

Withdrawal/Redaction Marker

Clinton Library

DOCUMENT NO. AND TYPE	SUBJECT/TITLE	DATE	RESTRICTION
001. resume	[Personally Identifiable Information] [partial] (6 pages)	00/00/1997	b(6)

COLLECTION:

Clinton Presidential Records
Staff Secretary
Todd Stern
OA/Box Number: 11210

FOLDER TITLE:

Climate Change Event-Thursday, July 24, 1997

2019-0774-S
rs3397

RESTRICTION CODES

Presidential Records Act - [44 U.S.C. 2204(a)]

- P1 National Security Classified Information [(a)(1) of the PRA]
- P2 Relating to the appointment to Federal office [(a)(2) of the PRA]
- P3 Release would violate a Federal statute [(a)(3) of the PRA]
- P4 Release would disclose trade secrets or confidential commercial or financial information [(a)(4) of the PRA]
- P5 Release would disclose confidential advice between the President and his advisors, or between such advisors [(a)(5) of the PRA]
- P6 Release would constitute a clearly unwarranted invasion of personal privacy [(a)(6) of the PRA]

C. Closed in accordance with restrictions contained in donor's deed of gift.

PRM. Personal record misfile defined in accordance with 44 U.S.C. 2201(3).

RR. Document will be reviewed upon request.

Freedom of Information Act - [5 U.S.C. 552(b)]

- b(1) National security classified information [(b)(1) of the FOIA]
- b(2) Release would disclose internal personnel rules and practices of an agency [(b)(2) of the FOIA]
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- b(7) Release would disclose information compiled for law enforcement purposes [(b)(7) of the FOIA]
- b(8) Release would disclose information concerning the regulation of financial institutions [(b)(8) of the FOIA]
- b(9) Release would disclose geological or geophysical information concerning wells [(b)(9) of the FOIA]

Draft One Pager

Today's Event: The President and Vice President are meeting with a small group of eminent scientists, including three Nobel Prize winners, to discuss the science of climate change and the widespread conviction among scientists that action to mitigate climate change is warranted.

The U.S., as a party to the Framework Convention on Climate Change, is engaged in long-term negotiations on mitigation of climate change. We hope to conclude the next phase of negotiations in December 1997 by agreeing to a legally binding target and timetable for reduction of greenhouse gas emissions.

Solid, internationally-agreed science is a critical aspect of climate change negotiations and decision making. It is among the most effective means of narrowing the disagreements among nations about the climate change issue. As the President stated in his recent address to the United Nations: "The science is clear and compelling: We humans are changing the global climate...No nation can escape this danger. None can evade its responsibility to confront it."

The U.S. has led the world in the support of environmental science, including climate change research, and in the application of the results of that research to environmental management and protection. This meeting is a result of the President's strong commitment to take action on climate change and to lay the scientific facts before the American people.

Why Climate Change is a Problem: Human activities are adding to the Earth's natural greenhouse effect by steadily increasing the atmospheric concentrations of greenhouse gases. Carbon dioxide (CO₂) is the largest part of this problem, accounting for about 85% of U.S. greenhouse gas emissions. Since about 1860, the atmospheric concentration of CO₂ has increased by about 30%. Other greenhouse gases, such as methane and nitrous oxide, amplify this problem. **Without intervention, emissions and concentrations of CO₂ will continue to increase, reaching the highest level in the last 50 million years by 2100 (over 700 parts per million by volume).**

A variety of global-scale changes are expected, with significant regional variations. Average temperature will rise another 2-6° F and sea level will rise another 6 to 28 inches. The Earth's water cycle will intensify, with increases in rainfall and snowfall. More precipitation will occur in "extreme" downpours, where large amounts of rain fall in a short period. Some areas will be threatened by increased flooding, while others will suffer through an increased incidence of drought as the interior of continents warms and dries.

The U.S. is vulnerable to such changes, with likely effects including stress on western water resources, soil moisture limitations in the Midwest, loss of coastal wetlands in the Southeast, and significant changes in forest ecosystems in many regions.

An extensive body of research suggests that these changes will have pervasive effects, some of them irreversible, on human health and ecological and socio-economic systems. Significant new stresses will be added to systems that are already affected by pollution, increasing resource extraction, and non-sustainable management practices. Continuing to increase greenhouse gas emissions increases the challenge of stabilizing concentrations and preserving environmental quality for future generations.

Sherry Rowland (NOBEL)

(Professor at UC Irvine, Foreign Secretary for the NAS, Past President of AAAS)

In 1995, Sherry Rowland, along with two of his colleagues, won the Nobel Prize in Chemistry for their pioneering research in atmospheric chemistry of the destruction of the ozone layer. Since receiving his Ph.D. from the University of Chicago in 1952, he has climbed the academic ranks in Chemistry, and is currently the Donald Bren Research Professor of Chemistry and Earth System Science at the University of California at Irvine. He also currently serves as the Foreign Secretary of the National Academy of Sciences, and is a former President and Chairman of the Board of the American Association for the Advancement of Science.

Mario Molina (NOBEL)

(Professor at MIT, PCAST – President's Committee of Advisors on Science and Technology)

Dr. Mario Molina was awarded the Nobel Prize along with Sherry Rowland, for their research on the thinning of the ozone layer. Molina and colleagues demonstrated experimentally how ozone-destroying chlorine functioned in the atmosphere. He is currently the Lee and Geraldine Martin Professor of Environmental Science at MIT, and was formerly at the University of California at Berkeley. He has received many awards including being elected to the National Academy of Sciences, and awarded the Pew Scholar on Conservation and the Environment. He has also served as an advisor to NASA, NSF, and NIH.

Jane Lubchenco

(Oregon State University, Past President of AAAS and Ecological Society of America)

Jane Lubchenco is truly a remarkable scientist. She is currently the Wayne and Gladys Valley Professor of Marine Biology and a Distinguished Professor of Zoology at Oregon State University, and has been awarded a litany of prestigious honors. She has been selected as a Pew Scholar in Conservation and the Environment, a MacArthur Fellow, a member of the National Academy of Sciences, and a member of the National Science Board. She is also an American Academy of Arts and Sciences Fellow, a Fellow to the American Association for the Advancement of Science, and has received numerous teaching awards. She has accomplished all of this, as well as devoting much of her attention to her two sons, since receiving her Ph.D. from Harvard University in 1975.

Stephen Schneider

(Professor at Stanford University, MacArthur Fellowship, AAAS Westinghouse Award for Public Understanding of Science and Technology)

After receiving his Ph.D. in Mechanical Engineering and Plasma Physics from Columbia University in 1971, Stephen Schneider focused on the influence of greenhouse gases and suspended particles on the earth's climate as a postdoctoral researcher at NASA's Goddard Institute for Space Studies, and later the National Center for Atmospheric Research, where he remained until 1996. In 1992, Dr. Schneider was awarded a MacArthur Fellowship for his admirable ability to integrate and interpret the results of global climate research through public lectures, seminars, media appearances, and research. He was also honored with the American Association for the Advancement of Science, Westinghouse Award for Public Understanding of Science and Technology for his ability to express environmental science and its implication for public policy to the general public. Currently he is a Professor in the Department of Biological Sciences, a Senior Fellow at the Institute for International Studies at Stanford University.

