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WORLD METEOROLOGICAL ORGANIZATION
GLOBAL OZONE RESEARCH AND MONITORING PROJECT—REPORT NO. 16

ATMOSPHERIC OZONE 1985

ASSESSMENT OF OUR UNDERSTANDING OF THE PROCESSE CONTROLLING ITS PRESENT DISTRIBUTION AND CHANGE

VOLUME I

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FEDERAL AVIATION ADMINISTRATION • NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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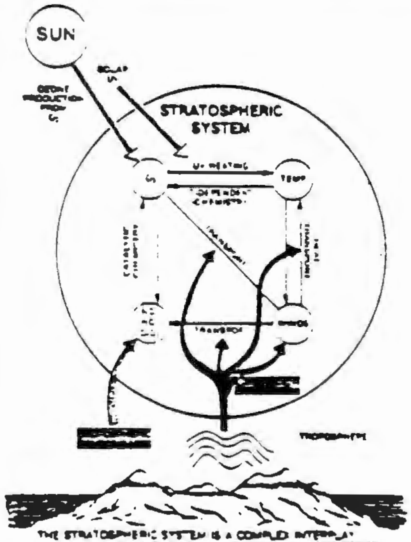
CHAPTER

1

INTRODUCTION AND SCIENCE SUMMARY



THE STRATOSPHERIC SYSTEM IS A COMPLEX INTERPLAY AMONG RADIATIVE, CHEMICAL AND DYNAMICAL PROCESSES THESE ARE DRIVEN BY SOLAR RADIATION TOGETHER WITH GASES AND ENERGY FROM THE TROPOSPHERE

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CHAPTER 1: INTRODUCTION AND SCIENCE SUMMARY

For several decades scientists have sought to understand the complex interplay between the chemical, radiative, and dynamical processes that govern the structure of the Earth's atmosphere. During the last decade or so there has been particular interest in studying the processes which control atmospheric ozone since it has been predicted that man-made pollutants might cause harmful effects to the environment by modifying the total column content and vertical distribution of atmospheric ozone. Until recently most of the emphasis was directed towards understanding the stratosphere where greater than 90% of the ozone resides. However, during the last few years there has been an increasing interest in studying those factors which control ozone in the troposphere.

Changes in the total column content of atmospheric ozone would modify the amount of biologically harmful ultraviolet radiation penetrating to the Earth's surface with potential adverse effects on human health (skin cancer) and on the aquatic and terrestrial ecosytems. Changes in the vertical distribution of atmospheric ozone, along with changes in the atmospheric concentrations of other infrared active gases, could contribute to a change in climate on a regional and global scale by modifying the atmospheric temperature structure.

The ozone issue has evolved from one of the effect of individual pollutants to consideration of a multiplicity of possible pollutants the effects of which must be considered together. The man-made and natural chemicals of interest include the nitrogen oxides (NO_x) from subsonic and supersonic aircraft, nitrous oxide (N_2O) from agricultural and combustion practices, chlorofluorocarbons (CFC's) used as aerosol propellants, foam blowing agents, and refrigerants, brominated compounds used as fire retardants, carbon monoxide (CO) and carbon dioxide (CO_2) from combustion processes, and methane (CH_4) from a variety of sources including natural and agricultural wetlands, tundra, biomass burning, and enteric fermentation in ruminants. It is now clear that these same gases are also important in the climate issue.

It should be noted that there are two distinct aspects of the issue that need to be considered, i.e. understanding those processes that control the atmospheric distribution of ozone today, and those processes that need to be understood in order to be able to predict the atmospheric distribution of ozone in the future. If changes are observed in the distribution of ozone we must be able to understand how periodic and episodic natural phenomena such as solar activity and volcanic eruptions cause ozone to vary in space and time in order to isolate the impact of the changing atmospheric concentrations of gases such as the CFC's, CO_2, CH_4, and N_2O.

Since the scientific community first attempted to understand the chemical, radiative, and dynamical processes which control the temporal and spatial distribution of atmospheric ozone today, and to predict the distribution of ozone in the future, our recognition of the breadth of the issue has steadily increased. Originally the research emphasis was focused on understanding the physical and chemical processes occurring within the stratosphere. Now, however, we recognize that in order to be able to predict the distribution of ozone in the future we cannot be confined to simply understanding stratospheric chemistry, radiation, and dynamics but we also need to understand the processes controlling the chemical composition of the troposphere, the exchange mechanisms for energy, mass and chemical constituents across the tropopause, and the role of biospheric processes in controlling the emissions of gases into the atmosphere. This has made the ozone issue an example of how one problem requires us to bring knowledge from a variety of sources to bear on its solution and how understanding this problem contributes back to other fields such as the trace gas-climate problem and the global cycling of nitrogen and carbon.

INTRODUCTION

Thus to really understand the processes which control atmospheric ozone and to predict perturbations we are drawn into a study of the complete Earth system. This requires us to study the Earth as a single coupled system which involves chemical, physical, and biological processes occurring in the atmosphere, on land, and in the oceans. This is exactly the same situation which exists if we want to understand and have some predictive capability for the climate system. This report mirrors these increasing perceptions of the coupled nature of the system and, while focusing on the stratosphere, gives more consideration to the other aspects of the issue than previous reports on the ozone issue.

In particular the scientific community recognizes, and this report discusses, that:

(a) There is strong coupling in the stratosphere between the chemistry, radiation, and dynamics. This is because atmospheric ozone is a strong absorber of solar radiation, thus strongly influencing the temperature structure and circulation of the stratosphere, which in turn controls the distribution of atmospheric ozone and the trace gases which control ozone.

(b) Since 1930, when Chapman first proposed a simple photochemical scheme involving only odd oxygen species to explain the atmospheric concentration of ozone, our understanding of the photochemistry of the atmosphere has evolved significantly. Scientists have refined this simple scheme by invoking the importance of trace concentrations (ppbv) of HO_X, NO_X, ClO_X, and to a lesser extent BrO_X species in catalytically controlling atmospheric ozone. In addition, we also recognize that the atmospheric concentrations of a number of carbon compounds including CO, CO_2, and CH_4 play a vital role in the photochemistry of ozone. In particular, we recognize that there is strong coupling between the individual members of each chemical family, and that while each of these families individually is important in controlling odd oxygen, there is strong chemical coupling between the different chemical families, thereby modifying their individual roles in controlling ozone.

(c) At different times during the last decade or so scientists have suggested that the atmospheric concentrations of one or more of the source gases of the hydrogen, carbon, nitrogen, chlorine, or bromine chemical families may be changing due to human activities, and in each case have attempted to predict the response of the ozone layer to such individual changes. We now have reliable experimental evidence that the atmospheric concentrations of several of the source gases, i.e. CH_4, N_2O, and the chlorofluorocarbons, are all currently changing at a significant rate and that their impact on atmospheric ozone must be considered collectively and not in isolation.

(d) We need to understand the role of the biosphere in regulating the emissions of gases such as CH_4, CO_2, N_2O, and CH_3Cl to the atmosphere, and we need to know the most probable future industrial release rates of gases such as the CFC's, N_2O, CO, and CO_2 which depend upon economic, social, and political factors.

(e) Because of the fact that neither the chemical composition nor the interplay between meteorology and chemistry can be duplicated exactly in the laboratory, heavy reliance must be placed on theoretical models to describe the present and future behavior of the atmosphere. As a consequence it is necessary to define a careful strategy of investigation involving the proper balance between laboratory studies of fundamental processes, field measurements, and theoretical studies.

(f) While one-dimensional photochemical models have been, and will continue to be, extensively used for assessment purposes we must place more emphasis in the future on the development of two-dimensional and three-dimensional interactive photochemical models. Such multidimensional models allow us to explore the seasonal, latitudinal, and longitudinal behavior of ozone. Also, given that they more realistically represent the real world, they are more amenable to validation using field measurements of atmospheric composition.

(g) The climate problem has broadened in scope from the CO_2-climate problem to the trace gas-climate problem. Changes in the atmospheric concentrations of ozone as well as H_2O, CH_4, N_2O, the CFC's, and other gases will all modify the thermal structure of the atmosphere.

(h) We need to improve our understanding of tropospheric chemistry because of its vital role in controlling the atmospheric lifetimes of many of the source gases such as CH_4 and CH_3Cl, which influence atmospheric ozone and the radiative balance of the atmosphere. We also recognize that changes in tropospheric ozone will influence the climate system and will affect our interpretation of trends in the total ozone column.

(i) A vital component of any atmospheric research program is the acquisition of well calibrated long-term (multiyear) measurements of atmospheric parameters in order to monitor the state of the atmosphere and to differentiate between the different scales of temporal variability.

(j) Global data sets obtained from satellites are essential to complement data obtained using ground, aircraft, balloon, and rocket based instrumentation. Such data sets are essential to more fully understand the interplay on a global scale between chemical, radiative and dynamical processes, and to validate aspects of the multidimensional models. In addition, such data are needed to check the geographical representativeness of local measurements of large scale phenomena.

Unlike some other more localized environmental issues, e.g. acid deposition, ozone layer modification is a global phenomenon which affects the well-being of every country in the world. Many nations around the world have actively demonstrated their commitment to understand the processes which control atmospheric ozone, and its susceptibility to change because of human activities, by funding research which should reduce the uncertainties that currently exist concerning the magnitude of predicted ozone modification for different atmospheric concentrations of pollutants. In order to achieve this required greater level of understanding, national and international scientific agencies have implemented long range research programs aimed at developing an organized, reliable body of knowledge of upper atmospheric processes while providing, in the near term, assessments of potential effects of human activities on the atmosphere.

Many governments around the world have recognized that the use of chlorofluorocarbons constitutes a potential threat to the stability of the ozone layer, and have taken a series of individual actions to regulate the use of these substances. However, there has been no coordinated international approach to safeguard the ozone layer. It was recognized by several nations that effective protection of the ozone layer requires a coordinated international approach to regulating substances that are thought to modify atmospheric ozone. Consequently, the United Nations Environment Program (UNEP) Governing Council, at its ninth session in 1981, decided to initiate work aimed at the elaboration of a global framework convention for the protection of the ozone layer. It was decided to establish an Ad Hoc Working Group of Legal and Technical Experts nominated by interested governments and intergovernmental organizations. Representatives from about twenty different countries met in Stockholm, Sweden in January 1982 to initiate formal discussions on the desirability of a global framework ozone convention which would (a) harmonize regulatory control actions on ozone modifying substances at the international level, (b) increase coordination of ozone related research, and (c) increase the exchange of information on all scientific, economic, technical, and legal issues relevant to the ozone issue. After a series of meetings of the Ad Hoc Working Group of Legal and Technical Experts, a Convention for the Protection of the Ozone Layer was adopted by twenty-one nations at a Diplomatic Conference held in Vienna, Austria, in March 1985. Since that time four more nations have signed the convention. At the thirteenth UNEP Governing Council meeting held in May, 1985, a schedule was adopted for the possible completion of a protocol to regulate chlorofluorocarbons. Since the convention specifically states that all measures taken under this convention should be based on relevant scientific and technical considerations, and that nations should collaborate on scientific assessments, the need for a comprehensive evaluation by the international scientific community of all facets of the ozone issue is clear.

Therefore, in order to provide governments around the world with the best scientific information currently available on whether human activities represent a substantial threat to the ozone layer, several scientific agencies agreed to co-sponsor a peer reviewed international assessment of our current state of knowledge. This assessment is much more comprehensive than any previous assessment. It discusses, among other topics, the physical, chemical, and radiative processes which control the spatial and temporal distribution of ozone in the troposphere and stratosphere; the magnitude of natural and industrial sources of substances capable of modifying atmospheric ozone; observations of the composition and structure of the stratosphere; the predicted magnitude of ozone perturbations for a variety of emission scenarios involving a number of substances changing both individually and together; the predicted climate change for similar trace gas scenarios employed to predict ozone perturbations; and the ozone and temperature data used to detect the presence or absence of a long-term trend. Previous assessments have tended to be narrower both in scope and in the degree of international participation.

There has been an increasing level of cooperation and coordination at the international level over the last decade for ozone assessment activities. This is demonstrated by the international participation in this report and the previous World Meteorological Organization (WMO)/National Aeronautics and Space Administration (NASA)/National Oceanic and Atmospheric Administration (NOAA)/Federal Aviation Administration (FAA) report in 1982. There have been at least three types of assessment report relating to the ozone issue produced over the last decade, i.e.

(a) comprehensive national assessment reports such as the series produced biennially by the National Academy of Sciences in the USA, the latest of which is "Causes and Effects of Changes in Stratospheric Ozone: Update 1983," and those issued by the Department of the Environment, United Kingdom, the latest of which is "Chlorofluorocarbons and Their Effect on Stratospheric Ozone (second report)" - Pollution Paper #15, 1979.

(b) international summary reports written by a small select group of scientists at a one-week meeting such as the yearly series issued by the UNEP Coordinating Committee on the Ozone Layer (CCOL), the latest of which is "Environmental Assessment of Ozone Layer Depletion and its Impact as of October 1984," and the one issued in 1981 by the Commission of the European Communities, (CEC), "Evaluation of the Effects of Chlorofluorocarbons on Atmospheric Ozone: Present Status of Research."

(c) comprehensive international reports such as that issued by the WMO in 1982 which had over 100 participants from the international scientific community, "The Stratosphere 1981: Theory and Measurements" WMO Global Ozone Research and Monitoring Project Report #11.

This scientific assessment is being co-sponsored by three US agencies, i.e. the National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA), and the National Oceanic and Atmospheric Administration (NOAA); three international agencies, i.e. the World Meteorological Organization (WMO), the United Nations Environment Program (UNEP), and the Commission of the European Communities (CEC), and Bundesministerium für Forschung und Technologie (BMFT) of the Federal Republic of Germany.

Approximately 150 scientists from Australia, Belgium, Brazil, Canada, the Federal Republic of Germany, France, Italy, Japan, Norway, the United Kingdom, and the United States of America contributed towards this assessment, which was coordinated by NASA.

This assessment builds upon previous national and international assessments, in particular the most recent comprehensive report, "The Stratosphere 1981: Theory and Measurements" WMO Global Ozone Research and Monitoring Project Report #11 which was prepared in 1981 (issued in 1982) and was co-sponsored by the same three U.S. scientific agencies, (NASA, FAA, and NOAA) and by one international scientific agency, WMO. The rationale for the scope of the present assessment report was based on information gained at a scientific workshop, entitled "Current Issues in Our Understanding of the Stratosphere and the Future of the Ozone Layer" which was held in Feldafing, Federal Republic of Germany in June 1984 with international participation, co-sponsored by NASA, FAA, WMO, and BMFT. The assessment activities officially began in the fall of 1984 when leading scientists were selected as chairpersons, and each charged with the responsibility to produce a specific chapter in the assessment report. At a meeting held in November, 1984, the timetable for the assessment was established and key atmospheric scientists who could make valuable contributions were identified and invited to participate in chapter working groups. The participants were chosen for their expertise and represented a cross section of the international scientific community. The assessment was developed through a series of small focused workshops, chapter by chapter, each addressing a specific scientific issue. Considerable care was taken to ensure that those aspects of the issue which involved more than one chapter were carefully coordinated. Over 30 small working meetings were held between November, 1984, and May, 1985, to prepare draft chapters which were then critically peer reviewed at a workshop held at Les Diablerets, Switzerland July 7-14, 1985. The 32 participants who attended the meeting included 19 chapter chairpersons, 8 senior reviewers from the atmospheric scientific community, and 5 sponsoring agency representatives. Based on the reviews, the chapters were then finalized and sent to the printers in November/December 1985.

The following section of the Introduction describes the contents, and major conclusions and recommendations for future research of each chapter of the assessment report.

CHAPTER 2: STRATOSPHERIC CHEMISTRY

This Chapter deals with the elementary chemical and photochemical processes involving atmospheric trace gases and is written in two parts. The first part discusses the recent improvements in the data base for the reactions currently identified to be important in describing the chemistry of the major chemical families of trace gases in the stratosphere or unpolluted troposphere, i.e. oxygen, hydrogen, nitrogen, chlorine, bromine, sulfur, halocarbons and hydrocarbons. The second part discusses a number of special issues relating to stratospheric chemistry including:

(a) The importance of ion chemistry; sodium chemistry; heterogeneous chemistry; and reactions between long-lived reservoir species in controlling ozone;

(b) The ability of current reaction rate theory to describe reactions with complex pressure and temperature dependence functions;

(c) Errors and uncertainties in current kinetic and photochemical data, and the prospects for improvement;

(d) Prospects for developing a systematic approach for identifying gaps in the chemical description of the atmosphere.

Major Conclusions and Recommendations

(1) There has been continued steady improvement in the data base for the reaction rate coefficients, product distributions, absorption cross sections, and photodissociation quantum yields of the elementary processes;

(2) No significant new catalytic cycles, or radical or reservoir species have been identified since WMO (1982);

(3) Changes or re-evaluations in accepted rate coefficients for several important reactions, e.g. $O+ClO$, $OH+HCl$, $OH+HNO_3$, and HO_2+NO_2+M have led to refinements in predictions of ozone depletion, and have in general improved agreement between measured and computed vertical profiles for trace gases.

(4) Further laboratory studies of the rates, branching ratios and photodissociation channels of reactions involved in the production of NO_x from N_2O in the stratosphere, are required to reduce the uncertainties in this source term.

(5) Several key reactions involving HO_x species proceed through long lived intermediates, resulting in complex pressure and temperature behavior, e.g. $OH+CO$, HO_2+O_3, HO_2+OH, etc. These reactions need further study to provide better characterization over the full range of atmospheric conditions.

(6) Uncertainties in the data base for BrO_x and coupled BrO_x-ClO_x catalyzed ozone destruction need to be reduced.

(7) A continued effort is required to identify possible missing chemistry or species of significance in the stratosphere, making use of all state-of-the-art experimental and computational techniques.

