation program funded by the World Bank and managed by the government of India, see "*A Plan to Save the Globe Dies in a Village*," WASH. POST at A1 (May 24, 1992). *See also*, "*Environmental Concern Mounts in Developing Nations*," WASH. POST at A3 (May 5, 1992).

196. Vassily Aksyonov, "*Schopenhauer Flies to Rio, Another Kind of Pollution: How Ideology Still Threatens Planet Earth*," WASH. POST at C4 (June 7, 1992).

197. *Id.*

198. In this continuing debate, one must be careful to avoid perpetuating certain linguistic misnomers which may not be intended, but are implied and betray our cultural bias. One would do well to decode these euphemisms. Such is the case whenever one speaks of 'developing' countries in a context where the adjective 'developing' more accurately refers to the level of industrialization of a given nation and therefore more appropriately should be read as 'industrializing'.

The use of the adjective 'developed' would then imply, *inter alia*, that the respective nation has reached a static plateau in the process of development, yet to be aspired to and achieved by the industrializing ('developing') country(ies). As in this context, the standard for measuring the degree of development is the level of industrialization it would be more appropriate to speak of 'industrialized' versus 'industrializing' nations in the framework of such a debate about development.

Moreover, using the adjective 'developed' instead of 'industrialized', when the debate is about the degree of industrialization, contains two other pitfalls which are obstacles to the evolution of a more equitable and fair-minded thought process. One, the word 'development' is far more inclusive and comprehensive in meaning than 'industrialization' which measures only one, albeit large and important, facet of human activity, and therefore assessing development only in terms of levels industrialization would do injustice to the comprehensive quality of the word 'development'.

Two, speaking of development in terms of levels of industrialization could be implicitly misunderstood for a message that the only development of consequence that is desirable and worth measuring in the transnational conduct of national affairs is the level of industrialization a country has attained.

It is therefore quite conceivable to envision a world in which a society is highly developed culturally and socially, yet not highly industrialized at all. Conversely, we may find that by encouraging not highly industrialized countries to abandon their own indigenous, evolutionary path, however incomprehensible and foreign it may be in its customs and procedures to industrialized countries, and to mimic any number of industrially more advanced nations, we may soon find ourselves in the company of highly industrialized countries which appear to have stagnated in their cultural, social, and human development.

199. WILLY BRANDT, NORTH-SOUTH: A PROGRAMME FOR SURVIVAL, REPORT OF THE INDEPENDENT COMMISSION ON INTERNATIONAL DEVELOPMENT ISSUES 30-31 (1980).

200. *See* John Ntambirweki, "*The Developing Countries in the Evolution of an International Environmental Law*," 14 HASTINGS INT'L. & COMP. L. REV. 905 (1991).

201. *See* Nathaniel C. Nash, "*Scrubbing The Skies Over Chile*," N. Y. TIMES at A4 (July 6, 1992).

202. E/CN.4/Sub.2/1982/SR.20,Sec.17 (1982) (emphasis supplied).

203. LOUIS HENKIN, HOW NATIONS BEHAVE: LAW AND FOREIGN POLICY 210-11 (1979).

204. Albert Gore, "*The Ozone Catastrophe: Warning From The Skies*," WASH. POST at B1, B2, Col. 3, 4 (February 9, 1992).

205. Richard Delgado, "*Our Better Natures: A Revisionist View of Joseph Sax's Public Trust Theory of Environmental Protection, and Some Dark Thoughts on the Possibility of Law Reform*," 44 VAND. L. REV. 1209, 1216 (1991).

206. Unwittingly, even the term 'environment' may be a product of this anthropocentrism. It implies that whatever is not human is just something that envelops man - surroundings that are inferior to him and that he should tend and develop in his own image. Nothing but the arrogance of an alleged master of the world and superior proprietor of reason could have produced the erroneous concept that life, the economy - the whole world - can be managed from one single center by one single planner.

Vaclav Havel, *"Rio and the New Millenium,"* THE N. Y. TIMES at A21, Col 1, 2 (June 3, 1992). For a discussion of anthropo-centric production systems, see, "*What are Anthropocentric Productions Systems? Why are they a Strategic Issue for Europe?*," Commission of the European Communities, EUR REPORT 13968 (EC, 1992); "*Anthropocentric Production Systems: The European Response to Advanced Manufacturing and Globalization*," Commission of the European Communities, EUR REPORT 13969 (EC, 1992).

207. Delgado, *supra* note 205, at 1217.

208. Delgado, *supra* note 205, at 1218.

209. Delgado, *supra* note 205, at 1217 n.57.

210. *See, e.g.*, HISATOKI KOMAKI, "THE FOUR STEPS TO ABSOLUTE PEACE," Vols. I-IX, (American Komaki: Peace Foundation 1992).

211. "The Nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased and not impaired in value; and behaves badly if it leaves the land poorer to those who come after it. That is what I mean by the phrase, conservation of natural resources. Use them; but use them so that as far as possible our children will be richer, and not poorer because we have lived." THEODORE ROOSEVELT, THE NEW NATIONALISM 52 (1910). When Professor Joseph Sax wrote his well-known article on public trust in 1970, he argued that because the nation's natural resources and parklands are limited commodities whose rapid consumption would render them unavailable either to ourselves or to future generations, we should look upon ourselves as trustees who hold such precious goods for the benefit of all. Joseph Sax, "*The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention*," 68 MICH. L. REV. 471 at 474, 484-490 (1970). *Contra*, Delgado, *supra* note 204.