Bob Shope

(Professor at University of Texas, Director of the Yale Arbovirus Research Unit for 24 years)

Robert Shope has devoted his career to the study of viruses carried by mosquitoes, ticks, and other biting insects. These viruses can cause life-threatening diseases in humans such as malaria, dengue and yellow fever, and encephalitis. Dr. Shope received his medical degree in 1954 from Cornell University. Since then, he spent many years in Malaysia, Brazil, and other tropical sites studying these insect-borne diseases. He has been a Professor of Epidemiology at Yale University's School of Medicine from 1975 – 1995, and served as the Director of the Yale Arbovirus Research Unit for much of that time. During that time he was awarded many honors, including the Walter Reed Award from the American Society of Tropical Medicine and Hygiene. He is presently a Professor in the Departments of Pathology and Microbiology and Immunology at the University of Texas Medical Branch.

Henry Kendall (NOBEL)

(Professor at MIT, Chairman of the Board of the Union for Concerned Scientists)

In 1990, Dr. Kendall won the Nobel Prize in Physics, along with two colleagues for his insightful work in particle physics. Henry Kendall is currently the J.A. Stratton Professor of Physics at the Massachusetts Institute of Technology. He has also served as the Chairman of the Board of the Union of Concerned Scientists, an organization of which he was a founding member. Throughout his impressive career, Dr. Kendall has focused on US energy and defense issues such as the nuclear arms race, nuclear power, and renewable energy. He has many other awards and honors including being elected to the National Academy of Sciences.

John Holdren

(Professor at Harvard University, PCAST)

John Holdren is a world-renowned expert on energy and environmental science. In 1995, he delivered the Nobel Peace Prize acceptance lecture on behalf of the Pugwash Conferences, on the occasion of that organization's sharing of the 1995 prize. He is currently the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy in the John F. Kennedy School of Government, and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences at Harvard University. From 1973 until 1996, he was a Professor of Energy and Resources at the University of California at Berkeley. Dr. Holdren is also a Distinguished Visiting Scientist at the Woods Hole Research Center. He has been elected to be a Fellow of the National Academy of Sciences, the American Physical Society, the American Association for the Advancement of Sciences, the California Academy of Sciences, and the American Academy of Sciences. He was also awarded the MacArthur Foundation Prize. He is currently chairing the Presidential Committee of Advisors on Science and Technology Study of the entire U.S. energy R&D portfolio in relation to the economic, environmental, and security challenges of the next century. Dr. Holdren received his Ph.D. from Stanford University in aeronautics, astronautics and theoretical plasma physics in 1970.

Biographies
June 18, 1997 - Washington, DC
Press Conference

John P. Holdren

Dr. Holdren is the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy in the John F. Kennedy School of Government, and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences, at Harvard University. Previously he was Professor of Energy and Resources in U.C. Berkeley's campus-wide interdisciplinary graduate program in energy and resources, which he co-founded in 1973 and co-led until 1996. Dr. Holdren is also Distinguished Visiting Scientist at the Woods Hole Research Center, Chair of the Committee on International Security and Arms Control of the National Academy of Sciences, Chair of the Executive Committee of the Pugwash Conferences on Science and World Affairs, and a member of President Clinton's Committee of Advisors on Science and Technology (PCAST). He is currently chairing a PCAST study of the entire U.S. energy R&D portfolio in relation to the economic, environmental, and security challenges of the next century. Holdren earned bachelors and masters degrees from M.I.T. and the Ph.D. from Stanford University in aeronautics, astronautics and theoretical plasma physics (1970). He is the author of about 300 articles and reports, and he has co-authored and co-edited thirteen books on these topics. Holdren is a member of the National Academy of Sciences, the AAAS, and the California Academy of Sciences, among others. In 1981 he received one of the first MacArthur Foundation Prize Fellowships; in 1993 he shared the Volvo Environment Prize; and in 1994 he received the Forum Award of the American Physical Society ("for promoting public understanding of the relation of physics to society"). In December 1995 he delivered the Nobel Peace Prize acceptance lecture on behalf of the Pugwash Conferences, on the occasion of that organization's sharing the 1995 prize with Professor Joseph Rotblat. (617) 495-1464

HENRY W. KENDALL

Dr. Henry W. Kendall is currently J. A. Stratton Professor of Physics at the Massachusetts Institute of Technology. He has served as the Chairman of the Board of the Union of Concerned Scientists since 1974 and was a founding member of the organization. A particle physicist, he was, along with two colleagues, awarded the Nobel prize in physics in 1990.

Dr. Kendall has been active in writing, analysis and public activities on US energy and defense issues and in the global issues of environmental pressures, resource management and population growth. He is co-author of numerous studies and books related to the nuclear arms race, nuclear power and renewable energy. His works include "Population, Environment and Resource Problems -- A Warning from World Scientists," prepared for the United Nations International Conference on Population and Development in September 1994, *The Fallacy of Star Wars* (1984), "No First Use" (*Scientific American*, March 1984), "Anti-satellite Weapons" (*Scientific American*, June 1984), "Space-based Missile Defense" (*Scientific American*, October 1984), "Accidental Missile Launch" (*Scientific American*, December 1990), *Beyond the Freeze: The Road to Nuclear Sanity* (Beacon Press, 1982), *Energy Strategies: Toward a Solar Future* (Ballinger Publishing Company, 1980) and numerous reports from the Union of Concerned Scientists on safety and regulatory problems with nuclear power. He also co-authored "Constraints on the Expansion of the Global Food Supply" (AMBIO, 1994).

Dr. Kendall served for a decade as a consultant to the Defense Department on classified matters through membership in the Jason Group of the Institute for Defense Analyses. He was a panel Chair on the Secretary of Energy's Task Force on Alternative Futures for the National Laboratories (May 1995 - February 1996), organized expert panels for the World Bank, is Chair of the Panel on Transgenic Crops for the Bank and a member of the National Academy of Sciences' Panel on Inertial Confinement Fusion, concerned with matters relating to the US nuclear Stockpile Stewardship Program. He has testified numerous times before Congress on the threat of nuclear war, energy policy, nuclear power issues, controlling oil well fires, anti-personnel mine clearing and other matters. He has lectured widely and appeared on many national television programs.

He received his undergraduate degree from Amherst College (1950) and his PhD from the Massachusetts Institute of Technology (1955). He taught at Stanford University from 1956 to 1961 before returning to M.I.T., where he has remained since.

He has remained an active teacher and continues in physics research employing the Stanford Linear Accelerator at Stanford University.

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JANE LUBCHENCO
Abbreviated Curriculum Vitae

CURRENT POSITION: Wayne and Gladys Valley Professor of Marine Biology and Distinguished Professor, Department of Zoology, Oregon State University, 3029 Cordley Hall, Corvallis, OR 97331-2914; phone 541-737-5337; fax 541-737-3360; email: lubchenj@bcc.orst.edu

PERSONAL INFORMATION: (b)(6) USA; U.S. Citizen; married to Bruce A. Menge, sons Alexei ('78) and Duncan ('81).

EDUCATION: B.A. 1969, Colorado College (Biology); M.S. 1971, University of Washington (Zoology); Ph.D. 1975, Harvard University (Ecology).