CHAPTER 3: TROPOSPHERIC TRACE GASES: SOURCES, DISTRIBUTION AND TRENDS

This Chapter discusses the important source gases (CFC's, CH_4, CO, CO_2, N_2O, and NO_x) which are emitted at the Earth's surface. For each of these gases, measurements of their current atmospheric concentrations and trends are discussed, as well as information about their sources and their possible future course.

Major Conclusions and Recommendations

(1) There is now compelling evidence that the composition of the atmosphere is changing on a global scale reflecting in part the metabolism of the biosphere and in part a broad range of human activities. These source gases play important direct and indirect roles in both atmospheric chemistry and climate.

(2) Halocarbons

- The halocarbons are generally of industrial origin except for CH_3Cl.
- The atmospheric concentrations of CFC-11, CFC-12, CH_3CCl_3, and CCl_4 as of late 1985 were about 230 pptv, 400 pptv, 130 pptv and 125 pptv and are observed to be increasing at annual rates of about 5% for CFC's 11 and 12, 7% for CH_3CCl_3 and 1% for CCl_4.
- The Atmospheric Lifetime Experiment (ALE) measurements indicate an increase in the atmospheric concentration of CFC-11 consistent with the Chemical Manufacturers Association (CMA) release estimates, but to explain the observed increase in the atmospheric concentration of CFC-12 requires a substantial additional source. Insufficient information is available about possible releases from the USSR and Eastern Europe. There is consistency between the sources and inventory for CCl_4 and CH_3CCl_3.
- Based on ALE data the atmospheric residence times for CFC-11, CFC-12, CCl_4, and CH_3CCl_3 are calculated to be approximately 75, 110, 50 and 6.5 years, respectively.
- Only a few atmospheric measurements exist, and there is limited information on emission strengths, for the numerous other halocarbons.

(3) Methane (CH_4), Carbon Monoxide (CO) and Carbon Dioxide (CO_2)

- The world-wide average atmospheric concentration of methane as of late 1985 was 1.65 ppmv, and for the last decade or so has been increasing at an annual rate of about 1%. In addition ice-core data indicate that the atmospheric concentration of CH_4 may have steadily increased over the last several hundred years from a value of approximately 0.7 ppmv.
- The important sources of methane include anaerobic environments such as: natural and agricultural wetlands, termites, enteric fermentation in ruminants, and biomass burning.
- The atmospheric concentration of CO is significantly greater in the Northern Hemisphere than the Southern Hemisphere, and there are indications of an annual rate of increase of 1-2%.
- Projections of concentrations of atmospheric methane and carbon monoxide into the future are difficult because the origins of the current increase of CH_4 are unknown, i.e. what fraction of the increase can be attributed to increased source strengths versus decreased atmospheric removal rates.
- The global mean concentration of CO_2 is currently about 344 ppmv and there is clear evidence of an annual rate of increase of about 0.5% predominantly because of the combustion of fossil fuels.
- The atmospheric concentrations of each of the carbon species exhibit seasonal variability which is largest at high latitudes in the Northern Hemisphere and smallest in the Southern Hemisphere. The seasonal variability in CO reaches 50%, CO_2 ranges from 0.5 to 5%, and CH_4 ranges from 2 to 4%.

(4) Nitrous Oxide (N_2O)

- The atmospheric concentration of nitrous oxide as of late 1985 was about 304 ppbv and is increasing at an annual rate of about 0.25%. Because of its long atmospheric lifetime, i.e. ~150 years, this implies that the current strength of the sources is 30% greater than that of the sinks.

Consequently, if the emissions of N_2O continue at their present rates the atmospheric abundance of N_2O would increase to about 400 ppbv. In addition, there is reason to believe that the strengths of the combustion and intensive agricultural sources of N_2O will continue to increase.

(5) Odd Nitrogen (NO_X)
- There are still many disputes over the magnitude of the lightning source of NO_X.
- It is likely that global emission rates of NO_X are increasing and little doubt that concentrations are now higher than preindustrial values. It is not clear to what extent industrial emissions of NO_X affect the remote atmosphere.

(6) Continued development of baseline measurements for CO, CH_4, N_2O, CO_2 and the halocarbons are vital.

(7) Flux measurements of biogenic gases from representative ecosystems, especially for CO_2, CH_4, N_2O, and NO, are needed in conjunction with studies of the underlying biological and geochemical processes which regulate the observed fluxes. In the case of CH_4, isotopic studies promise to elucidate the relative importance of various ecosystems in producing CH_4.

(8) Studies of trace gases in ice cores should elucidate the historical atmospheric concentrations of these gases.

(9) It is essential that the world-wide industrial production figures of all halocarbons be available.

CHAPTER 4: TROPOSPHERIC CHEMISTRY

This Chapter discusses various aspects of the chemistry of the troposphere. Significant emphasis is placed on discussing factors which control the abundance and distribution of OH and O_3. In addition the roles of these species are discussed in some detail, e.g. the role of OH in controlling the atmospheric abundances (lifetimes) of many trace gases which can affect the chemical composition or the radiative balance of the stratosphere and troposphere. The problems of the chemical description of the unpolluted or non-urban troposphere are considered separately from the polluted troposphere and the problem of transport from polluted to relatively unpolluted regions is discussed. Heterogeneous chemistry is highlighted as a poorly understood area which is likely to be important in the troposphere. Finally, there is a discussion of the problems of surface exchange and vertical redistribution.

Major Conclusions and Recommendations

(1) It is encouraging that the values of globally averaged OH calculated in models of the unpolluted troposphere now seem consistent with CH_3CCl_3 lifetime estimates. However, it should be noted that the lack of reliable atmospheric measurements of NO_X and CO contributes significantly to uncertainties in O_3 and OH photochemistry in the unpolluted troposphere.

(2) Many industrial compounds reach the unpolluted troposphere only after residence in the polluted troposphere - e.g., NO_X, CO, and non-methane hydrocarbons.

(3) One major difference between the chemistry of the troposphere and stratosphere is the recognized importance of heterogeneous reactions. However, our present understanding of heterogeneous

reactions is rudimentary. Consequently, theoretical models currently have to use simple parameterizations of processes not yet understood. Calculations indicate that in regions of high aerosol loading, scavenging by the aerosol could represent a significant sink for HNO_3, NO_3, H_2O_2 and possibly HO_2.

(4) Large temporal and spatial variations in the hydrological cycle can lead to large temporal and spatial variations in rainout removal rates and concentrations of species like odd nitrogen.

(5) Vertical redistribution in the troposphere is mainly accomplished by highly intermittent cloud processes that cannot be adequately described in a diffusive model.

(6) Surface deposition is dependent on a combination of the turbulent exchange rate near the surface and the interaction of the particular species with the surface.

(7) To understand the basic chemical cycles in the troposphere, and to predict the tropospheric response to perturbations requires:

- An evaluation of biological sources of chemical substances in the troposphere.
- Determination of the the global distribution of tropospheric trace gases and aerosol particles and assessment of relevant physical properties.
- Testing of photochemical theory through field and laboratory investigations of photochemically driven transformation processes.
- Investigations of wet and dry removal processes for trace gases and aerosol particles.

(8) Methods are now becoming available to measure surface fluxes of chemical species.

(9) Further laboratory studies are needed to determine the kinetics and mechanisms of the oxidation of methyl and other organic radical species under the 'low NO_X' conditions pertaining in the background troposphere.

CHAPTER 5: STRATOSPHERE-TROPOSPHERE EXCHANGE

This Chapter discusses the transport of mass and trace species between the stratosphere and troposphere. Meteorological processes in the tropics which are believed to affect exchange are reviewed; a special section is devoted to cumulonimbus clouds. Detailed aircraft case studies are described, and discussed in the context of the stratospheric water vapor budget. Exchange in the extratropics is considered from the meteorological point of view, and is largely concerned with tropopause folding during upper level frontogenesis. A theoretical outline is briefly presented, followed by a global scale isentropic diagnosis using First GARP Global Experiment (FGGE) data. Past work is reviewed, and recent aircraft studies are considered in some detail. Information about ozone exchange from ground based and satellite studies is also discussed. Results from general circulation models are considered, and analyses from an operational numerical weather prediction model are compared with aircraft data.

Major Conclusions and Recommendations

(1) While considerable progress has been made in aircraft-based studies, both of tropical cumulonimbus and extratropical exchange near polar front jet streams, there remains the need to incorporate

our understanding of these individual cloud-mass and synoptic-scale events into a global framework. In particular, synthesis of the global scale morphology of the cross-tropopause flux of specific molecules will require considerable thought and work, on case studies, satellite data, and global meteorological analyses.

(2) Case studies of exchange processes at subtropical jet streams, particularly above their cores, are required.

(3) Studies of exchange processes at polar front jet streams, particularly where the flow is split, are required, to investigate both the extent of mixing and the possibility of return flow to the stratosphere.

(4) Exchange in cut-off lows needs to be studied further, to establish how much of it is reversible.

(5) Studies near tropopause level should be made in cut-off anticyclones, with a view to establishing the tropopause behavior on radiative time scales.

(6) Investigation of exchange processes in connection with the largest (highest reaching) cumulonimbus storms is required, to establish whether or not they are consistent with the height of the hygropause.

(7) The sources of the water vapor between the tropopause and the hygropause needs to be established, especially in middle and high latitudes. This will afford valuable insight into the role of large scale, quasi-horizontal processes in cross-tropopause fluxes.

CHAPTER 6: DYNAMICAL PROCESSES

The Chapter begins with a description of the structure and circulation of the middle atmosphere and a discussion of the observational techniques on which this picture is based. Our current theoretical understanding of the circulation is presented; particular emphasis is given to the crucial role of eddy motions in the maintenance of the circulation. The present status of general circulation modeling of the region is discussed and the shortcomings of model climatologies are discussed in the light of theoretical knowledge.

The advent of satellite observations of middle atmosphere constituent distributions is having a major impact on our knowledge of these distributions and our understanding of the processes which control them. These new observations are described and our theoretical understanding of global transport processes and their representation in zonally-averaged transport models is discussed.

Major Conclusions and Recommendations

(1) Much of our information on the middle atmosphere circulation is based on satellite observation of temperature alone. Wind and higher-order derived quantities such as potential vorticity are derived from these measurements, together with lower boundary conditions from conventional analyses, using mathematical manipulations such as spatial differentiation which can degrade the signal-to-noise ratio. The availability of direct wind observations from UARS will greatly improve this situation.

(2) The major advantage of satellite measurements is their global coverage and uniformity. One further attribute which needs greater emphasis than it has received in the past is continuity of measure-

ment. This is highly desirable for the establishment of climatologies and absolutely vital for the detection of trends. It is therefore urged that further remote sensing missions be planned to succeed UARS following 1989 and that more emphasis be given to the intercalibration of successive satellite measurements.

(3) Ground-based techniques (radars and lidars) have proven to be very useful for dynamical studies, especially for important small-scale motions such as gravity waves. It is desirable that these facilities operate on a more continuous basis and that observations from different sites be coordinated. Equatorial measurements are needed and networks would be very valuable. Lidars and radars should be co-located.

(4) While general circulation modeling of the middle atmosphere is increasingly proving to be a useful tool in studies of the region, such models continue to have major deficiencies. The most serious of these is their pathology in generating winter high-latitude temperatures far below those observed. Theory suggests that this must be due to an underestimate of eddy transport processes; this could be a result of an inadequate representation of planetary wave activity or of the inability of the models to resolve gravity waves. The role of gravity waves in the actual stratospheric momentum budget requires further study.

(5) Our conceptual picture of stratospheric transport processes has changed dramatically in recent years and the theoretical basis of the parameterization of transport in zonally-averaged models has been made more secure. At the same time, however, the limitations of such models are becoming more apparent. Some of these limitations are obvious, given the highly three-dimensional nature of the wintertime flow (especially during active periods in the Northern Hemisphere). Others, such as the inability of zonally-averaged models to be truly interactive in the sense of predicting climate changes, are perhaps less obvious but equally important. Given the present problems of general circulation modeling and the expense of running such models with chemistry included, however, it is not envisaged that fully three-dimensional assessments will be forthcoming in the near future. Three-dimensional transport modeling may depend on a simplified approach; a new theoretical framework is needed to make this a reality.

CHAPTER 7: RADIATIVE PROCESSES; SOLAR AND TERRESTRIAL

There are two distinct parts to this Chapter. The first deals with solar radiation and its absorption in the stratosphere and mesosphere, and the second deals with terrestrial, or long-wave radiation. The discussion of the solar spectrum is broken up into irradiance from wavelengths shorter than 175 nm which affects the mesosphere and above, and the irradiance for wavelengths longer than this that affects the stratosphere. Tables are given for a reference solar spectrum, and variations of the solar spectral irradiance over the 27-day solar rotation period and the 11-year cycle. Other topics in the solar part of this chapter concern Rayleigh scatter, absorption by molecular oxygen, and ozone. The portion of this chapter dealing with terrestrial radiations deals with the adequacy of spectroscopic data to check our radiation calculations. It also deals with concepts of radiative damping, long-wave radiation in the stratosphere and mesosphere, as well as the distribution of net radiative heating through the atmosphere.

Major Conclusions and Recommendations

(1) Solar spectral irradiance is known to an accuracy of ±10-15% between 175-210 nm, ±10% or better between 210 and 330 nm, and to ±5% or better at longer wavelengths.

(2) The variability in solar irradiance is well determined for the 27-day solar rotation period but not for the 11-year solar cycle.

(3) The accepted values for the molecular oxygen absorption cross-sections at wavelengths relevant to the stratosphere and mesosphere are significantly smaller than those used a few years ago.

(4) An improved determination of cross sections in the Huggins bands would be valuable, especially for ground-based atmospheric ozone measurements.

(5) Improved determination of line shapes, line widths, and their temperature dependencies are needed to better calculate terrestrial heating rates. Present line-by-line calculations are based on idealized values that have not been verified in many cases.

(6) Other uncertainties in calculating terrestrial radiation include the influence of clouds and volcanic aerosols.

(7) The radiative role of trace gases such as N_2O and the CFC's merits further study.

(8) The continued analysis of satellite data sets for ozone, temperature, solar irradiance, and the outgoing terrestrial emission is essential for developing a complete understanding of radiative processes in the Earth's stratosphere and mesosphere.

(9) A drift-free record of the ultraviolet solar irradiance covering at least the wavelength range 175-400 nm is needed over one or more entire solar cycles.

CHAPTERS 8, 9, 10, AND 11: OXYGEN, HYDROGEN, NITROGEN AND HALOGENATED SPECIES: OBSERVATIONS AND INTERPRETATION

These Chapters review, and compare to both one-dimensional and two-dimensional model descriptions of the present-day stratosphere, the stratospheric measurements of oxygen, hydrogen, nitrogen, and halogen containing species obtained from ground, aircraft, balloon, rocket, shuttle, and satellite based instruments. There is a brief discussion of each of the *in situ* and remote sensing techniques currently being used to determine the chemical composition of the atmosphere, and a brief discussion of the accuracy and precision of the experimental data. The types of data described include vertical distributions and column contents as a function of season both at a limited number of geographic locations and globally, diurnal variabilities, and long term (multiyear) trends in the column contents. The species described include the source gases of the trace constituents (H_2O, N_2O, CH_4, and the halocarbons), and the active and inactive inorganic species from the oxygen ($O(^3P)$, $O(^1D)$, and O_3), hydrogen (H, OH, HO_2, and H_2O_2), nitrogen (N, NO, NO_2, NO_3, N_2O_5, $ClONO_2$, HNO_3, and HNO_4), chlorine (Cl, ClO, HCl, HOCl, and $ClONO_2$), and fluorine (HF) families.

Major emphasis is placed on describing the satellite data sets which have been analyzed, validated, released, and partially interpreted during the last four years. This includes data obtained by the Limb Infrared Monitor of the Stratosphere (LIMS), the Stratospheric and Mesospheric Sounder (SAMS), and the Solar Backscatter Ultraviolet/Total Ozone Monitoring System (SBUV/TOMS) instruments flown on the Nimbus 7 satellite, the Stratospheric Aerosol and Gas Experiment (SAGE) flown on the Applications Explorer II satellite, and the visible and infrared spectrometers flown on the Solar Mesospheric Explorer satellite.

Major Conclusions and Recommendations

Before discussing specific conclusions which may involve only one particular family of species there are seven conclusions of a more general character.

(1) The most significant recent development in our knowledge of O_x, HO_x, and NO_x in the stratosphere has been the release of several large satellite data sets. They have greatly improved our knowledge of the spatial and temporal distributions of O_3, H_2O, CH_4, N_2O, NO_2, and HNO_3 on a global scale.

(2) There are now some measurements of most key species, including the temporary reservoir species $ClONO_2$, N_2O_5 and HO_2NO_2 predicted to be important in the photochemistry of stratospheric ozone. However, the data base is rather limited in some instances, and while the observed abundances are generally consistent with current theory to within a factor of two or so, the measurements are not adequate for critically testing the photochemical models.

(3) Ground, aircraft, balloon, and rocket-based instrumentation have continued to provide an invaluable data base for vital but limited tests of photochemical theory.

(4) While there has recently been a significant advance in our understanding of the accuracy and precision of atmospheric composition data it is vital to continue the intercomparison of data obtained from different measurement techniques, especially for ClO, OH, HO_2, NO and NO_2.

(5) Several new experimental techniques have recently been developed and demonstrated which will enable us to obtain the type of data needed to test the photochemical models.

(6) We are still data limited, the accuracy and precision of many of the measurements need to be improved, and an improved measurement strategy needs to be formulated in order to more stringently test the photochemical models.

(7) Long term data sets of the vertical distributions of O_x, HO_x, NO_x and ClO_x species are needed both at discrete geographic locations and globally to determine changes in the composition of the stratosphere.

We will now discuss the specific major conclusions in the following order, i.e., oxygen, hydrogen, nitrogen, and halogen species.