POSITIONS:

Assistant Professor, Harvard University, 1975-77
Assistant Professor 1977-1982, Associate Professor 1982-88, OSU
Research Associate, Smithsonian Institution, 1978-present
Professor 1988-; Chair, Department of Zoology 1989-92, OSU
OSU Distinguished Professor, 1993-. Valley Professor of Marine Biology 1995-.
Visiting Professor: University of the West Indies, Kingston, Jamaica, 1976; Universidad Catolica, Santiago, Chile, 1986; Institute of Oceanography, Academica Sinica, Qingdao, P.R. China, 1987; University of Canterbury, Christchurch, New Zealand, 1995-96.
N.B.: From 1977-1989, Dr. Lubchenco worked part-time, by choice, so she could spend more time with her two young sons. She held a 0.5 FTE appointment for ten years, then a 0.75 appointment for two years; in 1989, she returned to full time.

INTERESTS/EXPERTISE:

Science and the environment; public understanding of science; marine conservation biology; ecosystem services; ecological causes and consequences of global change; biodiversity; sustainable ecological systems; rocky intertidal shores; evolutionary community ecology; marine biology; plant-herbivore interactions; chemical ecology; biogeography; molluscs; echinoderms; seaweeds.

HONORS AND AWARDS:

Science Citation Classic Paper, ISI Current Contents (1978 *American Naturalist* 112:23-39), 1978; George Mercer Award, Ecological Society of America, 1979 (co-recipient Bruce A. Menge); Outstanding Teacher Award, OSU Alpha Lambda Delta (freshman honor society), 1986; National Lecturer, Phycological Society of America, 1987-89; American Association for the Advancement of Science Fellow, 1990; Honorary D.S. degree, Drexel University, 1992; Pew Scholar in Conservation and the Environment, Pew Charitable Trusts, 1992-1995; Honorary D.S. degree, Colorado College, 1993; Distinguished Professor, Oregon State University, 1993; American Academy of Arts and Sciences Fellow, 1993; MacArthur Fellow, John D. and Catherine T. MacArthur Foundation, 1993; Oregon Scientist of the Year, Oregon Academy of Science, 1994; Golden Eagle Award, Council for International Nontheatrical Events (CINE), Washington, D.C. (for National Geographic film *Diversity of Life*), 1994, co-recipients James and Elaine Larison; Science Citation Classic Paper, ISI Current Contents (1991 *Ecology* 72: 371-412), 1994; National Academy of Sciences, member, 1996; National Science Board, member 1996 - 2000, nominated by President Clinton and confirmed by the U.S. Senate; AWIS Fellow, Association for Women in Science, 1997; Honorary D.S. degree, Bates College, 1997.

OFFICES HELD:

American Association for the Advancement of Science, President, Chair of Board of Directors (1996-1998); **Ecological Society of America**, President (1993); International Council of Scientific Union's Scientific Committee on Problems of the Environment = **SCOPE**, Executive Committee, 1992-1995; **American Institute of Biological Sciences**, Board of Directors, 1991.

EDITORIAL BOARDS:

American Naturalist, 1978-1981; *Oecologia*, 1985-1988; *Journal of Phycology*, 1987-1990; *Ecological Applications*, 1989-1993; *The Northwest Environmental Journal*, 1991-1993; *Trends in Ecology & Evolution*, 1991-present; *Ecological Issues*, 1995-present; *Ecosystems*, 1997-1999; Associate Editor, Academic Press *Encyclopedia of Biodiversity*, 1997-present; Advisory Editor, *Ecological Studies*, Springer-Verlag, 1993-present; *Conservation Ecology*, 1995-present.

BOARDS OF DIRECTORS OR TRUSTEES (current):

The Nature Conservancy, Science Advisory Board, 1993-present; **World Resources Institute**, Board of Directors, 1993-present; **Environmental Defense Fund**, Board of Trustees and Science Advisory Committee, 1995-present; **Monterey Bay Aquarium**, Board of Trustees and Program Committee, 1995-present.

OTHER CURRENT SERVICE:

Activities intended to communicate scientific knowledge to policy makers and the public, and to promote research on critical environmental topics include:

National Academy of Sciences/National Research Council (NRC) **Committee on Ecosystem Management and Sustainable Fisheries**, 1995-1997; NRC, **Committee on Biodiversity Forum**, 1995-97; NAS Committee on Creationism, 1996;

United Nations Environment Programme (UNEP), Scientific and Technical Advisory Panel (STAP), Roster of Experts, 1993-present;

Pew Fellows Program in Conservation and the Environment, Advisory Committee, 1995-1998;

Corvallis City Council, Advisory Commission on Open Space, 1995-present;

Living On Earth PBS radio show, Scientific Advisory Board, 1997-present;

Sustainable Biosphere Project, SCOPE, Planning Committee, 1992, Scientific Advisory Committee, Co-Chair, 1992-present;

Religion, Science and the Environment: The Black Sea as a Paradigm, Executive Chair of Scientific and Religious Steering Committee, 1996-1998;

UNESCO (United Nations Educational, Scientific, and Cultural Organization), Scientific Advisory Board, 1996-present;

IMAX film on biodiversity, advisory committee, 1996 - 98;

Sea Web, Spokesteam member (sponsored by the Pew Charitable Trusts to promote knowledge about marine issues), 1996 - 97.

SELECTED PUBLICATIONS - CITATION CLASSICS AND AWARD WINNERS

- 1978 Lubchenco, J. Plant species diversity in a marine intertidal community: importance of herbivore food preference and algal competitive abilities. *American Naturalist* 112:23-39. **ISI Citation Classic.**
- 1978 Lubchenco, J. and B.A. Menge. Community development and persistence in a low rocky intertidal zone. *Ecological Monographs* 48:67-94. **Mercer Award Winner, 1979.**
- 1991 Lubchenco, J., A.M. Olson, L.B. Brubaker, S.R. Carpenter, M.M. Holland, S.P. Hubbell, S.A. Levin, J.A. MacMahon, P.A. Matson, J.M. Melillo, H.A. Mooney, C.H. Peterson, H.R. Pulliam, L.A. Real, P.J. Regal, P.G. Risser. 1991. The Sustainable Biosphere Initiative: An Ecological Research Agenda. *Ecology* 72(2):371-412. **ISI Citation Classic.**

SELECTED RECENT PUBLICATIONS:

- 1995 Lubchenco, J., G.W. Allison, S.A. Navarrete, B.A. Menge, J.C. Castilla, O. Defeo, C. Folke, O. Kussakin, T. Norton, and A.M. Wood. Biodiversity and ecosystem functioning: Coastal systems. Pages 370-381 *In: Global Biodiversity Assessment*, Cambridge University Press, Cambridge, UK.
- 1995 Chapin, F.S., J. Lubchenco and H. Reynolds. Biodiversity effects on patterns and processes of communities and ecosystems. Pages 289-301 *In: Global Biodiversity Assessment, ibid.*
- 1995 Six additional multi-authored introductory and concluding chapters for Sections 5 and 6 on Biodiversity and Ecosystem Functioning, in the *Global Biodiversity Assessment, ibid.*
- 1995 Eisner, T., J. Lubchenco, E.O. Wilson, D.S. Wilcove and M.J. Bean. Building a scientifically sound policy for protecting endangered species. *Science* 269:1231-1232.
- 1996 Allison, G.W., B.A. Menge, J. Lubchenco and S.A. Navarrete. Predictability and uncertainty in community regulation: Consequences of reduced consumer diversity in coastal rocky ecosystems. Pages 371-392 *In: Mooney et al. (eds.), Functional Roles of Biodiversity: A Global Perspective*, John Wiley & Sons, Chichester, U.K.
- 1996 Lubchenco, J. The Endangered Species Act: Society presidents comment on scientific aspects of reauthorization bills. *Bulletin of the Ecological Society of America*, 77(2): 116-120 (includes multi-authored letters to members of Congress).
- 1996 Power, M.E., D. Tilman, J.A. Estes, B.A. Menge, W.J. Bond, L.S. Mills, G. Daily, J.C. Castilla, J. Lubchenco, and R.T. Paine. Challenges in the quest for keystones. *BioScience* 46: 609-620.
- 1997 Allison, G.W., J. Lubchenco, and M. Carr. Marine reserves are necessary but not sufficient for marine conservation. *Ecol. Applications* *In press.*
- 1997 Daily, G.C., S. Alexander, P.R. Ehrlich, L. Goulder, J. Lubchenco, P.A. Matson, H.A. Mooney, S. Postel, S.H. Schneider, D. Tilman, and G.M. Woodwell. Ecosystem Services: Benefits supplied to human societies by natural ecosystems. *Issues in Ecology* 2: 1-16.
- 1997 Peterson, C.H. and J. Lubchenco. Marine ecosystem services. Pp 177-194 *in* G. Daily (ed.), *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press, Washington, D.C.
- 1997 Vitousek, P.M., H.A. Mooney, J. Lubchenco, and J.M. Melillo. Human domination of earth's ecosystems. *Science: in press.*

1996

biography

F. Sherwood Rowland**Nobel Laureate in Chemistry, 1995**

F. Sherwood Rowland was born in Delaware, Ohio, in 1927, and received his B.A. degree from Ohio Wesleyan University. His "accelerated academy schedule" made him eligible for the final year of university in 1945, aged 18, but he then enlisted in the Navy, joining a programme to train radio operators and as a "Specialist in Athletics".

In 1948 he was admitted to the University of Chicago from which he received his M.S. and Ph.D. degrees. He taught at Princeton University and the University of Kansas before joining in 1964 the Department of Chemistry at the University of California, Irvine, where he is presently Donald Bren Research Professor of Chemistry and Earth System Science.

In 1973 his interest shifted from radiochemistry to atmospheric chemistry and focused on the chlorofluorocarbon-ozone problem which was soon to become a highly visible public concern. The paper he published with his co-worker Mario Molina in 1974 and their pioneering work subsequently led to the scientific understanding of the depletion of the ozone layer which has helped to shape far-reaching decisions on the prohibition of the release of gases that destroy ozone. It also led to the Nobel Prize in Chemistry of which he was co-recipient in 1995 together with P. Crutzen and M. Molina.

Sherwood Rowland is the author of over 330 scientific publications in the areas of atmospheric chemistry, radiochemistry, and chemical kinetics. He is an elected member of the US National Academy of Sciences, for which he is currently the Foreign Secretary, and has served as President and Chairman of the board of the American Association for the Advancement of Science.

His numerous international honours and awards include seven honorary doctorates of science and of laws, the Japan Prize in Environment Science and Technology, the Peter Debye Award in Physical Chemistry of the American Chemical Society, and the Roger Revelle Medal of the American Geophysical Union. In 1991, he was listed as one of the "1000 Makers of the Twentieth Century" by the London *Sunday Times*.

See also: <http://www.chem.uci.edu/research/faculty/rowland.html>

CURRICULUM VITAE

Frank Sherwood Rowland

Donald Bren Research Professor of Chemistry
University of California Irvine

Foreign Secretary
National Academy of Sciences

ADDRESS: Department of Chemistry
Irvine, California 92697-2025
Telephone: (714) 824-6016
FAX: (714) 824-2905

PERSONAL: Born Delaware, Ohio, June 28, 1927

DEGREES: B.A., Ohio Wesleyan University, 1948
M.S., University of Chicago, 1951
Ph.D., University of Chicago, 1952

EMPLOYMENT:

1994-present Foreign Secretary, United States National Academy of Sciences
1994-present Donald Bren Research Professor of Chemistry and Earth System Science,
University of California, Irvine
1964-1994 Professor of Chemistry, University of California, Irvine
1964-1970 Professor and Chairman of Chemistry, University of California, Irvine
1956-1964 Assistant Professor to Professor of Chemistry, University of Kansas
1952-1956 Instructor in Chemistry, Princeton University

POSITIONS: From July 1, 1994: Foreign Secretary of the National Academy of Sciences
1991-1993, (Successively) President-Elect, President, and Chairman of the Board of
the American Association for the Advancement of Science

HONORS AND AWARDS:

1995, Nobel Prize in Chemistry (with P. Crutzen and M. Molina)
"for their work in atmospheric chemistry, particularly concerning
the formation and decomposition of ozone."
1997, Alumni Medal, University of Chicago
1994, Roger Revelle Medal, American Geophysical Union
1993, Peter Debye Award in Physical Chemistry, American Chemical Society
1989, Japan Prize in Environmental Science and Technology
1988, Global 500 Role of Honour for Environmental Achievement, United Nations
Environment Programme
1987, Charles A. Dana Award for Pioneering Achievement in Health
1983, Tyler World Prize for Environmental Achievement
1979, Szilard Award, American Physical Society
1995, Member, American Philosophical Society
1994, Member, Institute of Medicine
1978, Member, National Academy of Sciences
1977, Member, American Academy of Arts and Sciences

**HONORARY
DEGREES:**

D.Sc., University of Chicago, 1989
D.Sc., Duke University, 1989
L.L.D., Ohio Wesleyan University, 1989
D.Sc., Whittier College, 1989
D.Sc., Princeton University, 1990
L.L.D., Simon Fraser University (Canada), 1991
D.Sc., Haverford College, 1992
D.Sc., University of East Anglia (U.K.), 1996
D.Sc., Clark University, 1996
L.L.D., Calgary University (Canada) 1997

PUBLICATIONS:

Approximately 350 research articles including:

"Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone", *Nature* 1974, 249, 810-812

Mario J. Molina and F. S. Rowland

"Chlorofluoromethanes in the Environment", *Review of Geophysics and Space Physics* 1975, 13, 1-35
F. S. Rowland and Mario J. Molina

STEPHEN H. SCHNEIDER

Stephen H. Schneider is a professor in the Department of Biological Sciences, a Senior Fellow at the Institute for International Studies, and Professor by Courtesy in the Department of Civil Engineering at Stanford University. He was honored in 1992 with a MacArthur Fellowship for his ability to integrate and interpret the results of global climate research through public lectures, seminars, classroom teaching, environmental assessment committees, media appearances, Congressional testimony, and research collaboration with colleagues. He has served as a consultant to Federal Agencies and/or White House staff in the Nixon, Carter, Reagan, Bush, and Clinton administrations. He also received, in 1991, the American Association for the Advancement of Science/Westinghouse Award for Public Understanding of Science and Technology, for furthering public understanding of environmental science and its implications for public policy.

Dr. Schneider received his Ph.D. in Mechanical Engineering and Plasma Physics from Columbia University in 1971. He studied the role of greenhouse gases and suspended particulate material on climate as a postdoctoral fellow at NASA's Goddard Institute for Space Studies. He was awarded a postdoctoral fellowship at the National Center for Atmospheric Research and was a member of the scientific staff of NCAR from 1973 - 1996, where he co-founded the Climate Project. In 1975, he founded the interdisciplinary journal, *Climatic Change*, and continues to serve as its Editor. He is also the Editor-in-Chief of the *Encyclopedia of Climate and Weather* and author of *The Genesis Strategy: Climate and Global Survival*; *The Coevolution of Climate and Life*; *Global Warming: Are We Entering the Greenhouse Century?* and *Laboratory Earth: The Planetary Gamble We Can't Afford to Lose*, among others. He has authored or co-authored over 200 scientific papers, proceedings, legislative testimonies, edited books and book chapters; some 120 book reviews, editorials, published newspaper and magazine interviews and popularizations. He is a frequent contributor to commercial and non-commercial print and broadcast media on climate and environmental issues, e.g., NOVA, Planet Earth, Nightline, Today Show, Tonight Show, Dateline, Discovery Channel, British, Canadian and Australian Broadcasting Corporations, among many others. At Stanford University he teaches classes in a dozen different departments and courses in Earth Systems, Civil Engineering, Biological Sciences and a Senior Honors Seminar in Environmental Science, Technology and Policy.

Dr. Schneider's current global change research interests include: climatic change; global warming; food/climate and other environmental/science public policy issues, ecological and economic implications of climatic change; integrated assessment of global change; climatic modeling of paleoclimates and of human impacts on climate, e.g., carbon dioxide "greenhouse effect" or environmental consequences of nuclear war. He is also interested in advancing public understanding of science and in improving formal environmental education in primary and secondary schools.

Robert E. Shope, M.D.

Dr. Shope has devoted his career to study of viruses carried by mosquitoes, ticks and other biting arthropods. These viruses cause diseases that are ecologically sensitive, especially to temperature and rainfall as well as human disturbances of the environment.

He received his medical degree from Cornell University (1954), completed two years of medical residency at the Yale-New Haven Hospital, and served in the U.S. Army for two years. He served at Camp Detrick, Frederick, Maryland, then for about 18 months at the Institute for Medical Research, Kuala Lumpur, Malaya. There, working with British and U.S. scientists, he treated patients with tropical diseases such as scrub typhus, dengue, Japanese encephalitis, and leptospirosis.

In 1958, he became a staff member of The Rockefeller Foundation in the arbovirus research program. He worked for 6 years in Belem, Brazil studying arthropod-borne virus epidemiology during the period of discovery of over 50 new viruses of the Amazon forests. In 1965, he moved with the Rockefeller Foundation Laboratory to Yale University to continue research and teaching in arbovirus taxonomy and epidemiology. In 1971 he became Director of the Yale Arbovirus Research Unit (WHO Collaborating Centre for Arboviruses). He held these positions until retirement from Yale in 1995. During the stay at Yale, he did research on Rift Valley fever, Lassa fever and other arenaviruses, dengue, yellow fever, and rabies-related viruses. In 1992, he co-chaired with Joshua Lederberg the Institute of Medicine's study on Emerging Infections, which has stimulated the development of emerging infections programs of the U.S. NIH, CDC, and the World Health Organization.

Since 1995, he has been Professor of Pathology at the WHO Center for Tropical Diseases, University of Texas Medical Branch, Galveston, Texas. With Dr. Robert Tesh, he continues to direct the World Arbovirus Reference Center which holds the world's most extensive arbovirus collection (more than 500 types) moved to Texas from Yale University. His interest in climate and the environment stems from a life-long experience with the diseases carried by biting insects and the prediction that many of these illnesses will be enhanced in distribution and severity by climate change.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed on Form Page 2.
Photocopy this page or follow this format for each person.

NAME		POSITION TITLE	
Robert E. Shope		Epidemiologist/Virologist	
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training)			
INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY
Cornell University, Ithaca, New York	B.A.	1951	Zoology
Cornell University Medical College, New York	M.D.	1954	Medicine

RESEARCH AND PROFESSIONAL EXPERIENCE. Concluding with present position, list, in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List, in chronological order, the titles, all authors, and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. If the list of publications in the last three years exceeds two pages, select the most pertinent publications. DO NOT EXCEED TWO PAGES.

RESEARCH AND PROFESSIONAL EXPERIENCE:

1995 - present Professor, Department of Pathology and Dept. of Microbiology and Immunology, University of Texas Medical Branch, Galveston, TX.

1975 - 1995 Professor of Epidemiology, Yale University School of Medicine.

1971 - 1995 Director, Yale Arbovirus Research Unit, Yale Univ. School of Medicine.

1967 - 1975 Associate Professor of Epidemiology, Yale Univ. School of Medicine.

1965 - 1967 Assistant Professor of Epidemiology, Dept. of Epidemiology & Public Health, Yale Univ. School of Medicine.

1963 - 1965 Director, Belem Virus Laboratory, Belem, Brazil.

1959 - 1965 Belem Virus Laboratory, Evandro Chagas Institute, Belem, Brazil.

1958 - 1974 The Rockefeller Foundation, Staff Member.

1957 - 1958 Assistant Resident, Internal Medicine, Yale Univ. (Grace-New Haven Hospital).

1955 - 1957 U.S. Army Medical Research Unit, Kuala Lumpur, Malaya.

1955 U.S. Army Medical Corps, Captain, Fort Detrick, Frederick, MD.

1954 - 1955 Intern, Internal Medicine, Yale University (Grace-New Haven Hospital).

HONORS

1974 Recipient Bailey K. Ashford Award, American Society of Tropical Medicine & Hygiene.

1980 President, American Society of Tropical Medicine & Hygiene.

1986 Fellow of the Queensland Institute of Medical Research.

1987 Recipient Richard M. Taylor Award, American Committee on Arboviruses.

1993 Walter Reed Award, American Society of Tropical Medicine and Hygiene.

SELECTED PUBLICATIONS: (>175 TOTAL)

Breiser-Wilke, I.M., Moenning, V., Kaaden, O-R and Shope, R.E. Detection of alphaviruses in a genus-specific antigen capture enzyme immunoassay using monoclonal antibodies. *J. Clin. Microbiol.* 29:131-137, 1991.

Mason, P.W., Pincus, S., Fournier, M.J., Mason, T.L., Shope, R.E. and Paoletti, E. Japanese encephalitis virus-vaccinia recombinants produce particulate forms of the structural membrane proteins and induce high levels of protection against lethal JE infection. *Virology*. 180:294-305, 1991.

Fonseca, B.A.L., Khoshnood, K., Shope, R.E. and Mason, P.W. Flavivirus type-specific antigens produced from fusions of a portion of the E protein gene with the *Escherichia coli* TRPE gene. *Am. J. Trop. Med. Hyg.* 44:500-508, 1991.