CHAPTER 8: OXYGEN SPECIES

(1) Comparison of three distinct satellite measurements (SBUV, LIMS and SAGE), suggests that we can determine ozone in an absolute sense to about 15% (one standard deviation) from 25-30 km and about 6% from 30-55 km.

(2) Comparison of ozone satellite and balloonsonde data suggests that the balloonsondes are systematically lower than SBUV above about 32 km. The cause of this is not currently recognized.

(3) Utilizing SBUV as the basic data source for four year zonal average profiles, the random uncertainties appear to be about 4% (one standard deviation) in mid- and high-latitude winter and about 2% elsewhere.

(4) The observed O_3 abundance above 35 km is underestimated, typically by 30 to 50%, by both one-dimensional and two-dimensional photochemical model calculations. The reason for this discrepancy is not yet clear but could be due to an underestimation of the calculated odd oxygen production rate, an overestimation of the calculated loss rate by HO_x in the mesosphere and/or NO_x in the stratosphere or to missing chemistry.

(5) This significant ozone imbalance in the photochemically controlled region of the middle atmosphere limits the confidence that can be attached to model predictions of future ozone changes in response to long-term increases in the atmospheric concentrations of source gases (e.g. chlorofluorocarbons, nitrous oxide, methane).

(6) Precise determinations of the $[O]/[O_3]$ ratio and of the diurnal variation of O_3 in the upper stratosphere and in the mesosphere are needed.

(7) Stratospheric measurements relating the O_2 cross section determinations by high resolution measurements of the solar irradiance from 180 to 250 nm are required, as are additional laboratory studies of the O_2 absorption cross sections (Schumann-Runge bands and Herzberg continuum) and of the photodissociation rate of O_3 producing $O(^1D)$.

CHAPTER 9: HYDROGEN SPECIES

(1) There has been no major expansion of the profile data base for HO_x (OH, HO_2, and H_2O_2) species since the last assessment.

(2) The only new profile data for OH since the last assessment is lower than most of the earlier data and current model predictions and, while not in serious conflict with model predictions, is insufficient to provide a critical test of theory.

(3) There are over seven years of quasi-continuous column measurements of OH which show a long-term trend, seasonal, diurnal, and spatial variability, and response to volcanic eruptions and a solar eclipse. A large fraction of the OH signal is due to OH in the mesosphere. This data awaits a theoretical interpretation.

(4) HO_2 measurements between 16 and 34 km, and 35 and 60 km have been obtained by *in situ* and ground-based techniques, respectively. The *in situ* HO_2 data between 16 and 34 km is significantly higher than predicted, and suggests a problem with either the measurements or our understanding of HO_x photochemistry.

(5) There has not yet been a single definitive observation of H_2O_2.

(6) From balloon *in situ* data there is clear evidence of a hygropause, a region of minimum H_2O mixing ratios a few km above the tropopause, and small scale vertical structure at northern mid-latitudes.

(7) The LIMS and SAMS H_2O and CH_4 data have clearly demonstrated that air is transported upward and poleward from the tropics, consistent with the Brewer-Dobson hypothesis, and that the total hydrogen budget of the stratosphere, principally $H_2O+2\times CH_4$, is relatively constant with values ranging from 6 to 7 ppmv.

(8) LIMS data has been used to derive global OH fields; (a) using the HNO_3/NO_2 ratio, and (b) by calculating its production and loss with temperature, H_2O, O_3, and HNO_3 data.

(9) Simultaneous measurements of odd hydrogen containing species are required over a full diurnal cycle to provide a more critical test of the photochemical models (OH, HO_2, H_2O_2, H_2O, in conjunction with temperature, solar flux, O, O_3, and NO_x determinations).

CHAPTER 10: NITROGEN SPECIES

(1) While we have a reasonable understanding of the diurnal variability of NO_2, a more rigorous test of theory requires more accurate experimental data.

(2) The observations of HNO_3 at high latitudes in winter, and above 30 km at all latitudes are not in agreement with the theoretical predictions.

(3) The global morphology and variability of N_2O has been measured from satellite, and can be adequately simulated with a two-dimensional photochemical model if the influences of the semiannual oscillation on the zonal mean cross-sections are taken into account.

(4) Using LIMS data the magnitude of the thermospheric source of total odd nitrogen to the stratosphere has been shown to be significant on a local, but not global, scale.

(5) Total budgets for odd nitrogen have been derived from satellite measurements (LIMS) of HNO_3 and nighttime NO_2. These are generally consistent with those derived from balloon observations, and predicted by two-dimensional photochemical models near 40 km. However, there are serious discrepancies between observations and two-dimensional photochemical models at lower altitudes.

(6) We now have a basic understanding of the dynamical and photochemical processes responsible for regional phenomenon such as the NO_2 Noxon Cliff.

(7) Global OH fields have been derived using LIMS NO_2 and HNO_3 data. However, given that we do not fully understand the quality of LIMS HNO_3 data above 35 km, and the HNO_3 profile above 30 km is not understood, care must be exercised in using the derived OH fields.

(8) N_2O_5, HNO_4, and $ClONO_2$ have been positively identified from ATMOS spectra.

(9) Simultaneous measurements of nitrogen containing species over a full diurnal cycle are required to critically test the photochemical models. These ratio measurements should be taken in conjunction with appropriate measurements of O_x, HO_x, and ClO_x species.

CHAPTER 11: HALOGENATED SPECIES

(1) While there has not been a significant expansion of the ClO profile data base the measured and model predicted ClO profiles now agree to within a factor of 2 between 28 and 38 km.

(2) The observed diurnal variation of ClO is in reasonable agreement with model predictions, but does show a somewhat slower morning rise than expected.

(3) The existing data base is inadequate to establish seasonal and latitudinal variations, or long-term increases in ClO predicted by theoretical models.

(4) Evidence of the presence of $ClONO_2$ has improved, with balloon-based observations being made in a second spectral region. In addition, $ClONO_2$ has been observed in the ATMOS spectra.

(5) The expected increase with time in stratospheric HCl has not been observed. It has presumably been masked by significant short-term variability in both tropospheric and stratospheric HCl.

(6) The measured and predicted increase with time in stratospheric HF are compatible.

(7) There is now general agreement between calculated and observed vertical profiles for the halogen source species.

(8) Simultaneous measurements of chlorine-containing species are required to provide a satisfactory test of the photochemical models (Cl, HCl, ClO, and $ClONO_2$, preferably coupled to temperature, solar flux, O_3, H_2O, CH_4 and NO_x determinations).

CHAPTER 12: ASSESSMENT MODELS

This Chapter considers the various types of models of the stratosphere which have been used to make predictions concerning the stratospheric composition and possible response to perturbations. One-dimensional models, although limited in many respects, have been our traditional tools. Recent important advances in the treatment of two-dimensional transport have opened the way for a new generation of assessment models with all the photochemical detail of the one-dimensional models but with a more physically-based transport.

Major Conclusions and Recommendations

(1) One-Dimensional Models

- One-dimensional models will continue to play a major role in assessment activities, particularly in the development of new photochemical schemes.

- A comparison of one-dimensional models shows a large range of calculated odd-nitrogen in the middle and upper stratosphere ranging from 13-20 ppbv. An important source of these differences is the treatment of radiation penetration in the Schumann-Runge bands, and more work appears necessary here. However, models with similar radiation schemes still show significant differences in odd nitrogen, and other causes are evidently also important.

(2) Two-Dimensional Models

- There have been significant theoretical advances in the treatment of transport in two-dimensional models.

- There is a good understanding of the cancellation between mean and eddy transport. A net transport circulation can be defined which is closely related to the residual and diabatic circulations.

- The limitations of the treatment of eddy transport in terms of K-theory, and the physical basis for this approach, are better understood.

- Important estimates of the size of the eddy coefficients have come from theoretical, GCM and data studies. These studies suggest the use of somewhat smaller k coefficients than hitherto, in combination with the transport circulation. However, more work is urgently needed in this area, bearing in mind, for example, the known limitations of GCM's and the problem of unresolved scales of motion in satellite data analyses.

- There has been important work on the dependence of the k coefficients (in one-dimensional as well as two-dimensional models) on photochemical lifetimes.

- Two-dimensional models can include some of the important photochemical-radiative-dynamical feedbacks.

- The goal of a completely self-consistent two-dimensional model is denied by our inability to model the eddies in a completely interactive fashion.

(3) Two-Dimensional Model Results

- With the above advances there are now two major classifications of two-dimensional models.
    - (1) Traditional Eulerian (with generally large eddy coefficients)
    - (2) Models with modified Eulerian — residual or diabatic — circulations (and generally smaller eddy coefficients).

- Whichever approach is employed, the eddies remain important. It is the establishment of the correct balance between mean and eddy transport which is crucial. The residual circulation models with small diffusion, in general, predict greater latitudinal structure than the other models. However, equally large differences are sometimes found between models of similar types as between modified and traditional Eulerian models.

- As with one-dimensional models, significant differences in the predicted odd-nitrogen values are found. Tropospheric removal and transport in the equatorial lower stratosphere are believed to play major roles in producing these differences. The equatorial lower stratosphere, where the radiative balance is the small difference of small terms, is identified as an extremely important area for future study.

- As with one-dimensional models, two-dimensional models generally underestimate ozone in the upper stratosphere.

(4) Three-Dimensional Models

- There have been some significant efforts to incorporate detailed chemistry schemes into three-dimensional models.

(5) Models for Assessment

- There is no indication at present that results from two-dimensional models should invalidate in a gross sense assessment studies with one-dimensional models.

- Two-dimensional models provide a much broader predictive capability than one-dimensional models. They can predict important latitudinal and seasonal effects which the one-dimensional models generally cannot. Two-dimensional models thus add significantly to our assessment capability.

- The inability of one-dimensional and two-dimensional models to reproduce upper stratospheric ozone and the significant differences sometimes found between models, for example in calculated odd-nitrogen, undermines our confidence in long term assessment. Priority must be given to resolving these problems.

(6) Testing Models

- Our confidence in models (especially for assessment purposes) depends on satisfactorily 'validating' these models against available data. This is too often an extremely subjective exercise.

- A hierarchy of tests for comparison of models and data could include:
  (a) Identification of predicted species
  (b) Comparison of altitude profiles, latitudinal and seasonal variations.
  (c) Isolation of processes (e.g. chemistry from dynamics by ratio measurements, diurnal variations, correlations).
  (d) Study of natural perturbations (Volcanic eruptions, solar proton events, sudden warmings, etc.)
  (e) Study of chemistry along air parcel trajectories.

CHAPTER 13: MODEL PREDICTIONS

This Chapter presents a series of model calculations detailing the present best estimates of the response of atmospheric composition to a variety of potential perturbations. The computations emphasize the coupled nature of the perturbations. The choice of scenarios involving changes in concentrations of CFC's, N_2O, CH_4 and CO_2 reflect the findings that all of their concentrations are currently increasing and that the perturbations are strongly coupled.

Major Conclusions and Recommendations

(1) Continued release of chlorofluorocarbons 11 and 12 at the 1980 rate would reduce the ozone vertical column by about 5-8% according to one-dimensional photochemical models and by a global average of about 9% according to two-dimensional models, with reductions of ~4% in the tropics, ~9% in temperate zones and ~14% in polar regions.

(2) A major finding of recent years is that two-dimensional models predict large seasonal and latitudinal variations in chlorine-induced ozone column reductions.

(3) All models with all scenarios predict that continued release of CFC's 11 and 12 at the 1980 rate will reduce local ozone at 40 km by ~40% or more.

(4) One dimensional models predict that the magnitude and even the sign of the ozone column changes due to increasing CFC's depend on the future trends of CO_2, CH_4, and N_2O. For example, at about 80% of the present CFC release rate, coupled with a doubling of CH_4 and an increase in N_2O by a factor of 1.2, one-dimensional models predict an ozone decrease of about 3% at steady state while two-dimensional models predict an ozone decrease of 4%. If a simultaneous doubling of CO_2 is also considered, one-dimensional models predict ozone column changes between +0.1 and −3.5%.

(5) If the release rate of CFC's should become twice the present level or if stratospheric Cl_x reaches 15 ppbv, the one-dimensional models predict that there will be a 3% to 12% reduction of the ozone column, assuming that the annual rates of increase in the atmospheric concentrations of CO_2, N_2O, and CH_4 continue at their present rate.

(6) One-dimensional models predict that the total ozone column is increased by CO, CO_2, and CH_4, and decreased by CFC's, N_2O and stratospheric aircraft. These individual perturbations do not have an additive effect on ozone.

(7) Time dependent scenarios were performed using one-dimensional models assuming CO_2, CH_4, and N_2O annual growth rates of 0.5%, 1% and 0.25%, respectively, in conjunction with CFC growth rates of 0%, 1.5% and 3% per year. The ozone column effects are relatively small ($<3\%$ over the next 70 years) for CFC increases of $\leq 1.5\%$ per year, but with a CFC growth rate of 3% per year the predicted ozone depletion is 10% after 70 years and still rapidly increasing.

(8) Over the range 1 to 15 ppbv of stratospheric chlorine, one-dimensional models are strongly nonlinear in terms of ozone-column change as a function of added Cl_x, in contrast to the two-dimensional models which are nearly linear over this range of Cl_x. The onset of the nonlinearity occurs in the regime where the Cl_x and NO_y mixing ratios become comparable.

(9) Monte Carlo calculations over the full range of the assessed uncertainties of photochemical parameters were performed with two one-dimensional models. One calculation considered only CFC perturbations. For the release of CFC's at the 1980 rate an ozone column depletion of $-(5.7 \pm 5.4)\%$ was calculated (1σ uncertainty range). In the second calculation an ozone column depletion of $-(7.7 \pm 5.8)\%$ was calculated for an increase of 14 ppbv of Cl_x in conjunction with a doubling of CH_4 and a 20% increase in N_2O. In each case the ozone depletion distribution was unsymmetrical with a long tail toward large perturbations.

(10) The past and future changes of the trace species, CH_4, N_2O, and CO_2, involve the biosphere and its great complexity. As the stratospheric models mature, the largest uncertainty in making future predictions of ozone concentrations will probably be the uncertainty in formulating the scenarios for future changes in CH_4, N_2O, and CO_2.

(11) It is vital to continue the development of two-dimensional models for assessment purposes. These must include the effects of temperature feedback.

(12) The new Monte Carlo method that screens the results against atmospheric observations should be emphasized.

CHAPTER 14: OZONE AND TEMPERATURE TRENDS

This Chapter contains a discussion of the evidence for statistically significant trends in ozone and temperature. In particular, the evidence for a trend in the total ozone and in ozone profiles is examined. Temperature data in the troposphere and in the lower stratosphere are also examined from the viewpoint of looking for trends.

Major Conclusions and Recommendations

(1) Global trend estimates of total ozone determined from the Dobson spectrophotometer network indicate little overall support for a statistically significant trend during the 14-year period 1970-1983.

(2) Recent evidence has been presented that indicates a considerable decrease in Antarctic total ozone during the spring period since about 1968. This is presently the subject of further analysis.

(3) Trend estimates from 13 ozone balloonsondes indicate statistically significant positive trends in the lower troposphere and negative trends in the lower stratosphere. The interpretation of these results, however, is clouded by uncertainties in instrument behavior and lack of a global station network.

(4) Ozone trend estimates from 13 Umkehr stations indicate statistically significant negative trends from 1970 to 1980 in the middle stratosphere that are in substantive agreement with results from one-dimensional numerical models. The observational results are sensitive to the inclusion of a term to account for stratospheric aerosol impact on the measurements and the spatial distribution of the sites, but do not appear sensitive to the inclusion of a 10.7 cm flux variation (an indicator for solar flux variation).

(5) Examination of the NOAA SBUV-2 satellite measurement program indicates that if the system operates as designed, it is capable of global ozone trend detection in the middle to upper stratosphere, as well as total ozone, to within about 1.5% over a period of one decade at the 95% confidence level.

(6) As with other long-term measurement programs however, it is necessary to examine continually the SBUV-2 instrument performance and satellite measurements and compare them with independent data.

(7) We note, moreover, that the SBUV-2 data are inherently total ozone and ozone profiles between 25 and 55 km. If ozone trends can be determined unambiguously from the Earth's surface to the overlap region with the SBUV-2 profiles, a high-quality measurement program would exist.

(8) Two independent analyses of lower stratospheric temperatures during the period 1965-1979 are suggestive of a downward temperature trend. Inconsistencies between the two analyses, however, preclude firm conclusions.

(9) The large cooling in rocketsonde temperatures reported for the early 1970's appears now to be due to a change in the rocketsonde temperature measurement system. Taking this into account, statistically significant negative trends are observed in June rocketsonde data at 40-45 km from 1973-1983 that are in substantive agreement with results from one-dimensional numerical models. These preliminary results will have to be examined further with a more complete data set.

(10) Examination of the NOAA TOVS stratospheric satellite temperature measurement program indicates that it is essential that the instrument-to-instrument consistency be verified by a high quality, independent data system. Such a system does not exist.

(11) Resolve the causes of the ozone measurement biases between SBUV, LIMS and SAGE and thereby, reduce the absolute error estimates.

(12) Determine the impact of implementation of the Bass and Paur (1984) ozone absorption coefficients on the ground-based measurements and compare the results with the satellite observations.

(13) Continue development of the ground-based ozone profile measurement program with particular emphasis on the following:

(a) determination of the aerosol impact on Umkehr measurements from El Chichon.
(b) development of the high altitude (≈ 40 km) balloon sampling system with specific attention to the adjustment procedure to match the Dobson total ozone measurements.
(c) development of a lidar system capable of routine ozone measurements in the troposphere and stratosphere, especially above 40 km.

(14) Develop a long-term satellite and ground-based temperature measurement program sufficient to measure a mid-stratospheric temperature trend to a 95% confidence level of 1.5K/decade.

(15) Update the accuracy (as opposed to precision) estimates of the meteorological rocketsondes and satellite observations.