Salas, R., Manzione, N., Tesh, R.B., Rico-Hesse, R., Shope, R.E., Betancourt, A., Gody, O., Bruzual, R., Pancheco, M.E., Ramos, J., Taibo, M.E., Garcia Tamayo, J., Jaines, E., Vasquez, C., Araoz, F. and Querales, J. Venezuelan hemorrhagic fever. *Lancet* 338:1033-1036, 1991.

Howe, D.K., Vodkin, M.H., Noval, R.J., Shope, R.E. and McLaughlin, G.L.: Use of the polymerase chain reaction for the sensitive detection of St. Louis encephalitis viral RNA. *J. Virol. Methods* 36:101-110, 1991.

Pincus, S., Mason, P.W., Konishi, E., Fonseca, B.A.L., Shope, R.E., Rice, C.M. and Paoletti, E.: Recombinant vaccinia virus producing the prM and E proteins of yellow fever virus protects mice from lethal yellow fever encephalitis. *Virology* 187:290-297, 1992.

Konishi, E., Pincus, S., Paoletti, E., Laegreid, W.W., Shope, R.E. and Mason, P.W.: A highly attenuated host-range restricted vaccinia virus strain, NYVAC, encoding the prM, E, and NS1 genes of Japanese encephalitis virus prevents JEV viremia in swine. *Virology* 190:454-458, 1992.

Lederberg, J., Shope, R.E. and Oaks, Jr., S.C.: *Emerging Infections. Microbial Threats to Human Health in the United States*, National Academy Press, Washington, D.C., pp 294, 1992.

Pincus, S., Mason, P.W., Konishi, E., Fonseca, B.A.L., Shope, R.E., Rice, C.M. and Paoletti, E.: Recombinant vaccinia virus producing the prM and E proteins of yellow fever virus protects mice from lethal yellow fever encephalitis. *Virology* 187:290-297, 1992.

Konishi, E., Pincus, S., Fonseca, B.A.L., Shope, R.E., Paoletti, E. and Mason, P.W.: Comparison of protective immunity elicited by recombinant vaccinia viruses that synthesize E and NS1 of Japanese encephalitis virus. *Virology* 185:401-410, 1992.

Konishi, E., Pincus, S., Paoletti, E., Shope, R.E., Burrage, T. and Mason, P.W.: Mice immunized with a sub-viral particle containing the JEV M and E proteins are protected from lethal JEV infection. *Virology* 188:714-720, 1992.

Vodkin, M.H., McLaughlin, G.L., Day, J.F., Shope, R.E. and Novak, R.J.: A rapid diagnostic assay for eastern equine encephalomyelitis viral RNA. *Am. J. Trop. Med. Hyg.* 49:772-776, 1993.

Tesh, R.B., Jahrling, P.B., Salas, R.A. and Shope, R.E.: Description of Guanarito virus (Arenaviridae: *Arenavirus*), the etiologic agent of Venezuelan hemorrhagic fever. *Am. J. Trop. Med. Hyg.* 50:452-459, 1994.

Shope, R.E.: The discovery of arbovirus diseases. *Ann. N.Y. Acad. Sci.* 740:138-145, 1994.

Fonseca, B.A.L., Pincus, S., Shope, R.E., Paoletti, E. and Mason, P.W.: Recombinant vaccinia viruses co-expressing dengue-1 glycoproteins prM and E induce neutralizing antibodies in mice. *Vaccine* 12:279-285, 1994.

Sumiyoshi, H., Tignor, G.H. and Shope, R.E.: Characterization of a highly attenuated Japanese encephalitis virus generated from molecularly cloned cDNA. *J. Infect. Dis.* 171:1144-1151, 1995.

Konishi, E., Mason, P.W., Shope, R.E.: Enzyme-linked immunosorbent assay using recombinant antigens for serodiagnosis of Japanese encephalitis. *J. Med. Virol.* 48:76-79, 1996.

Perera, L.P., Peris, J.S.M., Weigama, D.J., Calisher, C.H., Shope, R.E.: Nairobi sheep disease virus isolated from *Haemaphysalis intermedia* ticks collected in Sri Lanka. *Ann. Trop. Med. Parasitol.* 90:91-93, 1996.

Wang, E., Weaver, S.C., Shope, R.E., Tesh, R.B., Watts, D.M. and Barrett, D.T.: Genetic variation in wild-type yellow fever virus. *Virology* 225:274-281, 1996.

Heiman, V.J., Tesh, R.B., Shope, R.E., Watts, D.M. and Barrett, A.D.T.: The small RNA of Oropouche virus: nucleotide sequence and comparison with other members of the genus *Bunyavirus*. *J. Gen. Virol.* (submitted)

RELEVANT RECENT PRIOR RESEARCH SUPPORT:

1. Support for World Reference Center for Arboviruses; R.B. Tesh, PI; NIH 2 R01 AI10984-26; R.E. Shope 10% time and effort.
2. World Reference Center for Arboviruses; R.E. Shope, PI, US Army DAMD17-87-G-7005 and DAMD17-94-J-4001; 40% time and effort to 06/30/95. Role in both projects: Identifying arboviruses and providing reagents to laboratories throughout the world.

Mario J. Molina is the Lee and Geraldine Martin Professor of Environmental Sciences at the Massachusetts Institute of Technology. He is a member of the National Academy of Sciences and the American Association for the Advancement of Science. He has served on federal advisory committees for the National Aeronautics and Space Administration, the National Science Foundation, and the National Institutes of Health.

Dr. Molina is a former Senior Research Scientist at the Jet Propulsion Lab. His area of expertise is chemistry of the stratosphere, and he is famous for his work on determining the sources of stratospheric ozone depletion.

Dr. Molina was an undergraduate at the Universidad Nacional Autonoma de Mexico, and he received his Ph.D. in physical chemistry from the University of California, Berkeley.

Dr. Molina won the Nobel Prize for Chemistry in 1995 with Dr. Sherwood Rowland for their work in explaining the thinning of the ozone.

MARIO J. MOLINA

B.S. Universidad Nacional Autonoma de Mexico
1965

Ph.D. University of California, Berkeley
1972

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mmolina@mit.edu



Professor Molina's research interests lie in a field which is common to atmospheric chemistry and to chemical kinetics and photochemistry. The main objective of the research is the understanding of the potential implications of changes in the chemical composition of the earth's atmosphere: human activities are increasing the atmospheric concentrations of chlorofluorocarbons, methane, carbon dioxide and other gases on a global scale.

The atmospheric chemistry research involves reactions of small molecules and free radicals whose study permits testing of chemical dynamic theories at a fundamental level. New methods are being developed as extensions of discharge-flow techniques and the laser photolysis-kinetic spectroscopy. The concentrations of the transient species are directly monitored, for example, by chemical ionization mass spectrometry, resonance fluorescence, or laser induced fluorescence, to measure accurately absolute rate constants and reaction channel branching ratios for elementary processes.

Similar methods are employed to study photochemical processes: direct observation of the primary photodecomposition products' "commonly reactive radicals" is often the best, if not the only, way to elucidate the details of the photolytic mechanism.

Another field of research which is being developed involves heterogeneous atmospheric processes. This research has shown that polar stratospheric clouds which consist of ice-like particles are chemically very active. Exploring these processes and developing suitable techniques for their study is part of a program to elucidate the role of aerosols and clouds in the changing chemistry of the global atmosphere.



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CURRICULUM VITAE

September 1993

MARIO J. MOLINA Martin Professor of Atmospheric Chemistry

Education:

Universidad Nacional Autónoma de México; Ingeniero Químico (Chemical Engineer Degree)	1965
University of Freiburg, West Germany; Postgraduate (Polymerization Kinetics)	1967
University of California, Berkeley; Ph.D. (Physical Chemistry)	1972

Professional Positions:

Assistant Professor, Universidad Nacional Autónoma de México	1967-68
Postdoctoral Associate, University of California, Berkeley	1972-73
Postdoctoral Associate, University of California, Irvine	1973-75
Assistant Professor, University of California, Irvine	1975-79
Associate Professor, University of California, Irvine	1979-82
Member of Technical Staff, Jet Propulsion Laboratory, Caltech	1982-84
Senior Research Scientist, Jet Propulsion Laboratory, Caltech	1984-89
Professor, MIT Department of Earth, Atmospheric and Planetary Sciences and Department of Chemistry	1989-present
Martin Professor of Atmospheric Chemistry, MIT	1992-present

Honors and Awards:

UCI Alumni Association Special Recognition for Contributions in Basic Research	1976
Newport Democratic Club Public Service Award for Service to the Environment	1977
Alfred P. Sloan Foundation Fellow	1976-78
Camille and Henry Dreyfus Teacher-Scholar	1978-82
Tyler Ecology and Energy Award	1983
Society of Hispanic Professional Engineers Award for Achievement in Science and Technology	1983
Council for Recognition of Hispanics, Science Honoree	1984
American Chemical Society Esselen Award	1987
American Association for the Advancement of Science Newcomb-Cleveland Prize	1987-88
NASA Medal for Exceptional Scientific Achievement	1989
United Nations Environment Programme Global 500 Award	1989
Orange County Section of the American Chemical Society Service Through Chemistry Award	1989
Pew Scholar on Conservation and the Environment	1990-1992
Member (elected), National Academy of Sciences	1993

Major Research Interests:

Atmospheric Chemistry
Gas Phase Kinetics and Photochemistry; Heterogeneous Chemistry

Membership in Professional Societies:

American Chemical Society
American Physical Society
American Geophysical Union
Sigma Xi Scientific Research Society
American Association for the Advancement of Science

Selected Advisory Activities:

NSF Oversight Committee, Fluorocarbon Technology Assessment, Systems Control, Inc.	1976
NIH Advisory Committee to the Director, Recombinant DNA Research	1977
UCI Affirmative Action Committee, UCI Academic Senate	1978-79
NRC-NAS Commission on Human Resources	1978-81
NASA Panel for Chemical Kinetic and Photochemical Data Evaluation	1978-present
UCI Committee on Undergraduate Scholarships, Honors and Financial Awards UCI Academic Senate	1980-81
NCAR Scientific Programs Evaluation Committee, Panel Review of Atmospheric Chemistry Division, Boulder, CO	1986
UCR Ad Hoc Committee for Review of the Statewide Air Pollution Research Center, Riverside, CA	1988
NASA Advisory Committee to Oversee the Scientific Assessment of Atmospheric Effects Associated with Stratospheric Emissions from High Speed Civil Transports	1988-present
Editorial Advisory Board of the International Journal of Chemical Kinetics	1988-91
DOE Review Panel for the Molecular Science Research Center at the Pacific Northwest Laboratories, Batelle, Richland, WA	1988
NOAA Review Panel for the Aeronomy Laboratory (Chair)	1989
NSF Advisory Committee for Atmospheric Sciences	1989-present
NRC-NAS Steering Committee on Aeronautical Technologies	1990-present
NRC-NAS Committee on Atmospheric Chemistry	1991-present

Selected Professional Activities:

Testified by invitation at hearings before the House of Representatives Subcommittee on Public Health and Environment of the Committee on Interstate and Foreign Commerce, 93rd Congress; the U.S. Senate Subcommittee on Toxic Substances and Environmental Oversight of the Committee on Environment and Public Works; and before numerous state legislatures on the issue of chloro- fluorocarbons and stratospheric ozone depletion.	1974 1981
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TRW/NASA Consultant, Halogen Occultation Experiment (HALOE) Langley Research Center	1979-81
Co-chairman, 14th Informal Conference on Photochemistry Newport Beach, CA	1980
NRC/NAS Panelist, Postdoctoral Fellowships Program	1982-87
Organizer and Presider, Symposium on Antarctic Ozone Depletion AAAS Annual Meeting, Boston, MA	1988
Organizer and Presider, Symposium on Physical Chemical Problems in the Earth's Atmosphere, 196th National Meeting of the American Chemical Society, Los Angeles, CA	1988
Panelist, Annual Meeting of the National Academy of Sciences President's Circle on Issues Confronting the Global Future, Irvine, CA	1989
Co-organizer and lecturer, Atmospheric Chemistry Workshop Nat. Aut. Univ., Mexico City	1991
Co-chairman, Gordon Conference on Atmospheric Chemistry, New Hampton, NH	1991
Co-chairman, Atmospheric Chemistry Colloquium for Emerging Senior Scientists, MIT, Cambridge, MA	1991
Sigma Xi National Lecturer	1992-94

Studies/workshops which produced published proceedings:

1977	NASA Workshop	<i>"Chlorofluoromethanes and the Stratosphere"</i>
1979	NASA Workshop	<i>"The Stratosphere: Present and Future"</i>
1982	Dahlem Konferenzen	<i>"Atmospheric Chemistry"</i>
1985	NASA/WMO Workshop	<i>"Atmospheric Ozone Assessment Report"</i>
1987	NSF Workshop	<i>"Chemistry and the Environment 1988"</i>
1987	EPA & IGPA	<i>"Science, Universities and the Environment"</i>
1988	UNEP Workshop	<i>"Scientific Review of the Depletion of the Ozone Layer"</i>
1988	AFEAS Workshop	<i>"Alternative Fluorocarbon Environmental Acceptability Study"</i>
1989	UNEP/WMO Workshop	<i>"Scientific Assessment of Stratospheric Ozone: 1989"</i>

AAAS	=	American Association for the Advancement of Science
DOE	=	Department of Energy
EPA	=	Environmental Protection Agency
NAS	=	National Academy of Sciences
NASA	=	National Aeronautics and Space Administration
NCAR	=	National Center for Atmospheric Research
NIH	=	National Institutes of Health
NOAA	=	National Oceanic and Atmospheric Administration
NRC	=	National Research Council
NSF	=	National Science Foundation
UCI	=	University of California at Irvine
UCR	=	University of California at Riverside
UNEP	=	United Nations Environment Programme
WMO	=	World Meteorological Organization

SELECTED INVITED LECTURES

(which produced meeting proceedings or published abstracts)