(16) Determine the satellite ozone and temperature temporal and spatial sampling requirements with estimates of resolution, accuracy and precision necessary to verify chemical, dynamical and radiation theory.

CHAPTER 15: TRACE GAS EFFECTS ON CLIMATE

This Chapter examines our understanding of how increasing concentrations of radiatively active trace gases might lead to changes in the Earth's climate. The nature of the radiative forcing of the climate system from changes in trace gas concentration is discussed. The roles of the various types of climate models are discussed, and the predictions of resulting climate perturbations resulting from individual increases in atmospheric trace gas concentrations are presented from such models. The role of the oceans in delaying these climate changes is discussed. Finally, the effects of simultaneous increases in trace gas concentrations on the climate are estimated.

Major Conclusions and Recommendations

(1) The problem concerning the greenhouse effects of human activities has broadened in scope from the CO_2-climate problem to the trace gas-climate problem.

(2) Non-CO_2 greenhouse gases in the atmosphere are now adding to the greenhouse effect by an amount comparable to the effect of CO_2. This is a fundamental change from the situation during the period of 1850-1960.

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(3) The rate of increase of the total greenhouse forcing is now 3-10 times greater than the mean rate for the period 1850-1960.

(4) The cumulative effect of the increase in all trace gases for the period from 1850-1980 is a predicted equilibrium warming in the range of 0.7 to 2 K. The three-fold range in the estimated equilibrium warming arises from the currently perceived uncertainty in the sensitivity of climate models. The contribution of the non-CO_2 trace gases to the cumulative equilibrium surface warming is about 30%. Time dependent calculations with a simplified one dimensional diffusive ocean model suggest that a surface warming of about 0.4-0.8 K (of the 0.7 to 2 K) should have occurred during 1850 to 1980. The estimated surface warming is not inconsistent with the value of 0.5 to 0.6 K that can be inferred from observed surface-air temperature records.

(5) If the growth rates of trace gas concentrations (or their emission rates) that were observed during the decade of the 1970's continue unabated for the next several decades, non-CO_2 trace gases can have as much impact as CO_2 on future trends of surface and atmospheric temperatures. For the various trace gas scenarios considered in this study, the equilibrium surface warming for the period 1980 to 2030 range from 0.8 to 4.1 K. This wide range in the projected warming is due to the range in the assumed scenarios as well as due to the earlier mentioned uncertainty in climate sensitivity of current models.

(6) Thus for the 180 year period from 1850 to 2030, our assessment suggests a trace gas induced cumulative equilibrium surface warming in the range of 1.5 to 6.1 K. Because of the huge thermal inertia of the world oceans, only about 40 to 50% of the above equilibrium warming will be realized by the year 2030. Consequently, if the current rate of increase in trace gas concentrations continue unabated for the next several decades, the climate system would be increasingly in a state of disequilibrium with the radiative forcing by the trace gases.

(7) The important non-CO_2 greenhouse gases are $CFCl_3$, CF_2Cl_2, CH_4, N_2O, O_3 and stratospheric H_2O. On time scales longer than a century, radiatively active gases with lifetimes of the order of 100-500 years (e.g., CF_3Cl, CF_4, CF_2ClCF_2Cl, CF_3CF_2Cl, $CBrF_3$) may also become important in determining climate change if their growth rates continue to increase indefinitely.

(8) CFC's, through their indirect chemical effects on O_3, have a potentially large stratospheric cooling effect, as large as that due to CO_2 increase. For a given scenario for increase in trace gases (including CO_2), the computed stratospheric cooling is significantly larger (by factors ranging from 2 to 10 depending on the altitude) than the computed surface warming.

(9) In addition to the direct radiative effect, many of the trace gases have indirect effects on climate. For example, addition of gases such as CH_4, CO and NO_X can alter tropospheric O_3, which is a radiatively active gas. Within the troposphere, the indirect climate effects can be as large as the direct effects. On the other hand, within the stratosphere, temperature changes are largely determined by indirect effects of CFC's. Stratospheric H_2O will increase due to the oxidation of the increasing concentrations of CH_4, and can be influenced by the trace gases through their effect on tropical tropopause temperatures. Furthermore, increases in tropospheric H_2O, through the temperature-H_2O feedback, can perturb tropospheric chemistry and alter the concentration of CH_4 and O_3.

(10) The fundamental issue that needs to be addressed within the context of the trace gas-climate problem is the relative importance of transport, chemistry and the indirect effects of trace gases in governing the long-term trends of tropospheric and stratospheric O_3, CH_4 and stratospheric H_2O. A credible and successful attack on this problem must include model as well as *in situ* observational studies. The specifics of such studies are identified in this assessment.

(11) Cloud feedback continues to be the major source of uncertainty in the surface temperature sensitivity of climate models. At present, even the sign of this feedback is not known.

(12) The next crucial issue concerns accurate determination of decadal trends in radiative forcings, trace gases, planetary albedo (to determine effects of aerosols and cloud feedback) and surface-troposphere-stratosphere temperatures. The observational challenges are formidable and must be overcome for a scientifically credible interpretation of the human impacts on climate.

APPENDIX A: CHEMICAL KINETICS DATA BASE

This Appendix contains tables of evaluated data for chemical rate constants and equilibrium constants. The first table gives rate constants for second order reactions. The reactions are grouped into the classes: O, $O(^1D)$, HO_x, NO_x, hydrocarbon reactions, ClO_x, BrO_x, FO_x, SO_x, and metal reactions. The second table gives rate constants for three-body reactions in the form of values for the low pressure limit and for the high pressure limit. There is also a table of equilibrium constants for those systems in which unstable products may be formed in association reactions. The values given are those recommended by the NASA Panel for Data Evaluation in the Panel's complete report which was published by the Jet Propulsion Laboratory, Pasadena, CA as JPL Publication 85-37.

APPENDIX B: SPECTROSCOPIC DATABASE: INFRARED TO MICROWAVE

Accurate modeling of radiative transfer in the atmosphere is very dependent on the accuracy to which the spectroscopic parameters of the optically active atmospheric gases are known. The primary objective of this Appendix is to review the status of the presently available database of spectroscopic parameters (line positions, intensities, pressure-broadened halfwidths, etc.) in the infrared to microwave spectral region for molecules of interest for remote sensing and climate studies in the terrestrial atmosphere. In addition, this review contains detailed discussions of quantitative high-resolution atmospheric spectroscopy, laboratory spectroscopy (including reviews of current capabilities and efforts in progress), and spectroscopic data accuracy requirements for space-based remote sensing of the atmosphere.

Major Conclusions and Recommendations

(1) The three major computer-accessible compilations of spectroscopic line parameters (AFGL, GEISA, and JPL) contain among them data on over 400,000 transitions for 42 molecular species, covering the spectral range from 0 cm^{-1} to 18,000 cm^{-1}. For the parameters presently contained in the compilations approximately 80% of the line positions, 50% of the intensities, and only 5% of the air-broadened halfwidths may be considered to be of sufficient accuracy for most atmospheric remote sensing applications. In addition, spectroscopic parameters are totally missing from the compilations for a number of species of atmospheric interest (e.g. N_2O_5 and HNO_4).

(2) With the present capabilities for laboratory spectroscopy and analysis, line positions can be routinely determined with high absolute accuracy. However, absolute line or band intensities and pressure-broadened halfwidths can be measured with accuracies no better than 5%. This level of accuracy is insufficient to meet some of the requirements for future space-based atmospheric sensors.

(3) The two major requirements for further work in laboratory spectroscopy for atmospheric measurements and climate modeling are:
   (a) Line Positions and Intensities: Spectral parameters are needed for several infrared bands of major and trace constituents where data are either totally missing from the present compilations or are of very poor quality. These problems are generally more severe at wavelengths shorter than 3 μm, although improvements are needed for certain species in all spectral regions.
   (b) Line Widths: Improved knowledge of air-broadened halfwidths and their temperature dependence is needed for nearly all of the optically active atmospheric species. Self-broadened and nitrogen-broadened halfwidths are also needed for special applications such as gas correlation radiometry.

(4) Other requirements, in order of their relative importance, include laboratory and theoretical studies of deviations from the Lorentz line shape, accurate integrated intensities and band model representations for unresolved bands, more accurate absorption coefficients for the important pressure induced bands of oxygen and nitrogen, improved models for the temperature and pressure dependence of the water vapor continuum, improved parameters for transitions involved in non-LTE radiative transfer in the upper atmosphere, and quantification of other effects such as pressure induced line shifts which are presently considered to be insignificant for atmospheric spectroscopy.

APPENDIX C: INSTRUMENT INTERCOMPARISONS AND ASSESSMENTS

This Appendix summarizes what has been learned regarding the reliability with which the concentrations of stratospheric trace species can be measured with current techniques and instruments. During the last several years, there have been a number of field campaigns that have focused on the assessment of this reliability by direct intercomparison of results for a given species obtained by a variety of different methods applied simultaneously under representative atmospheric conditions. These formal and rigorous intercomparisons have revealed both strengths and shortcomings.

Major Conclusions and Recommendations

(1) Stratospheric ozone can likely be measured with a ±4% relative uncertainty at altitudes up to about 40 km with state-of-the-art balloon-borne *in situ* UV absorption photometers.

(2) The monitoring-type electrochemical ozonesondes appear to have, on the average, an overall uncertainty of ±10% and a precision of 5% at stratospheric altitudes below 25-30 km, given consistent preparation of the sondes.

(3) The data from the frostpoint and fluorescence water vapor instruments have a systematic difference of about 0.75 ppmv (20%), the origin of which remains unknown.

(4) Such intercomparisons are vital to real progress in assessing the reliability of stratospheric observations and must be a component of experimental research in this field.

(5) There are numerous unresolved differences among the results of balloon-borne long path techniques for several species, e.g. NO_2.

APPENDIX D: OZONE AND TEMPERATURE MONTHLY MEANS

This Appendix is provided because global monthly mean charts of ozone and temperature have become available, covering for the first time the height range 30 to 0.1-mbar, (approximately 24 to 64 km).

For both hemispheres these charts are given for the four mid-season months, and for the pressure levels 30, 10, 1, and 0.1 mbar, (0.4 mbar for ozone). Charts with total ozone are provided separately. This set of charts shows clearly the very close coupling between the temperatures and the ozone distribution and demonstrates the influence of the large-scale planetary waves, giving rise to very large longitudinal variations.

A discussion on the regular and interannual variability of temperature and ozone is followed by a description of the mean state.

Federal Register
Vol. 51, No. 7
Friday, January 10, 1986

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Ch. I

[OAR-FRL-2949-3]

Stratospheric Ozone Protection Plan

AGENCY: Environmental Protection Agency.

ACTION: Announcement of Program Plan.

SUMMARY: This notice describes recent activities related to protection of the stratospheric ozone layer and outlines EPA's program plan for future examination of the issue. By enhancing EPA's research and analysis related to stratospheric ozone protection, this program will provide necessary technical information for use in future Agency decisions on whether or not to regulate chlorofluorocarbons (CFCs) or other chemicals that may affect the ozone layer. In addition, the plan places considerable emphasis on United States participation in on-going international research and discussions of global strategies for protecting the ozone layer.

This notice provides a broad outline and general schedule for the stratospheric ozone protection program. Throughout the implementation of this program, EPA encourages public review and participation. Where appropriate, the Agency will announce in the Federal Register upcoming workshops and conferences and the availability of papers for review.

FOR FURTHER INFORMATION CONTACT: Stephen Seidel, U.S. Environmental Protection Agency, 401 M St. S.W., Washington, D.C. 20460 (202) 382-2787.

SUPPLEMENTARY INFORMATION:

Background

By preventing most potentially harmful ultraviolet radiation (UV-B radiation) from penetrating to the earth's surface, the ozone layer acts as an important shield protecting human health, welfare and the environment. The possibility that the production, use, and release of chlorofluorocarbons (CFCs) could cause the depletion of stratospheric ozone was first theorized in a 1974 article in *Nature* by Rowland and Molina. If a net depletion of total-column ozone (i.e., the total quantity of ozone encountered by radiation penetrating from the top of the atmosphere to the earth's surface at any given location) occurred, more UV-B radiation would penetrate to the earth's surface.

Possible health and environmental effects of exposure to increased UV-B radiation could include: increases in non-melanoma skin cancer; suppression of the human immune system; decreases in the productivity of commercially important crops and aquatic organisms; and accelerated degradation of polymeric materials. In addition, EPA and the National Institutes of Health have recently initiated studies to determine whether or not exposure to UV-B radiation can contribute to melanoma skin cancer. Finally, production and use of CFCs may contribute to the predicted global warming from the "greenhouse effect" through two pathways. First, changes in the distribution of total-column ozone could possibly increase temperature, and second, CFCs themselves are infrared-absorbing gases that act directly (in the same manner as carbon dioxide) to raise global surface temperature.

Although less was known about the possible causes and effects of ozone depletion in the mid-1970's, EPA and other agencies responded to concerns about this issue by promulgating regulations in 1978 limiting the use of CFCs as a propellant in nonessential aerosol spray cans (43 FR 11301: March 17, 1978). CFC use as an aerosol propellant had grown to 56 percent of total CFC use in this country and 25 percent of total world consumption in 1974. By significantly reducing CFC use and therefore the risks of ozone depletion, this action has provided more time to address the complex scientific questions involved in assessing those risks.

While several other countries also acted to limit CFC use in aerosol propellants, this use continues in most countries. In addition, CFCs are used here and abroad for many important industrial and commercial processes, including refrigeration, air conditioning, and foam blowing, and as a solvent by the electronics industry.

In 1980 EPA issued an advance notice of proposed rulemaking discussing possible further limits on domestic production of CFCs under section 157 of the Clean Air Act, 42 U.S.C. 7457 (45 FR 66726: Oct 7, 1980). However, some of the scientific information summarized in that notice was soon outdated by more recent work in the field, and there have been substantial changes in the research community's understanding of several important aspects of the issue since then. In general, the more recent work has demonstrated that possible changes in the ozone layer are affected by a more complex array of physical and chemical forces than previously thought, and that substantial uncertainties remain to be resolved before such changes can be predicted with confidence. In addition, EPA believes that any decision on further regulation of domestic CFC production or use must be based on further research and analysis, and should be evaluated in the context of possible international regulatory actions. Today's notice outlines the Agency's current plan for further examination and resolution of this issue.

Two current areas of activity set the context in which EPA is acting. Both scientific and diplomatic efforts are underway, and each figures significantly in the Agency's plan. First, the scientific research community has expanded its efforts to improve our understanding of the physical and chemical forces that affect the ozone layer and how these may change over time. For example, researchers now recognize that atmospheric constituents other than CFCs have been increasing, and that future changes in these substances must also be considered in modelling the future evolution of the atmosphere. Researchers have also placed additional emphasis on the potential climatic impacts that might be caused by changes in atmospheric chemical composition.

Several major reports on related scientific issues are planned for the next year. A major review of atmospheric science issues related to ozone modification is scheduled to be published in January 1986. This report is being sponsored by the National Aeronautics and Space Administration (NASA), the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP), and other national and international organizations. NASA is also preparing a companion report to EPA and Congress on this subject. UNEP's Coordinating Committee on the Ozone Layer will hold meetings in 1986 and will issue a report that covers atmospheric science and other areas of research related to the effects of exposure to UV-B radiation on human health, welfare and the environment. The Fluorocarbon Program Panel of the Chemical Manufacturers Association (CMA) continues to fund research primarily related to ozone monitoring and atmospheric modelling. Finally, in October 1985, the WMO convened a conference in Villach, Austria to examine potential changes in climate that could, in part, result from increases in CFCs and other ozone-modifying substances and from changes in the vertical distribution of ozone.

The second major focus of recent activities has centered on international negotiations concerning protection of the ozone layer. Conducted under the auspices of UNEP, these negotiations resulted in the adoption of the Vienna Convention for the Protection of the Ozone Layer in March 1985. This convention creates a framework for international cooperation on research, monitoring and information exchange. It also provides procedures for the future adoption of measures to control, limit, prevent or reduce emissions of ozone-modifying substances, should such measures be deemed necessary. This treaty comes into force after formal acceptance by twenty nations.

While successfully adopting the framework convention, the Diplomatic Conference in Vienna failed to agree on any appropriate global control measures. In lieu of such measures, it passed a resolution calling for an economic workshop to analyze relevant aspects of control options and for continued negotiations culminating in a second Diplomatic Conference currently planned for April 1987.

Program Plan

EPA's stratospheric ozone protection program integrates the diverse scientific and economic research being carried on by EPA and by other organizations into a coherent framework for future Agency decisionmaking on both the domestic and international aspects of this issue. (See Figure 1.) Three primary elements of the Agency's program are: (1) conducting analyses and research across a range of economic and scientific subjects aimed at narrowing uncertainties; (2) participating in a series of workshops and conferences both in the United States and abroad aimed at improving understanding of all aspects of this issue; and (3) deciding by November 1987 whether additional domestic regulation of CFCs is warranted, based on the information gained during the period of study.

Key areas for analysis include: evaluating potential future rates of growth in emissions; modelling the changes to the ozone layer that may result from changes in the atmosphere's composition; analyzing model parameters and predictions in light of atmospheric monitoring data; evaluating potential health, welfare and environmental effects from exposure to increased UV–B radiation or changes in climate related to ozone modification; and analyzing potential economic impacts, including the potential benefits from limiting UV–B exposure and the potential costs of limiting future increases in CFCs and other atmospheric perturbants.

Analysis of *future demand for CFCs and other atmospheric perturbants* and the *costs and feasibility of emission reduction technologies* will be subject of a domestic workshop scheduled for March 1986 and a UNEP-sponsored international workshop scheduled for May 1986.

Analysis of issues related to the *measurement and modelling of atmospheric changes* will be based on the NASA/UNEP report scheduled to be available in January 1986, a planned companion report to be prepared for EPA and Congress by NASA and the results from on-going studies being conducted or funded or NASA, CMA's Fluorocarbon Program Panel, the National Oceanic and Atmospheric Administration and others.

Analysis of *potential health, welfare and environmental effects* from increased exposure to UV–B will draw from on-going research being funded by EPA in the areas of plant and aquatic effects, human health effects, materials damage, and climate impact assessments. Results of this research, along with that sponsored by other organizations, will also be used by UNEP's Coordinating Committee on the Ozone Layer for part of its report, scheduled for publication in 1986. In addition, the United States and UNEP are jointly sponsoring an international conference on health and environmental effects related to ozone depletion and climate change. This conference is now set for mid-June 1986 in Washington, D.C.

EPA is also planning to convene a workshop to evaluate *alternate global and domestic control strategies,* tentatively set for July 1986. This domestic workshop will be followed by a UNEP-sponsored international workshop on the same issue now scheduled for September 1986. These two workshops set the stage for resumption of international negotiations concerning a control protocol scheduled to begin in November 1986.

EPA, in conjunction with the Department of State, plans to prepare an environmental impact statement pursuant to Executive Order 12114, "Environmental Effects Abroad of Major Federal Actions," in the event that a protocol is adopted.

A more detailed discussion of specific studies and research to be used for these activities is available to the public by contacting Mr. Stephen Seidel at the address provided above.

Decisionmaking Process

Research and analyses prepared as part of EPA's program plan or developed by other sources will be integrated into one or more staff papers that will serve as the basis for future Agency decisionmaking. EPA intends to make these staff papers available for review by the public and by its Science Advisory Board. The final staff papers will serve as the technical basis for any regulatory decisions.

At the same time, EPA will continue to participate actively in the ongoing UNEP workshops and will provide support to the Department of State in negotiations concerning possible global strategies to protect the ozone layer. Because of the global nature of this issue, any decision concerning future domestic regulatory actions will be evaluated in the context of ongoing international negotiations.

By May 1987, EPA plans to issue a Federal Register notice summarizing the results of its program and either proposing further regulation related to this issue or presenting the basis for a proposed decision to take no further action at this time. A **Federal Register** notice promulgating regulations or announcing a decision to take no immediate action is scheduled for November 1987.

EPA intends to make every effort to undertake the above activities within the timetable presented. However, the exact timing of many of the intermediate dates is contingent on outside parties or international agreements and therefore is subject to change. Any such changes will be discussed in individual Federal Register notices announcing the details of specific meetings and conferences.

Dated: November 29, 1985.

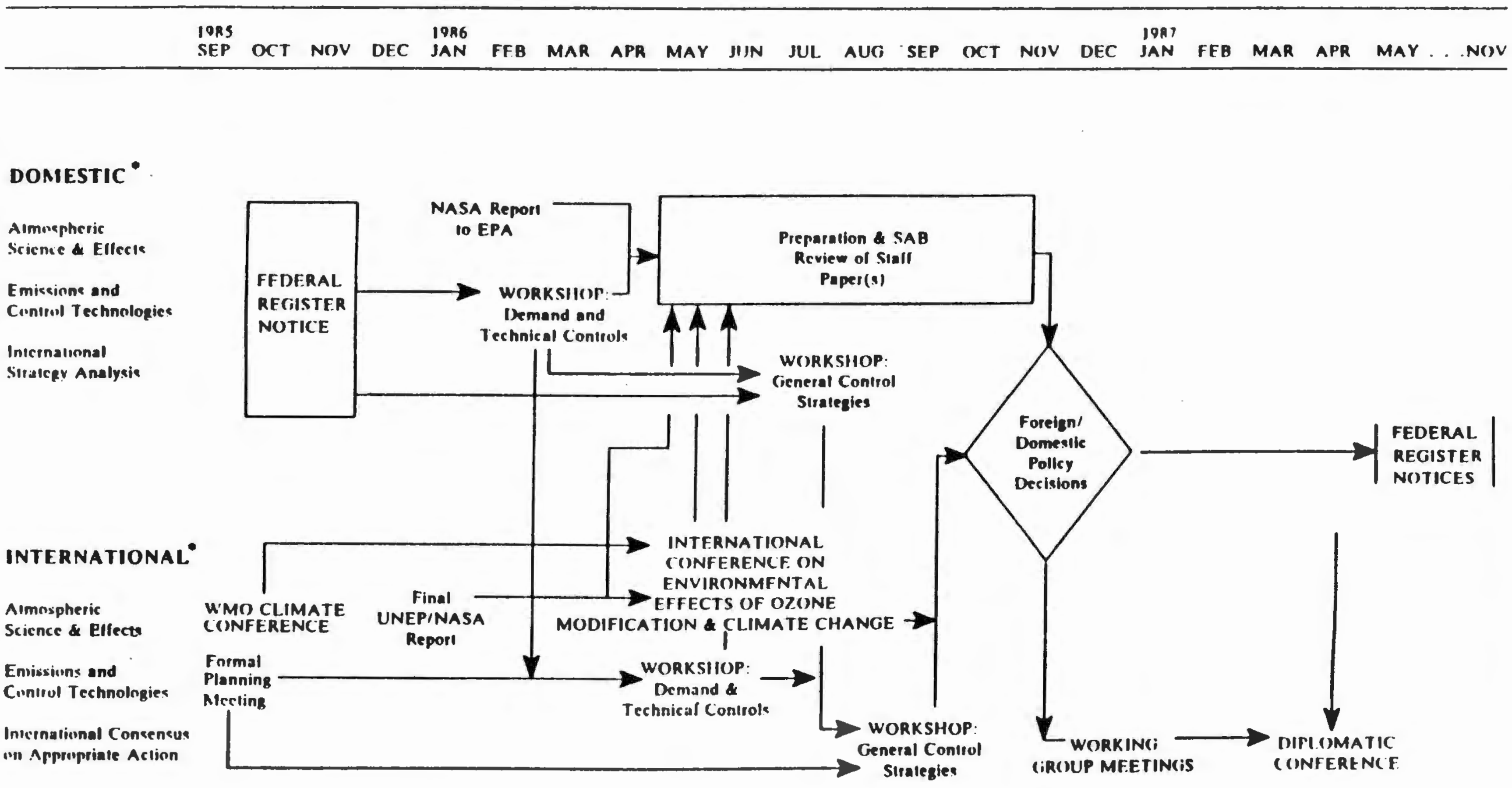
Charles L. Elkins,

Acting Assistant Administrator for Air and Radiation.

[FR Doc. 86-45 Filed 1-9-86; 8:45 am]

Figure 1

ACTIVITIES RELATED TO EPA'S STRATOSPHERIC OZONE PROTECTION PROGRAM



* STUDIES ONGOING IN ALL CATEGORIES TO SUPPORT MAJOR EVENTS

BILLING CODE 6560-50-C

OFFICE OF THE UNITED STATES
TRADE REPRESENTATIVE
EXECUTIVE OFFICE OF THE PRESIDENT
WASHINGTON
20506

January 14, 1986

MEMORANDUM

TO: CFC Trade Work Group

FROM: Amelia Porges AP
Associate General Counsel

SUBJECT: Trade Law Issues and Ozone Layer Negotiations

Negotiations have now begun on a Protocol to the Vienna Convention for the Protection of the Ozone Layer. This protocol would be the basis for an international regime for the regulation of production and trade in chlorofluorocarbons (CFCs). You have asked about trade law considerations relevant to the design of this regulatory regime. The following discussion is necessarily abstract at this point, and can only flag possible problems. Pep Fuller, Bob Reinstein and I will be glad to answer more concrete questions on trade policy and trade law as the negotiations develop.

As long as the trade restrictions imposed are related to the conservation of natural resources, or necessary to the protection of human, animal or plant health, nothing in the GATT will prevent their adoption as long as they are not a disguised restriction on international trade. Similarly, all that is required to satisfy the GATT Standards Code is that the standards set be scientifically valid. Thus, any rule that satisfies the requirements of U.S. law (the Clean Air Act) will probably satisfy the GATT and the Code (and bilateral FCN treaties).

A trade regime for CFCs may require that the parties discriminate against CFC trade from non-parties. This raises two technical issues worth thinking about: dealing with transshipment of goods from non-parties to parties, and designing a rule of origin for the products subject to the protocol. Both can be dealt with, in the protocol itself and/or in national implementation of the protocol.

GATT and the Standards Code

GATT (the General Agreement on Tariffs and Trade) regulates our trade relations with its ninety members. All of the current signatories of the Vienna Convention on the Protection of the Ozone Layer are also GATT contracting parties, with the exception of Morocco, which is in the final stages of GATT accession, and the USSR and Byelorussian and Ukrainian SSRs. GATT confers rights and obligations on its members with respect to imports and exports of products from its member countries. It does not regulate government treatment of foreign firms, nor does it regulate services, investment or technology transfer.

The GATT generally bans quantitative restrictions on imports or exports, and prohibits import charges in excess of tariff concessions; these strictures would apply to any restriction on trade except if imposed under one of the exceptions provided in the GATT. However, GATT Article XX provides:

> Subject to the requirement that such measures are not applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail, or a disguised restriction on international trade, nothing in this Agreement shall be construed to prevent the adoption or enforcement by any contracting party of measures: ...
>
> (b) necessary to protect human, animal or plant life or health;
>
> (g) relating to the conservation of exhaustible natural resources if such resources are made effective in conjunction with restrictions on domestic production or consumption;...

Under Article XX, the members of the agreement could impose a ban or restriction or import fee on imports of CFCs (or products made with or containing CFCs) to the extent that such action is <u>necessary</u> to protect human, animal or plant life or health, <u>and</u> if the measure does not treat like cases differently. Similarly, we could certainly justify ozone-related trade measures as relating to the conservation of the ozone layer, an exhaustible natural resource, since the parties to the agreement would presumably be applying restrictions on domestic production or consumption.

Nothing in the GATT would prohibit a party from applying trade restrictions against all non-signers (regardless of whether they actually conform to agreement standards) on the basis that they have not formally acceded to the agreement. For instance, Japan and Norway have notified the GATT that they prohibit all imports of whalemeat from countries not signatories to the International Whaling Convention.[1]

The standard in Article XX(j) is a very broad one. It could

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[1] GATT/L/4814, L/5165.

conceivably permit sanctions against non-CFC trade of all non-signers, if such sanctions could be defended as environmentally motivated and as a functioning part of the agreement. Note that measures under XX(j) need not be <u>necessary</u> to the conservation of exhaustible natural resources-- just related to such conservation. For GATT purposes, the closer the relation, the better.

In order to introduce greater discipline and transparency in national regulatory systems affecting trade, the Agreement on Technical Barriers to Trade[2] (commonly known as the Standards Code) was negotiated under GATT auspices in the Tokyo Round, and entered into force in 1980. All but a few developed countries are members of the Code, and many developing countries (although there are no members that are not GATT members).

The Code does not interfere with the adoption per se of regulations that meet real health and safety needs. Rather, it sets rules for setting standards and maintaining certification systems. One of these rules is that standards-setting and certification systems should not create unnecessary obstacles to international trade (this obligation is implemented with respect to USG regulatory activities in section 402 of the Trade Agreements Act of 1979 (19 U.S.C. 2532). The term "unnecessary obstacle" is not defined in the Code and has not been interpreted by the Standards Code Committee nor through disputes brought under the Code.

The Code covers the preparation, adoption and application of standards; determination of conformity with standards; and operation of certification systems. With regard to these activities, the Code generally requires that national and most favored nation treatment be accorded to products of other parties to the Code.[3] If a standard is scientifically justified (as U.S. law requires our standards to be), the Code will not stand in the way of its adoption as long as it imposes no unnecessary obstacles to trade.

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[2] Agreement on Technical Barriers to Trade (Standards Code), 31 UST 405, TIAS 9616, done at Geneva April 12, 1979, entered into force January 1, 1980.

[3] The Code does not cover regulation of processes and production methods, except where a party to the Code considers that Code obligations are being circumvented by the drafting of requirements in terms of processes and production methods rather than in terms of characteristics of products. <u>See</u> Standards Code Art. 14.25. A standard that prohibited the use of CFCs to clean electronics, and prohibited as well the importation of electronics that had been cleaned with CFCs, would be one example of regulation of processes or production methods.

Bilateral Treaties

The U.S. has entered into many bilateral friendship, commerce and navigation (FCN) treaties over the years. Most FCN treaties were negotiated by the U.S. from 1945-62, based on a standard draft text. There are two treaty provisions of concern in the context of a CFC regime: most-favored-nation treatment (which requires that we give products of the treaty partner treatment no less favorable than treatment given to products of any other party), and national treatment (which requires treatment no less favorable than treatment given our own products). These provisions are contained in almost all of the 1945-62 FCNs, and (in some form) in many other of our bilateral trade treaties.

However, Article XXI, paragraph 3 of the standard FCN draft permits any action that is specifically permitted by the GATT. Thus, any action permitted by GATT Article XX is permitted under the standard FCN text.

The treaty question should be re-examined when it is clearer what the obligations of the protocol are likely to be, and who the participants and non-participants are likely to be.

Transshipment and Rules of Origin

A trade regime for CFCs could require agreement members to discriminate in their trade between the products of members and non-members. This raises two questions: first, how to deal with transshipment or diversion, and second, how to determine the origin of imports. These are both essentially technical issues that you may wish to raise in a later stage, when the trade aspects of the protocol have taken shape.

Transshipment is an issue whenever there is a trade regime that discriminates by origin. For instance, the International Coffee Agreement[4] provides that in times of oversupply and low coffee prices, exporting members are to be subject to export quotas, and importing members are to enforce these quotas through limiting their imports from ICA members to coffee that has a an export license issued by an exporting member.[5] Where a country has filled its export quota (and, under the ICA, therefore ceases issuing export licenses) its exporters may be tempted to transship

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[4] International Coffee Agreement, 1983, TIAS ___-, done at London Set. 16, 1982, entered into force definitively Sept. 11, 1985.

[5] A limited amount of imports from non-members is permitted, but the level of imports is set low enough to provide a strong incentive for coffee exporting countries to join.

coffee through a country that has not filled its quota and mislabel the coffee as being from the country of transshipment.[6] However, the customs laws of the United States and most countries provide substantial penalties for acts of this sort, which constitute customs fraud[7] through false labeling of origin. If exporters or importers of CFCs were to transship CFCs or CFC products in order to evade restrictions on imports from non-agreement countries, this would almost certainly constitute customs fraud.

The other issue is determining where goods are from, for the purposes of the regime that would govern trade in CFCs and/or products. If this regime does significantly restrict trade, the rule of origin may be an important issue.

If the products to be regulated here are produced in such a manner that the entire chain of production takes place in one country, determination of origin may be relatively straightforward. However, origin may not be so simple to decide for products of a multi-stage manufacturing process. Also, trade restrictions may lead producers to change the "origin" of products: after a U.S. antidumping order on televisions from Japan, for instance, the TV exporters shipped TV kits to Taiwan for assembly and export to the U.S. If CFC technology lends itself to this kind of evasion, and if such evasion would undermine the effectiveness of the agreement in practice, you may want to consider origin questions carefully in the protocol negotiations, and perhaps provide a uniform origin rule.

Cleared: Pep Fuller

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[6] Preferably, unused export quotas are redistributed to other member coffee exporting countries that are a position to use them.

[7] Entry of goods into the U.S. by means of false statements, regardless of whether the U.S. government is defrauded of duties, is punishable under 19 USC 1592 (civil customs fraud--subject to forfeiture of merchandise); 18 USC 542 (criminal customs fraud--$500 fine/2 years prison); and 18 USC 1001 (false statements to the Federal government).

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OES

KQ 11/28

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'86 NOV 28 P1:21

United States Department of State

Washington, D. C. 20520

'86 NOV 28 P9:03

November 28, 1986

ACTION MEMORANDUM

S/S 11/28

Orig to FAIM
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TO: E - Mr. Wallis

FROM: OES - John D. Negroponte

SUBJECT: Circular 175: Request for Authority to Negotiate a Protocol to the Convention for the Protection of the Ozone Layer

ISSUE FOR DECISION:

Whether to authorize negotiation of a protocol to the Vienna Convention for the Protection of the Ozone Layer which would control emissions of ozone-depleting substances.

ESSENTIAL FACTORS:

The Problem

There is general scientific agreement that human activities are substantially altering the chemistry of the atmosphere in ways which threaten both the quantity and the vertical distribution of ozone. Certain chlorine and bromine substances, when emitted into the atmosphere, act as catalysts in a series of chemical reactions resulting in a depletion of ozone. Ozone depletion, by permitting greater quantities of harmful ultra-violet radiation to reach the earth's surface, will pose significant, even if currently difficult to quantify, risks for health and ecosystems. Given the complex chemistry and dynamics of the atmosphere, scientific uncertainties currently prevent a conclusive determination of safe levels of emissions. Because of the long atmospheric lifetime of these molecules, emissions affect the ozone layer for decades. The nature of the ozone layer requires international action if protective measures are to be effective.

The chemicals at issue for this protocol -- chlorofluorocarbons ("CFCs") and some bromine compounds -- have substantial economic and social value, being widely used in refrigeration, foam-blowing, fire-extinguishers, as solvents, and in most countries as aerosols. (Their use in non-essential aerosols was banned in the United States in 1978.) The U.S., Japan and EC countries currently account for about 90% of world production and consumption.

The International Process

The Vienna Convention for the Protection of the Ozone Layer, adopted under auspices of the U.N. Environment Program (UNEP) on March 22, 1985 and ratified by the United States on August 14, 1986, provides for cooperation in research, monitoring and information exchange. The Convention obliges the Parties to cooperate in taking measures to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the ozone layer. The Diplomatic Conference which adopted the Convention did not reach agreement, however, on a protocol to control emissions of ozone-depleting substances. The final act of the Diplomatic Conference called for a series of scientific and economic workshops on the atmospheric science, effects of ozone depletion, and alternative control measures, followed by resumption of negotiations, looking toward adoption of a control protocol in 1987 if possible. Negotiations are to resume December 1, 1986, with a diplomatic conference to conclude the protocol tentatively scheduled for April 1987.

The Domestic Setting

The Environmental Protection Agency, under terms of a court order approving a settlement reached in a lawsuit against the EPA Administrator by the Natural Resources Defense Council, must publish in the Federal Register by May 1, 1987 a proposed decision on the need for further domestic regulation of CFCs under Sec. 157 of the Clean Air Act. Compared to other environmental laws, the Act sets a low threshhold for required action by EPA: "the Administrator shall propose regulations for the control of any substance, practice, process, or activity...which in his judgment may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, if such effect in the stratosphere may reasonably be anticipated to endanger public health or welfare." In this connection, EPA is going through an extensive risk assessment process. A final EPA decision is required by the court order by November 1, 1987.

An important goal in seeking an early and effective international agreement (in addition to the goal of more effectively protecting the ozone layer) is to avoid disadvantage to U.S. industry as a result of unilateral U.S. regulatory action required by the Clean Air Act. Unilateral U.S. action in advance of international agreement could undercut the global control effort.

The principal producer- and user-industry group, the "Alliance for Responsible CFC Policy," has reversed its previous total opposition to controls, issuing a statement September 16, 1986 that "responsible policy dictates, given the scientific uncertainties, that the U.S. government work in cooperation with the world community...to consider establishing a reasonable global limit on the future rate of growth of fully halogenated CFC production capacity."

Proposed Position

Our approach in the international negotiations is intended to influence those negotiations to achieve the most effective international agreement possible. It does not prejudge the EPA Administrator's decision on domestic regulation.

Although considerable evidence exists linking certain chlorine and bromine substances to depletion of ozone, remaining scientific uncertainties prevent any conclusive statement concerning safe levels of emissions. As a result, the Administrator of EPA recommends an international risk management strategy which would give a strong incentive for rapid development and employment of emission controls, recycling practices and safer substitute chemicals. We should therefore seek a protocol that explicitly or in effect provides for:

I. A near-term freeze on the combined emissions of the most ozone-depleting substances;

II. A long-term scheduled reduction of emissions of these chemicals down to the point of eliminating emissions from all but limited uses for which no substitutes are commercially available (such reduction could be as much as 95%), subject to III; and

III. Periodic review of the protocol provisions based upon regular assessment of the science. The review could remove or add chemicals, or change the schedule or the emission reduction target.

These elements would provide a desirable margin of safety against harm to the ozone layer while scientific research continues. At the same time, this approach would provide as much certainty as possible for industrial planning in order to minimize the costs of reducing reliance on these chemicals, while allowing adequate time for adjustment.

The timing, stringency and scope of the phased reductions will have to be negotiated. We would promote a scheme which allows flexibility for each nation to determine how it will implement domestically its international obligation. In reponse to UNEP's invitation, we have prepared for discussion purposes the attached draft text for the operative paragraphs of a protocol.

We would favor setting national limits at or near current levels, in order to avoid increases in emissions from any Party. Elimination of most emissions would obviate the difficult question of equity -- the view that developing countries have a right to a fair share of world markets if a global limit on emissions is set: developing countries will have less reason to seek to expand use of products which will be obsolete in the forseeable future and they will benefit from the development of substitutes and of recycling and containment techniques.

We will seek to include in the protocol measures to regulate relevant trade between parties and non-parties in order to create incentives for nations to adhere to the protocol's emissions limits. These measures will have an ancillary effect of protecting U.S. industry from unfair competition. We will assure that any trade provisions included in the protocol are consistent with the General Agreement on Tariffs and Trade (GATT) and other aspects of U.S. trade policy.

We have undertaken extensive consultations with industry and environmental groups and will continue to do so as the negotiations progress.

Legal Authority and Funding

We expect that no additional legislation will be required to implement the provisions of a protocol specifying the regulation of ozone-depleting substances. As discussed in the attached legal memorandum, EPA has authority under the Clean Air Act to regulate ozone-depleting substances which may reasonably be expected to endanger public health or welfare and is currently conducting the risk assessment required to determine the need for additional regulation.

It has not yet been determined whether this protocol would be concluded as an executive agreement or as a treaty subject to the advice and consent of the Senate. This will depend, in part, on the content of the protocol and nature of the undertakings therein. The requirements of the National Environmental Policy Act (NEPA) and E.O. 12114 on Environmental Effects Abroad of Major Federal Actions are currently being considered.

Costs related to implementation of a protocol will depend on the requirements of the protocol. As a party to the Vienna Convention for the Protection of the Ozone Layer, we are already committed to the establishment of a Secretariat (in an existing international organization such as UNEP or WMO) and Conference of the Parties when that agreement enters into force. Any additional costs to administer the protocol will be incremental. We will seek to minimize the services required of the Secretariat and any requirement for funding to support such services, and we will make every effort to ensure that necessary support staff are provided within existing levels. EPA will be responsible for reports to the Secretariat, participation in technical reviews, and other commitments of a technical nature assumed under the protocol.

Financial support for a cooperative science program to form the basis for periodic review of the protocol provisions will need to be considered. EPA, NASA, NOAA and other technical agencies would participate in any cooperative science program resulting from the protocol with their own funds. The U.S. already has a dynamic and extensive program on both the atmospheric science and effects science, and as such is already by far the largest contributor to international scientific cooperation in these areas. The protocol may be a means to draw additional commitments from other nations to contribute to scientific efforts. It will be possible to assess the need for any additional U.S. support in this area only as the negotiations progress. We will consult with and obtain the approval of OMB regarding any commitment that could not be satisfied out of currently appropriated funds.

RECOMMENDATION:

That you authorize negotiation of a protocol to the Vienna Convention for the Protection of the Ozone Layer which would control emissions of those substances which are the most significant contributors to ozone depletion in accordance with the principles outlined above. Subsequent authority will be sought to conclude any international agreement resulting from these negotiations.

Approve ______________ Disapprove ______________

11/26/86

Attachments:

A. Legal Memorandum
B. Draft protocol text

Circular 175: Protocol for Protection of Ozone Layer

Drafter: OES/ENH:SButcher
11/16/86 647-9312 0936T
Revised 11/26/86 16:00

Clearance: OES:REBenedick
OES/ENH:JRouse
L:EVerville(Substance)
L/OES:DColson
L/OES:DKennedy
L/T:HCollums
L/EBC:GRosen
E:MBailey
EB:ASundquist
IO:LGalini
M/MO:ALaPorta
M/COMP:CCasper
EPA:BLLong
NASA:JFletcher
NOAA:JFletcher
Commerce:MTKelly
USTR:APorges/RReinstein
DPC:THarris
CEQ:CNee
DOE:EWilliams
OMB:JIrwin/DGibbons

SB

United States Department of State

Washington, D.C. 20520

MEMORANDUM OF LAW

SUBJECT: Authority to Negotiate a Protocol to the Convention for the Protection of the Ozone Layer to Control Emissions of Ozone-depleting Substances

The accompanying action memorandum from OES requests authorization to negotiate a protocol to the Vienna Convention for the Protection of the Ozone Layer which would control emissions of substances, such as certain chlorine and bromine substances, that deplete stratospheric ozone. As indicated in the action memorandum, the United States is supportive of a protocol that would impose a freeze on emissions of most ozone-depleting substances, followed by a long-term scheduled reduction of emissions of these substances to a point of eliminating all but limited uses for which there are no commercially available substitutes -- subject to periodic review of the protocol, and if scientifically warranted, modification of its provisions.

Legal authority to negotiate such a protocol derives from the constitutional authority of the President to conduct foreign relations and the statutory authority of the Secretary of State, 22 U.S.C. §2656, to manage the foreign affairs of the United States on a day-to-day basis. There is also ample statutory authority for the negotiation of international environmental agreements specifically.

For example, section 102(F) of the National Environmental Policy Act of 1969 directs all agencies of the federal government to "recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment." 42 U.S.C. §4332(F). Likewise, section 2 of the United Nations Environment Program Participation Act of 1973 provides that "[i]t is the policy of the United States to participate in coordinated international efforts to solve environmental problems of global and international concern." 22 U.S.C. §287 note. The participation of the United States in the negotiation of the proposed protocol would be consistent with that policy.

With respect to the development of international agreements for the protection of the stratosphere, section 156 of the Clean Air Act grants the President the authority "to enter into international agreements to foster cooperative research ... and to develop standards and regulations which protect the stratosphere consistent with regulations applicable within the United States." 42 U.S.C. §7456. This section further authorizes the President, through the Secretary of State and the Assistant Secretary for Oceans and International Environmental and Scientific Affairs, to "negotiate multilateral treaties, conventions, resolutions, or other agreements, and formulate, present, or support proposals at the United Nations and other appropriate international forums." Id.

The key aspect of the protocol will be the parties' commitment to control their emissions of certain ozone-depleting substances. Under section 157 of the Clean Air Act, 42 U.S.C. §7457, EPA currently has the statutory authority to regulate such substances where they may reasonably be expected to endanger public health or welfare. Thus, it is anticipated that this obligation would be within the purview of existing U.S. legislation, although it may be necessary for EPA to promulgate additional regulations to implement specific control measures. Other statutory authorities under which regulations related to the protection of stratospheric ozone have been issued--e.g., the Federal Food, Drug, and Cosmetic Act, 21 U.S.C. §301 et seq.; the Consumer Product Safety Act, 15 U.S.C. §2051 et seq.; and the Toxic Substances Control Act, 15 U.S.C. §2601 et seq.--also may provide, if necessary, a supplemental basis for meeting U.S. obligations under the protocol.

Final determination of whether the protocol should be concluded as a treaty or an executive agreement and whether it is consistent with existing U.S. laws obviously is dependent upon a final text. In the event the final text of the protocol imposes obligations on the United States that exceed existing laws, the protocol most likely will need to be concluded as a treaty, subject to the advice and consent of the Senate to ratification. It may also be necessary to seek new legislation permitting the implementation of the protocol before its entry into force.

While the provisions to be included in the protocol are still in an evolutionary stage, the action memorandum and attached drafted protocol text indicates that the U.S. delegation will propose for incorporation in the protocol measures regulating the trade of ozone-depleting chemicals and technologies for producing those chemicals between parties to the protocol and non-parties. (There is currently no definitive U.S. position with respect to additional trade controls.) Under section 157 of the Clean Air Act, the Administrator of the Environmental Protection Agency has authority to promulgate regulations for the control of any substance, practice, process or activity (or any combination thereof) which in his judgment may reasonably be anticipated to affect the stratosphere, especially ozone in the stratosphere, if such effect may reasonably be anticipated to endanger public health or welfare. 42 U.S.C. §7457. The language of section 157 appears to be broad enough to permit the issuance of regulations by EPA to implement a protocol provision requiring trade restrictions to protect against ozone depletion and its attendant deleterious effects.

However, if the authority granted pursuant to section 157 is insufficient for this purpose, section 6 of the Toxic Substances Control Act ("TSCA"), 15 U.S.C. §2605, generally authorizes the EPA Administrator to prohibit or limit by rule the manufacture (defined to include importation) and distribution in commerce of a chemical substance or mixture presenting an unreasonable risk of injury to health or the environment, such as the ozone-depleting substances at issue here.1/ Correlatively, section 13 of TSCA requires the Secretary of Treasury to refuse entry into the Customs territory of the United States any chemical substance or mixture, or article containing a chemical substance or mixture, offered for entry in violation of a rule issued under section 6 of TSCA. See 15 U.S.C. §2612.

EPA's authority to regulate the export of such substances, mixtures, or articles under TSCA is somewhat circumscribed. With the exception of certain labelling, notification, reporting and information-retention requirements, TSCA is inapplicable to a chemical substance or mixture, or article containing a chemical substance or mixture, that is manufactured, processed, or distributed in commerce solely for export from the United States unless the Administrator finds that it presents an unreasonable risk of injury to health within the United States or to the environment of the United States. TSCA section 12, 15 U.S.C. §2611. In this case, because the environmental problem is global in nature and consequently requires corrective measures universally, it is likely that such a finding could be made--i.e., that such

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1/ EPA may exercise its regulatory authority under TSCA if the Administrator finds that a risk of injury to health or the environment could not be effectively eliminated under another statute administered by EPA or by another federal agency. TSCA sections 6(c) and 9(a), 15 U.S.C. §§2605(c) and 2608(a).

exports in the long-run will have adverse health or environmental effects within the United States. Indeed, EPA made such a finding in 1978 when it prohibited (subject to an exception for certain essential uses and uses in articles exempted under section 3 of TSCA, 15 U.S.C. §2602) the processing of chlorofluorocarbons (CFCs) into aerosol propellant articles intended for export.2/ 43 Fed. Reg. at 11,319 and 11,321 (1978).3/

The validity of a restriction on relevant trade with non-parties in relation to the obligations of the United States under the General Agreement on Tariffs and Trade (GATT) has also been examined. The GATT normally bans quantitative restrictions on imports or exports and prohibits import charges in excess of tariff concessions. However, in consultation with the United States Trade Representative, we have concluded that a trade restriction could be drafted appropriately to fall within the general exception to the GATT contained in Article XX(b) which permits the adoption or enforcement of measures by contracting parties necessary to protect human, animal or plant life or health. Article XX(g) of the GATT also contains a general exception for the adoption or enforcement of measures "relating to the conservation of exhaustible natural resources if such resources are made effective in conjunction with restrictions on domestic production or consumption which could also be applicable." Ozone-related trade measures could be justified under Article XX(g) as relating to the conservation of the ozone layer, an exhaustible natural resource, since the parties to the agreement would presumably be applying restrictions on domestic production or consumption. It should be noted, however, that these exceptions to the GATT are

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2/ EPA's 1978 ban prohibited all non-essential aerosol propellant uses of CFCs--a suspected ozone-depleting chemical. EPA's action was proposed and initiated under TSCA before the addition of section 157 (the stratospheric ozone protection provisions) to the Clean Air Act. In the Federal Register notice of its action, EPA observed that "[b]ecause chlorofluorocarbon emissions anywhere in the world deplete the ozone layer and adversely affect health and the environment of the United States, the Administrator finds that chlorofluorocarbon discharges from aerosol propellant articles made in the United States and shipped abroad also cause an unreasonable risk of injury." 43 Fed. Reg. 11,319 (1978).

3/ The Export Administration Act, 50 U.S.C. App. 2401 et. seq., could also provide a vehicle for regulating the export of protocol-covered chemicals and technologies related to their production.

subject to the requirement that measures not be applied in a manner which would constitute a means of arbitrary or unjustifiable discrimination between countries where the same conditions prevail or a disguised restriction on international trade. GATT, Article XX.

In light of the above, there is no legal objection to the negotiation of a protocol to the Vienna Convention for the Protection of the Ozone Layer as outlined in the accompanying action memorandum, subject to the concurrence of L and other interested bureaus in the final text of the protocol and provided additional Circular 175 authority is obtained for conclusion of the protocol.

David A Colson

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Drafted: L/OES:DKennedy DK
11/20/86 x71370

Clearance: L/T:HCollums
L/EBC:GRosen (draft)
EPA/OGC:NKetcham-Colwill
USTR/OGC:APorges
DK

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U.S. POSITION PAPER

UNEP Ozone Layer Protocol Negotiations

First Session: December 1-5, 1986

Geneva, Switzerland

BACKGROUND:

This meeting is the first negotiating session on an ozone layer protocol since the Diplomatic Conference in Vienna in March 1985. The Vienna Conference saw the conclusion and adoption of the Convention for the Protection of the Ozone Layer, which establishes a framework for cooperation on research, monitoring an information exchange, and provides for the possible future adoption of control protocols. The U.S. was one of 24 original signatories to the Convention, and has since become one of eight to ratify it.

There was considerable debate on a control protocol during the previous round of negotiations, but because consensus could not be reached on the optimal control strategy, a protocol was not adopted at the Vienna Conference. Instead, the Conference passed a resolution calling for a series of workshops on the economic and technical aspects of various control strategies, followed by a resumption of protocol negotiations.

During the past year two workshops were held. The first, held in Rome this past May, focused on projections of emissions of the ozone-modifying gases and on the technical feasibility of controls. The second, hosted by the U.S. in Leesburg, assessed various generic control strategies with respect to a number of evaluative criteria (e.g., effectiveness, cost, equity, etc.). Although there was much disagreement during the Rome workshop, a preliminary consensus seemed to emerge from the congenial atmosphere of the Leesburg meeting.

Since the Leesburg meeting, the U.S. has communicated with other governments on several occasions: (a) a cable in October expressing U.S. hopes for the negotiations; (b) a cable in early November conveying U.S. views on a protocol ("U.S. Views Statement"); (c) a cable on November 22 conveying the U.S. proposed protocol text; and (d) bilateral consultations with the UK, Canada, FRG, and the EC Commission.

U.S. POSITION:

I. Election of Officers (Agenda item 2):

A. Chair: The delegation should support the election of Winfred Lang of Austria as chair for the meeting. Lang served ably in this capacity at the Vienna Diplomatic Conference in March 1985.

B. Vice chair(s) and rapporteurs: For the other positions on the meeting bureau, the delegation should support competent, "neutral" individuals, and seek geographic balance for the overall bureau.

II. Review of relevant UNEP activities (Agenda item 3):

Prior to the opening of the meeting, the alternate head of delegation should confer with the UNEP officers and ask that time spent on this item be kept as brief as possible, in order to allow maximum time for discussion of the protocol text.

III. Protocol discussions (Agenda item 4):

A. The overall U.S. goals during the negotiations are to reach agreement on:

1. A meaningful near-term first step to reduce significantly the risk of stratospheric ozone depletion and associated environmental and human health impacts.

2. A long-term strategy and goals for coping with the problem successfully.

3. A carefully-scheduled plan for achieving the long-terms goals, including periodic reassessment and appropriate modification of the strategy and goals in response to new scientific and economic information.

B. U.S. objectives for the negotiations are contained in the "U.S. Views Statement". The delegation should seek to reach agreement on:

1. A near-term freeze on the combined emissions of the most ozone-depleting substances.

2. A long-term scheduled reduction in emissions of these chemicals down to the point of eliminating

all but limited uses for which no substitutes are commercially available. Such reductions could be as much as 95 percent.

3. Periodic assessment and possible adjustment of the control measures based on a regular review of the science.

C. Proposed Protocol text:

The U.S. has drafted a text of the operative articles of a protocol which meets the above goals and objectives. For the purposes of this meeting, the delegation should support this text as the U.S. position. It should support having UNEP distribute it as a conference room document and should seek to have it become the focus for the negotiations.

D. Specific positions on articles of U.S. draft text:

1. Article II (Control Measures):

a. Timing - Keeping in mind that it may be 3-5 years before the protocol enters into force, the delegation should, for the purposes of this meeting, initially support replacing the brackets in front of "years" in paragraphs 1, 2, 3, and 4 with 1, 3, 6, and 10, respectively, but as a fall-back should seek to have the following range put in the brackets:

para. 1: 1 - 2 years
para. 2: 3 - 5 years
para. 3: 6 - 9 years
para. 4: 10 - 14 years.

b. Stringency - The delegation should support retaining the percentages currently in brackets in paragraphs 2, 3, and 4. As it is unlikely that agreement on this will be reached at this meeting, the delegation should as a fall-back seek to have a range set in each of these brackets, with 20 percent as the low end of the range for paragraph 2 and 95 percent as the upper end of the range for paragraph 4.

c. Chemical Coverage - Further review after the U.S. Views Statement was issued has revealed that "fully-halogenated alkanes" is too broad, in that it includes certain chemicals that we do not think should be controlled (e.g., CCl_4). The specific chemicals the U.S. believes should be controlled are: CFC 11, 12~~,~~ 113, ~~and 115,~~ and Halon 1211 and 1301. The EC members will likely want to include only CFC 11, 12, and perhaps 113, at this time.

The delegation should use its discretion on whether there is some tactical advantage to be gained by continuing to support control of all fully-halogenated alkanes for the time being, in order to use this as a bargaining chip to eventually achieve the U.S. preferred list. If it appears there is no tactical advantage to be gained, the delegation should seek to amend the text by:

- replacing the phrase "all fully-halogenated alkanes" with "the controlled substances";
- adding to Article I the following definition: "Controlled substances" means those substances listed in Annex A;
- listing all of the chemicals noted above in Annex A (which should be submitted as a conference document).

2. <u>Article III</u> (Calculation of Aggregate Annual Emissions):

<u>Production vs. Net Use</u> - In the U.S. Views Statement and the draft protocol text, the option of controlling either production or "net use" (i.e., production exports + imports) was left open. Article II calls for reductions in <u>emissions</u>, and Article III is constructed so that emissions can be represented by either production or "net use". Using production would make the protocol simpler and compliance easier to monitor, but the "net use" approach allows greater freedom of trade among the Parties.

U.S. thinking at this time is to favor the "net use" approach, and thus the delegation should support retention of subparagraph b and c of paragraph 1 (subparagraph d is applicable under either approach and should also be retained). However, beyond the immediate objective of retaining the bracketed language the delegation should keep a low profile on this question, try to stimulate fruitful discussion on the pros and cons of either approach, and try to gain an understanding of how other countries feel about this.

Because the terms "use" and "consumption" may carry undesirable connotations of, e.g., specific use bans, the delegation should use the phrase "adjusted production" to stand for the "net use" concept.

3. Article IV (Assessment and Adjustment of Control Measures):

All of the text in this Article is unbracketed and the delegation should support its retention, (with the amendment noted below) while being open to drafting improvements. If there are any disagreements in substance, the delegation should seek to have whatever part is in controversy retained in brackets rather than deleted.

The above notwithstanding, the delegation should seek to amend paragraph 3 so that the Parties will take into account not only scientific, but also economic and technical, information in their assessment of the control measures. Annex II of the Convention and/or old Article V (see below) should be referenced in the amending language.

4. Article V (Control of Trade):

The delegation should strongly support retention of this Article. For the blank brackets in front of "years" in paragraphs 1 and 2, the delegation should support having this be the same number as for Article II paragraph 1.

The delegation should support retention of the final bracketed clauses of paragraphs 1 and 2 -- which are included so as to avoid conflict between these provisions with ~~the GATT and~~ domestic laws -- ~~and may agree to having these be unbracketed~~.

The delegation should support retention of subparagraph b of paragraph 2 ~~and may agree to having this be unbracketed.~~

If there is sentiment in the meeting that paragraph 3 is too weak, the delegation may support having a second alternative added and may suggest the following text:

> Within [ ] years after entry into force of this Protocol, each Party shall restrict imports of products containing or produced with fully-halogenated alkanes from any state not party to this Protocol [, unless such state is in full compliance with Article II and this Article, and has submitted information to that effect as specified in paragraph 1 of Article VI]. The Parties shall develop as soon as possible guidelines for harmonizing these restrictions, to be included in an annex to this Protocol.

5. Article VI (Reporting of Information): The delegation should support retention of this Article but be open to any suggested improvements. The delegation may agree to deletion of subparagraph 3b if most other delegations believe it is not needed.

E. Positions on other sections of previously negotiated Draft Protocol Text:

The U.S. draft operative articles are intended for incorporation into the protocol text developed during the previous sound of negotiations i.e., the fifth revised draft text.

In general, the delegation should press for having maximum time spent on the "operative" articles, and suggest that the other articles be discussed at a subsequent meeting (or, at least, that the preamble be discussed last). If unsuccessful, the delegation should use the following guidance:

1. Preamble:

    a) replace references to chlorofluorocarbons by something more general, like "certain man-made chemicals";

    b) delete references to aerosols;

    c) seek to remove preambular paragraphs that weaken the thrust of the protocol.

2. Old Article I (Definitions): Delete paragraph 4; add new definition of "controlled substances" as noted earlier.

3. Old Article V (Research, Development, and Exchange of Information):

   The cable to UNEP indicated that the U.S. draft articles II - VI were intended to replace Articles II - V of the 4th revised draft text. Although there is no direct replacement for old Article V, the delegation may, if this is raised, indicate that the essence of this is covered in new Article IV and Annex II of the Convention. However, if there is still sentiment for retaining this article, the delegation may agree to its retention, but suggest that everything up to the first comma in paragraph 1 be deleted.

4. Old Article VI (Technical Assistance) - support as is.

5. Old Article VII (Secretariat Functions) - redraft subparagraph b and c to be consistent with new operative articles.

6. Old Article VIII (Meeting of the Parties) - consider how to incorporate specific reference to the "assessment meetings" for purposes of paragraph 3 of new Article IV.

7. Old Articles IX - XII - support as is.

IV. Plans for Future Work (Agenda item 5):

The delegation should strongly support having the negotiations stick to the current UNEP schedule (i.e., second negotiating session in February; Diplomatic Conference in April 1987), noting that it has been almost two years since the Vienna Diplomatic Conference affirmed the need for a control protocol.

V. Other Matters (Agenda item 6):

Under this item, UNEP may ask for pledges from participating countries to offset the cost of future meetings, ~~and/or to support participation~~ by developing country representatives. If so, the delegation should indicate that the U.S. EPA is willing to contribute $20,000. The delegation may, at its discretion, make this pledge on a matching funds basis.

GENERAL ISSUES

I. Press: All press inquiries should be referred to the head of delegation.

II. Budgetary Commitments: The delegation should not commit the U.S. to any activity that cannot be funded out of current appropriations.

Drafted by:
Jim Losey
EPA/OIA (382-4894)
11/25/86

Clearances:
Richard Benedick: State/OES/E
Bill Long: EPA/OIA
Ted Harris: DPC
Ed Shykind: Commerce
Robert Watson: NASA
Barbara Moore: NOAA
Richard Brozen: OMB
Coleman Nee: CEQ

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ACTION OES-09

INFO LOG-00 COPY-01 ADS-00 AID-00 INR-10 EUR-00 SS-00
OIC-02 AF-00 CIAE-00 EB-03 DINT-05 DODE-00 H-01
BUD-02 IO-19 EXIM-06 NEA-07 NSF-02 ARA-00 NSAE-00
L-03 LAB-04 TRSE-00 PM-10 EAP-00 OPIC-07 CEA-01
DOTE-00 OMB-01 STR-17 SIL-01 HHS-06 AGRE-00 FRB-01
ACDA-12 USIE-00 JUSE-00 SP-02 SNP-01 CEQ-01 PRS-01
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USOECD

FOR OES, IO/SCT AND E
PASS EPA FOR THOMAS AND GREEN
USDOC FOR M. KELLEY AND E. SHYKIND
USDOC FOR NOAA T. CALIO
WHITEHOUSE FOR OPC T. HARRIS
WHITEHOUSE FOR CEQ A. HILL
NASA FOR R. WATSON
USTR FOR REINSTEIN
DOE FOR T. WILLIAMS
NAIROBI ALSO FOR UNEP PERM REP
BRUSSELS FOR USEC
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E.O. 12356: N/A
TAGS: SENV, UNEP, OTRA
SUBJECT: UNEP NEGOTIATIONS ON PROTOCOL TO PROTECT OZONE LAYER, GENEVA, DECEMBER 1-5, 1986 (DELEGATION REPORT)

REF: A) STATE 364665, B) STATE 349396, C) STATE 255252 (NOTAL)

1. SUMMARY: FIRST ROUND OF RESUMED NEGOTIATIONS BY QUOTE AD HOC GROUP OF GOVERNMENT-DESIGNATED LEGAL AND TECHNICAL EXPERTS FOR PREPARATION OF A PROTOCOL ON CHLOROFLUOROCARBONS TO THE VIENNA CONVENTION FOR THE PROTECTION OF THE OZONE LAYER UNQUOTE CONCLUDED EARLY FRIDAY AFTERNOON (DECEMBER 5). REPRESENTATIVES FROM ALL REGIONAL BLOCS AGREED THAT NEW MEASURES MUST BE TAKEN IN NEAR-TERM TO CONTROL EMISSIONS OF OZONE DEPLETING CHEMICALS. HOWEVER, WHILE DIFFERENCES OVER THE SCOPE, STRINGENCY AND TIME-PHASING OF CONTROL MEASURES WERE NARROWED, THEY WERE NOT RESOLVED. DISCUSSIONS HELPED CLARIFY SPECIFICS AND RATIONALE OF VARIOUS PROPOSALS; DELINEATED ISSUES RELATED TO CONTROL STRATEGIES, TRADE ASPECTS, AND DEVELOPING COUNTRY PARTICIPATION THAT REQUIRE FURTHER ANALYSIS BY THE U.S. AND OTHERS; ESTABLISHED THAT EUROPEAN COMMUNITIES (EC), JAPAN AND USSR ARE PREPARED TO MOVE BEYOND PREVIOUSLY-HELD POSITIONS (ALTHOUGH HOW FAR IS YET TO BE DETERMINED); AND REVEALED UNEXPECTEDLY STRONG DEVELOPING COUNTRY SUPPORT FOR A PROTOCOL AND U.S. POSITIONS IN GENERAL (ALBEIT FROM A SPARSE LDC TURNOUT). PROSPECTS FOR NEXT SESSION HEAVILY DEPENDENT UPON EUROPEAN COMMUNITIES' WILLINGNESS TO CONSIDER CONTROL MEASURES OVER LONG TERM, AND UNEP'S ABILITY TO PREPARE ADEQUATE BASIS FOR DISCUSSIONS, INCLUDING ATTRACTING PARTICIPATION BY MORE GOVERNMENTS. OVERALL, USDEL BELIEVES IMPORTANCE OF THIS INITIAL ROUND OF NEGOTIATIONS CAPTURED VERY WELL IN WASHINGTON POST EDITORIAL OVER WEEKEND WHICH OBSERVED THAT QUOTE ALL THE MOVEMENT IS IN THE RIGHT DIRECTION UNQUOTE. END SUMMARY.
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2. PARTICIPATION: WEEK-LONG NEGOTIATING SESSION ATTRACTED SOME 120 PARTICIPANTS FROM 25 GOVERNMENTS AND THE COMMISSION FOR THE EUROPEAN COMMUNITIES, 5 OTHER INTERGOVERNMENTAL ORGANIZATIONS (UNEP, OECD, WMO, ECE, AND COUNCIL OF EUROPE), AND NINE NONGOVERNMENTAL INTERNATIONAL BODIES, INCLUDING INTERNATIONAL CHAMBER OF COMMERCE, EUROPEAN CHEMICAL INDUSTRY AND AEROSOL ASSOCIATIONS, ENVIRONMENTAL DEFENSE FUND, WORLD RESOURCES INSTITUTE AND NATURAL RESOURCES DEFENSE COUNCIL. GOVERNMENT PARTICIPATION WAS ONLY ONE-HALF OF UNEP'S EARLIER ESTIMATE (OF 55): (ARGENTINA, AUSTRALIA, AUSTRIA, BELGIUM, BRAZIL, CANADA, DENMARK, EGYPT, FINLAND, FRANCE, FRG, HUNGARY, ITALY, JAPAN, MEXICO, NETHERLANDS, NORWAY, PHILIPPINES, PORTUGAL, SWEDEN, SWITZERLAND, USSR, USA, UK, AND URUGUAY)

FOLLOWING WERE NOTABLE ABSENCES: CHINA, INDIA, KENYA, NIGERIA, AND EC MEMBERS IRELAND, SPAIN, AND GREECE. BELGIUM, NEW CHAIR OF COUNCIL OF EUROPEAN COMMUNITIES BEGINNING ON 1 JANUARY, WAS REPRESENTED (ON LIMITED BASIS ONLY) BY GENEVA MISSION OFFICER, AS WAS MEXICO. LARGE AMERICAN CONTINGENT PRESENT. IN ADDITION TO OFFICIAL DELEGATION (HEADED BY STATE DEPARTMENT DEPUTY ASSISTANT SECRETARY RICHARD BENEDICK), SESSION ATTRACTED SIX CONGRESSIONAL STAFFERS, FIVE INDUSTRY REPRESENTATIVES AND FOUR PRIVATE ENVIRONMENTAL ORGANIZATIONS.

3. ATMOSPHERICS: MEETING ABLY RUN BY ELECTED BUREAU: WINFRED LANG (AUSTRIA) CHAIRMAN; VLADIMIR ZAKHAROV (USSR) AND AHMED IBRAHIM (EGYPT) VICE-CHAIRMAN; GERALDO NASCIMENTO-SILVA (BRAZIL) RAPPORTEUR. UNEP DEPUTY EXECUTIVE DIRECTOR WILLIAM MANSFIELD SET GOOD TONE IN OPENING STATEMENT WHICH EMPHASIZED ACCUMULATING SCIENTIFIC EVIDENCE OF THREAT TO GLOBAL ECOSYSTEM, AND THE SOLID GROUNDWORK AND MOMENTUM WHICH THE PAST TWO YEARS OF INTERNATIONAL SCIENTIFIC MEETINGS AND CONSULTATIONS HAD CREATED. MANSFIELD'S QUOTE RISING TIDE IN THE AFFAIRS OF MEN UNQUOTE WAS SOMEWHAT STEMMED, HOWEVER, BY UNEP'S FAILURE TO HAVE KEY DRAFT PROTOCOL TEXTS (BY U.S. AND CANADA) AVAILABLE FOR DISTRIBUTION UNTIL SECOND DAY, AND SUBSEQUENT INABILITY TO PRODUCE TRANSLATIONS OF MEETING ROOM PAPERS QUICKLY IN ALL LANGUAGES. (USSR RESERVED ON FINAL REPORT IN ABSENCE OF RUSSIAN VERSION.)
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4. MEETING WAS VERY USEFUL IN DEFINING A COMMON UNDERSTANDING OF KEY CONCERNS AND OPTIONS ON WHICH AN EFFECTIVE SECOND SESSION DEPENDS. SEVERAL DELEGATES

(PARTICULARLY FRG) NOTED PRIVATELY THE GREAT VALUE THEIR GOVERNMENTS RECEIVED FROM THE RECENT BRIEFINGS IN EUROPE PRESENTED BY A STATE DEPARTMENT/EPA TEAM, AND URGED THAT THEY BE CONTINUED AND AIMED AT EVEN HIGHER LEVELS OF GOVERNMENT OFFICIALS. NEGOTIATING SESSION ITSELF UNDOUBTEDLY CONTRIBUTED TO HEIGHTENED OFFICIAL AND PUBLIC AWARENESS. PRESS COVERAGE (FOREIGN AND LOCAL) WAS HEAVY, WITH MEETING RECEIVING PROMINENT ATTENTION IN SWISS AND FRENCH PAPERS AND ON TV.

5. MID-WEEK VISIT TO NEGOTIATIONS BY EPA ADMINISTRATOR LEE THOMAS AND ASSOCIATE ADMINISTRATOR FITZHUGH GREEN FURTHER SYMBOLIZED U.S. COMMITMENT TO NEGOTIATION PROCESS; AND DINNER FOR HEADS OF DELEGATION AND AMERICAN TEAM HOSTED BY THOMAS AND MISSION CHARGE RONALD FLACK AT AMBASSADOR'S RESIDENCE PROVIDED WELCOME OPPORTUNITY TO EXPLORE ATTITUDES ON FUTURE PROSPECTS IN LESS FORMAL ATMOSPHERE.

6. GOVERNMENT POSITIONS/APPROACHES:

(A) U.S. - BENEDICK INTRODUCED ON MONDAY BASIC THREE-PART POSITION (I.E., NEED FOR EARLY FIRST STEP, LONG TERM STRATEGY AND WELL-DEFINED PROCESS) ALONG WITH PROTOCOL TEXT CALLING FOR EARLY EMISSIONS FREEZE AND SUBSEQUENT TIME-PHASED REDUCTION. GIVEN TENOR OF MEETING, AND ABSENCE OF DEBATE ON SPECIFICS, USDEL FOCUSSED ITS EFFORTS ON ENSURING BROAD SUPPORT FOR BASIC ELEMENTS OF A PROTOCOL WHICH WOULD HAVE BOTH MEANINGFUL NEAR AND LONGER TERM CONTROL MEASURES; WOULD COVER THE BROADEST SPECTRUM OF POTENTIAL OZONE DEPLETING CHEMICALS; AND WOULD CONTAIN GOOD SCIENTIFIC ASSESSMENT AND TECHNOLOGY FORCING MECHANISMS. THERE WAS VIRTUALLY NO DEBATE ON SUBSTANCE OF U.S. DRAFT PROTOCOL TEXT, OR OTHERS.

(B) CANADA - CANADIANS PRESSED THEIR PROPOSAL (GLOBAL EMISSIONS LIMIT ALLOCATED NATIONALLY ON BASIS OF GNP AND POPULATION) QUITE VIGOROUSLY THE FIRST TWO DAYS BUT BACKED OFF WHEN IT RECEIVED VIRTUALLY NO SUPPORT. CANADIAN DELEGATION THEN CONCENTRATED ON SUPPORTING U.S. AND NORDIC EFFORT TO ACHIEVE CONSENSUS ON BROAD UTLINES OF PROTOCOL RATHER THAN ON SPECIFIC FORMULAS.

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(C) NORDICS - ON TUESDAY, NORWAY, FINLAND AND SWEDEN ENDORSED U.S. APPPROACH IN GENERAL, AND TABLED AN AMENDMENT TO THE U.S. TEXT CALLING FOR A FIRST STEP PHASE-DOWN OF EMISSIONS OF 25 PERCENT RATHER THAN A FREEZE, WITH CONTROLS BASED ON ADJUSTED PRODUCTION (PRODUCTION MINUS EXPORTS PLUS IMPORTS MINUS CHEMICALS DESTROYED) RATHER THAN ON STRAIGHT PRODUCTION. PREDICTABLY, NORDICS WERE AGGRESSIVE IN PURSUING EARLY PROTOCOL, AND OUTSPOKEN IN OBJECTING TO WHAT THEY PERCEIVED TO BE UNWILLINGNESS OF EUROPEAN COMMUNITIES TO MOVE VIGOROUSLY.

(D) EUROPEAN COMMUNITIES - EC COMMISSION DISTRIBUTED QUOTE PROVISIONAL PAPER UNQUOTE ON WEDNESDAY, BASED STRUCTURALLY ON U.S. TEXT BUT WITH SEVERAL IMPORTANT DIFFERENCES: ONLY CFC 11 AND 12 WOULD BE FROZEN AT 1986 PRODUCTINN LEVELS, AND ANY LONGER TERM RONTROLS WOULD ONLY BE STUDIED. COMMISSION PROFESSED INABILITY TO NEGOTIATE ANY FURTHER BECAUSE OF ONLY LIMITED ATTENTION PROVIDED TO OZONE ISSUE AT NOVEMBER 24 EC COUNCIL MEETING, WHICH WAS DOMINATED BY THE RHINE ACCIDENT AND CHERNOBYL. EC CLAIMED THAT ITS MANDATE THIS WEEK WAS THEREFORE VERY LIMITED, AND THAT THE RESULTS OF THIS MEETING WOULD HAVE TO BE PRESENTED TO THE NEXT SCHEDULED EC COUNCIL OF ENVIRONMENT MINISTERS MEETING ON MARCH 20. THIS PROVED A MAJOR STUMBLING BLOCK TO FURTHER PROGRESS, ESPECIALLY WHEN THE HEADS OF THE U.K. AND EC DELEGATIONS DEPARTED GENEVA WEDNESDAY NIGHT.

(E) SOVIETS - WHILE USSR DELEGATION ACKNOWLEDGED OZONE DEPLETION RISK AT OUTSET, THEY SEEMED UNFAMILIAR WITH, AND WERE SHARPLY CRITICAL OF, SCIENTIFIC EVIDENCE TO SUPPORT URGENT MEASURES. ON THAT BASIS, THEY ARGUED THAT ONLY CFC 11 AND 12 SHOULD BE CONTROLLED, AND BY THOSE WHO HAVE CAUSED THE PROBLEM (U.S. AND EC NATIONS, BY INFERENCE). LATE THURSDAY, JUST BEFORE THE DEBATE ENDED, THE SOVIETS INTRODUCED A MURKILY WORDED TEXT CALLING FOR A GLOBAL PRODUCTION LIMIT FOR CFC 11 AND 12, ALLOCATED TO NATIONS BASED ON THEIR PRODUCTION CAPACITIES AND POPULATION, WITH LDCS ENJOYING TOTAL EXEMPTION FROM CONTROLS. WHILE THIS IS SOMEWHAT SIMILAR TO CANADIAN APPROACH, NEITHER SOVIETS (NOR OTHERS) DREW THIS COMPARISON. PRIVATELY, SOVIETS EXPRESSED STRONG INTEREST IN COLLABORATING WITH USG ON OZONE RESEARCH, INCLUDING ANTARCTICA.

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(F) JAPAN - JAPANESE DELEGATION, BOTH IN PLENARY DEBATE AND IN AD HOC WORKING GROUP ESTABLISHED BY CHAIRMAN, CAME ACROSS AS MOST CONSERVATIVE OF WESTERN NATIONS ON THIS ISSUE, INDICATING THAT JAPAN FAVORS A PRODUCTION CAPACITY CAP, ON CFC 11 AND 12 ONLY. (THIS IS THE PREVIOUS POSITION OF THE EC.) THE JAPANESE WERE FRANK IN ADMITTING THAT THEIR APPROACH IS TIED TO THEIR RECENT LARGE EXPANSION OF CFC 113 CAPACITY TO SERVE ELECTRONICS INDUSTRY, NOTING THAT THE DESIRE IS TO SUBSTITUTE FOR OTHER SOLVENTS FOUND TO BE TOXIC IN WORKING PLACE ENVIRONMENTS.

7. STATUS OF KEY ISSUES

(A) SCOPE OF COVERAGE - NO COUNTRY DISPUTED NEED TO CONTROL CFC 11 AND 12, AND MANY WANT TO INCLUDE 113 (JAPAN OPPOSED). U.S., NORDICS AND CANADA ARGUED FOR EVEN BROADER COVERAGE TO INCLUDE HALONS, BUT SOVIETS INSISTED THAT WORKING GROUP'S MANDATE AS OBTAINED FROM UNEF WAS QUOTE NARROW UNQUOTE (I.E., ONLY FULLY HALOGENATED CHLOROFLUOROCARBONS).

(B) STRINGENCY OF CONTROLS - EARLY FREEZE ON GROWTH OF CFC 11 AND 12 AT CURRENT LEVELS WAS COMMON TO MANY COUNTRY POSITIONS. LITTLE COMMONALITY ON CONCEPTS OF FURTHER LONGER TERMS REDUCTIONS IN EMISSIONS, PHASE-DOWNS, OR PHASE-OUT. U.S. TEXT (NOW BACKED BY NORDICS) WHICH CALLS FOR POSSIBLE REDUCTION OF 95 PERCENT IS MOST STRINGENT, AND WE BELIEVE HAS BEEN HELPFUL IN FORCING OTHERS TO CONSIDER STEPS BEYOND WHAT THEY WOULD OTHERWISE TAKE

(C) TIMING OF CONTROL MEASURES - SCHEDULING OF CONTROL MEASURES NOT DISCUSSED IN ANY DETAIL. U.S. PRESSED TO PRESERVE TWO-TIERED APPROACH OF EARLY MEANINGFUL FIRST STEP (I.E., FREEZE) FOLLOWED BY CAREFULLY SCHEDULED REDUCTION OVER LONG TERM. THERE SEEMS TO BE CONSENSUS THAT BOTH NEAR AND LONG TERM SHOULD BE ADDRESSED IN PROTOCOL, BUT NO AGREEMENT ON DETAILS OF LATTER.

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(D) SCIENTIFIC REVIEW MECHANISM - SOLID AGREEMENT ON CONCEPT, BUT ISSUES OF COMPOSITION, FREQUENCY AND SCHEDULING OF SCIENTIFIC REVIEW AND ASSESSMENT MEETINGS, REPORTING CHANNELS AND FINANCING REMAIN TO BE ADDRESSED.

(E) TRADE CONTROLS - CANADA AND MEXICO FORMALLY

EXPRESSED STRONG SUPPORT FOR U.S. TRADE ARTICLE. EC PROPOSAL CALLED FOR STUDY ONLY. INFORMAL DISCUSSIONS REVEALED BROAD INTEREST IN INCLUDING TRADE PROVISION IN PROTOCOL TO PROVIDE NECESSARY TEETH AND SAFEGUARDS, AND ALSO IN EXAMINING THE FEASIBILITY OF HAVING IT INCLUDE PRODUCTS WHICH CONTAIN OR ARE MADE WITH CONTROLLED CHEMICALS.

(F) DEVELOPING COUNTRY TREATMENT - NORDIC AND USSR PROPOSALS BOTH EXEMPTED LDCS FROM CONTRACT PROVISIONS, SOVIETS PROVIDING COMPLETE EXEMPTION WHILE NORDICS APPLYING PROVISIONS ONLY TO PARTIES WITH PER CAPITA USE ABOVE 0.2 KG. CANADA INDICATED SUPPORT FOR EXEMPTION OF ANY COUNTRY WITH PER CAPITA USE BELOW WORLD AVERAGE (0.16 KG.). ARGENTINA ARGUED STRONGLY FOR A QUOTE POLLUTER PAYS APPROACH UNQUOTE, WITHOUT ELABORATING. (ARGENTINE REPRESENTIVE VERY HELPFUL AND SUPPORTIVE OF U.S. POSITIONS THROUGHOUT, AS WAS EGYPTIAN DELEGATE.)

1. NEXT WORKING GROUP MEETING: UNEP SECRETARIAT ANNOUNCED THAT NEXT MEETING HAS BEEN SCHEDULED FOR FEBRUARY 23-27, 1987. HOWEVER, EC (WITH JAPANESE SUPPORT) ASKED FOR POSTPONENT UNTIL APRIL, SINCE EC COUNCIL WILL NNT MEET UNTIL MARCH 20. USSR FURTHER COMPLICATED SITUATION BY SAYING THAT NO FURTHER SESSION SHOULD BE HELD UNTIL UNEP'S GOVERNING COUNCIL (WHICH CONVENES IN MID-JUNE) CAN CLARIFY WORKING GROUP'S MANDATE REGARDING SCOPE OF CHEMICALS TO BE CONSIDERED. U.S., NORDICS, CANADA AND ARGENTINA STRONGLY ARGUED THAT FEBRUARY DATE (KNOWN TO ALL PARTIES FOR OVER A YEAR) SHOULD BE MAINTAINED. RESULT WAS THAT WORKING GROUP REFERRED THE ISSUE TO UNEP EXECUTIVE DIRECTOR TOLBA FOR RESOLUTION. STREATOR

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

December 16, 1986

MEMORANDUM FOR: Ralph Bledsoe
Executive Secretary
Domestic Policy Council

SUBJECT: Stratospheric Ozone

Attached is possible language on the Stratospheric Ozone issue and a copy of the U.S. position being used in U.N. negotiations.

Lee M. Thomas

P.S. Sorry for the delay.

State of the Union Message

Ozone Layer Protection

The United States continues to lead international efforts to meet a growing potential threat to the earth's ozone layer.

Twelve years ago, two American scientists found that the stratospheric ozone layer could be depleted by the increasing emissions of certain industrial chemicals -- with possible major harm to human health and the environment. In 1978 the United States was the first nation to act against this peril: the Environmental Protection Agency banned non-essential uses of chlorofluorocarbons as an aerosol propellant in spray cans. Then for four years our scientists and policymakers cooperated on an international Convention to Protect the Ozone Layer. The United States ratified this last August.

Most nations now agree that the ozone layer is endangered. With them the United States is striving to develop specific control measures over emission to the atmosphere of ozone-depleting substances. Negotiations on control measures began in Geneva in December, and we hope to see them succeed during the coming year.

The industrial chemicals at issue have served humanity well in the past, and the economic costs of change may be considerable. Also, though our scientific understanding of ozone depletion is advancing rapidly, many uncertainties remain. But government, industry and environmentalists are collaborating closely. A firm U.S. position for saving the ozone layer has already resulted. I am confident that it will trigger a consensus in the months ahead. Together with other nations the United States is poised for a vital step to keep our biosphere safe.

Summary of U.S. Position
Ozone Layer Protocol Negotiations
Geneva, December 1-5, 1986

The U.S. position is to negotiate a control protocol with the following elements:

A near-term freeze on the combined emissions of the most ozone-depleting substances

A long-term scheduled reduction in emissions of these chemicals

A mechanism for assessment and possible adjustment of the control measures based on a regular review of the science.

ous than common stocks. The risk to small savers hardly justifies regulation beyond existing disclosure rules.

specific benefits of greater
carefully delineated. Junk bonds make ugly lumber. But it takes all sorts of boards to build an economy.

NYTimes 12/16/86

Why Toy With the Ozone Shield?

At ground level, ozone is a pollutant. Higher up, the oxygen-derived gas serves as a shield for all life against the ultraviolet rays of the sun. This vital screen is at serious risk of erosion from an otherwise beneficial class of industrial chemicals known as chlorofluorocarbons, or CFC's. After a decade of controversy, a consensus has emerged that world production of CFC's should at least be capped. But a meeting at Geneva this month produced little agreement on practical steps, largely because of foot-dragging by Europeans.

CFC's are used in home refrigerators, auto air conditioners, foams for insulating, packaging and cushioning, and as cleansers in electronic chip factories. A major use abroad, though banned in America since 1978, is as propellants in aerosol sprays. The chemicals are harmless and stable until they waft up to the stratosphere. There, broken apart by sunlight, their chlorine atoms act as a catalyst in destroying molecules of ozone.

A mere 2.5 percent depletion of the ozone layer would lead to half a million extra cases of human skin cancer, according to the Environmental Protection Agency. Until recently there has been little agreement on how fast the ozone shield is in fact eroding, and how much to blame man-made chemicals versus natural causes. But in 1979 a huge hole in the ozone layer was found over the Antarctic. Experts dispute whether the hole is caused by chemicals or by wind patterns, but in either case it is disconcerting evidence of the ozone shield's fragility.

Last September Du Pont, the largest producer of CFC's, called for a worldwide limit on emissions of the chemicals. Du Pont's new position is bolstered by its commendable success in developing new forms of CFC that don't threaten the ozone layer. Even the trade group for CFC consumers and producers has come around to favoring an international cap on production capacity.

But current production is only two-thirds of full capacity and rapidly growing. The State Department, backed by the Environmental Protection Agency, seeks to freeze production at current levels, then gradually phase out CFC emissions. That's the better course. There's already a vast supply of CFC's in use, most of which will eventually leak out and reach the stratosphere.

At the recent Geneva meeting, the Common Market countries announced tentative agreement with the idea of a production freeze. That's a welcome advance, but tentative is not actual, and the Europeans wish to freeze only some CFC's. Such half-measures make only half sense. The possibility of serious damage to the ozone shield is wholly real. The Europeans cannot even muster the resolve needed to remove CFC's completely from deodorant sprays. But since they have now agreed there is a problem, they should be ready to support serious steps, like a freeze on current CFC production, by the next ozone meeting.

The Worm and the Apple

Favoritism for Fish

The Case for Chlorine

Bad enough that 92 sewage treatment systems discharge effluent into streams feeding New York City's drinking water reservoirs. Now the state's Department of Environmental Conservation proposes to allow one such plant — serving the village of Delhi (pronounced Dell-High) in the western Catskills — to stop disinfecting its effluent with chlorine. For that, give the agency a worm.

The department says eliminating chlorine treatment

priate time to consider relaxing sewage discharges into the New York City water supply system." Another purification method, like ozone treatment, might help fish without hurting people. But simply cutting off chlorine would put the health of a metropolis at risk for the convenience of a small town and the comfort of fish.

Reclaiming the Square

The New York City Parks Department hoped that a recent facelift of Washington Square would begin to reclaim the Greenwich Village park from drug

remains in jeopardy because the city

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status by your working profile of Walter E. Fauntroy ("A Legislator With Statehood on His Mind," Washington Talk page, Nov. 30).

On the other hand, I wish to clarify one statement in the article. The proposed constitutional amendment passed by Congress in 1978 would *not* have brought statehood. Rather, it would have given the District of Columbia representation in Congress as if it were a state (two senators and one representative).

The bill introduced by Mr. Fauntroy in the last Congress is a constitution for the state of New Columbia and, if it is passed by a majority vote of Congress, might provide statehood for the District of Columbia. Some constitutional scholars, however, believe that a constitutional amendment would still be required because of the unique history of the District of Columbia.

The League of Women Voters of the District of Columbia and our parent organization, the League of Women Voters of the United States, have been battling for "self-determination" for District of Columbia residents since 1920. What we lack now is voting representation in the Congress of the United States. Indeed, we strongly believe that taxation without representation is tyranny!

ANN STULTS
President, League of Women
Voters of the District of Columbia
Washington, Dec. 5, 1986

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What Happened to Follow-Up on F

To the Editor:

"Follow Up on Fetal Health" (editorial, Nov. 7), regarding the Department of Agriculture's handling of the evaluation of the special supplemental food program for women, infants and children, known as the WIC program, was misleading and on one point was erroneous. Congress did not ask Dr. David Rush to lead the national WIC evaluation. The Department of Agriculture selected him from among many outstanding candidates because of his sound scientific credentials. It was our belief then, as it is today, that a rigorous and unbiased evaluation is important in assessing program effectiveness and insuring that the taxpayer's dollar is well spent.

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