- 1976: Stratospheric chemistry of chlorine compounds. In *Proceedings of the Joint Symposium on Atmospheric Ozone* (IAOCC/ICACGP, Dresden, German Democratic Republic).
- Stratospheric chemistry chlorofluorocarbons. In *Abstracts of the Symposium on Fluorine Compounds in the Environment* (172nd National Meeting, Amer. Chem. Soc., San Francisco).
- 1977: Atmospheric Chemistry of Chlorofluorocarbons. In *Proceedings of the XV International Congress of Entomology: Symposium on "The Impact of the Chlorofluorocarbons/Ozone Question on Insecticidal Aerosols"*, p. 399 (Academic Press, New York).
- 1980: Laboratory measurements of absorption cross sections. In *Proceedings of NATO Advanced Study Institute on Atmospheric Ozone, October 1979*. A. Aiken, Ed. (Report No. FAA-EE-80-20), p. 589.
- 1981: Kinetics of hydroxyl radical reactions of interest in the stratosphere. In *Abstracts of the 28th IUPAC Congress*. (Int. Union of Pure and Applied Chem., Vancouver, British Columbia, Canada).
- 1983: Laboratory chemistry and stratospheric ozone. In *Proceedings of the Indo-US Workshop on Global Ozone Problem* (New Delhi, India).
- Rates of reaction of OH with HNO₃ and with HCl. In *Abstracts of the Amer. Chem. Soc. 185th National Meeting, Div. of Environmental Chemistry* (Seattle, WA).
- 1987: Heterochemical studies on ice chemistry. In *Report of the Fluorocarbon Program Panel Meeting, Chemical Manufacturer's Association* (Edinburgh, Scotland).
- Ice chemistry and antarctic ozone. In *Abstracts of the Symposium on Heterogeneous Reactions in the Atmosphere, Pacific Conference on Chemistry and Spectroscopy*. (Irvine, CA).
- 1988: Heterogeneous chemical processes in ozone depletion. In *Proceedings of the Symposium on Ozone Depletion, Greenhouse Gases and Climate Change, Board on Atmospheric Sciences and Climate*. (National Academy of Sciences, Washington, DC).
- Chlorofluorocarbons in the environment: A review. In *Proceedings of the Symposium on Environmental Fate of Organochlorine Compounds in the Atmosphere, 36th ASMS Conference on Mass Spectroscopy and Allied Topics*. (ASMS, San Francisco, CA).
- The chemical mechanisms for ozone loss over Antarctica. In *Abstracts of the Symposium on Current Trends in Atmospheric Sciences, International Congress of Geochemistry and Cosmochemistry*. (Paris, France).
- 1989: The chemistry of some reactions believed to be important in ozone depletion over Antarctica. In *Proceedings of the International Ozone Symposium*. R. Bojkov and P. Fabian, Eds. (Deepak, Hampton, VA).
- Global atmospheric chemistry of halogens. In *Abstracts of the International Symposium on Global and Regional Environmental Atmospheric Chemistry*. (Beijing, China).

Laboratory chemistry and stratospheric clouds. In *Abstracts of the Symposium on the Role of Clouds in Atmospheric Chemistry and Global Climate*. (Amer. Met. Soc., Anaheim, CA).

Heterogeneous chemistry in the Antarctic stratosphere. In *Abstracts of the Symposium on Fundamental Kinetic Processes Linking CFC Release to Global Ozone Destruction in the Polar Stratosphere*. (Amer. Chem. Soc., Dallas, TX).

Heterogeneous chemistry on polar stratospheric clouds. In *Abstracts of the Symposium on the Climate Effects on Aerosols*. (Amer. Assoc. for Aerosol Res., Reno, NV).

Stratospheric ozone: Current Concerns. In *Abstracts of the Symposium on Global Environmental Chemistry - Challenges and Initiatives*. (Amer. Chem. Soc., Miami, FL).

Chemistry of Antarctic ozone depletion. In *Abstracts of the Third International Conference on Southern Hemisphere Meteorology and Oceanography*. (Amer. Met. Soc., Buenos Aires, Argentina).

SELECTED PUBLIC LECTURES

1976: *Protection of the Ozone Layer*, Institute of Higher Studies, Santa Barbara, CA.

Stratospheric Pollution Due to Man-Made Chemicals, Agricultural Research Center, US Dept. of Agriculture, Beltsville, MD.

1979: *The Aerosol Threat to the Environment*, Continuing Education Div., Santa Barbara City College, CA.

1980: *Química de la Estratósfera; Cinética Química Contemporánea: Teoría y Experimentos*, Córdoba, Argentina.

1987: *Chemistry of the Atmosphere and Ozone Layer*, National SACNAS Conference, El Paso, TX.

1988: *Chemistry of the Atmosphere*, MBRs/MARC Program Seminar Series, University of Texas at San Antonio.

The Changing Chemistry of the Global Atmosphere, Annual Meeting of the Caltech board of Trustees, Palm Springs, CA.

1989: *The Greenhouse Effect*, Caltech Assoc./Faculty Dinner, Pasadena, CA.

Ozone Depletion at the Poles, XVIII Reunión de Física Estadística, Oaxtepec, Morelos, Mexico.

Stratospheric Ozone Depletion, David French Lecture, Claremont College, CA.

1990: *The Antarctic Ozone Hole*, Featured Lecture, Celebration of the Sciences, Washington College, MD.

Our Endangered Atmosphere, Panelist, Earth Day, 1990: The Science Behind the Issues, Organized by the American Chemical Society and the University of Massachusetts, MA.

PUBLICATIONS

- 1972: Tandem chemical laser measurements of vibrational energy distribution in the dichloroethylene photoelimination reactions. *J. Chem. Phys.*, **56**, 3988 (with G.C. Pimentel).
- 1973: Chemical laser studies of vibrational energy distributions: The equal-gain and zero-gain temperature techniques. *IEEE J. Quantum Electronics*, **QE-9**, 64 (with G.C. Pimentel).
- 1974: Stratospheric sink for chlorofluoromethanes-chlorine atom catalyzed destruction of ozone. *Nature*, **249**, 810 (with F.S. Rowland).
- Predicted present stratospheric abundances of chlorine species from photodissociation of carbon tetrachloride. *Geophys. Res. Lett.*, **1**, 309 (with F.S. Rowland).
- 1975: Chlorofluoromethanes in the environment. *Rev. Geophys. and Space Phys.*, **13**, 1 (with F.S. Rowland).
- Some unmeasured chlorine atom reaction rates important for stratospheric modeling of chlorine atom catalyzed removal of ozone. *J. Phys. Chem.*, **79**, 667 (with F.S. Rowland).
- The ozone question. *Science*, **190**, 1038 (with F.S. Rowland).
- Natural halocarbons in air and sea. *Nature*, **258**, 775 (with F.S. Rowland and C.C. Chou).
- 1976: Estimated future atmospheric concentrations of CCl_3F (fluorocarbon-11) for various hypothetical tropospheric removal rates. *J. Phys. Chem.*, **80**, 2049 (with F.S. Rowland).
- Stratospheric formation and photolysis of chlorine nitrate, ClONO_2 . *J. Phys. Chem.*, **80**, 2711 (with F.S. Rowland and J.E. Spencer).
- Estimated stratospheric concentrations of chlorine nitrate, ClONO_2 . *J. Phys. Chem.*, **80**, 2713 (with F.S. Rowland and J.E. Spencer).
- 1977: The temperature dependences of the ultraviolet absorption cross-sections of CCl_2F_2 and CCl_3F , and their stratospheric significance. *J. Phys. Chem.*, **81**, 286 (with C.C. Chou, W.S. Smith, H. Vera Ruiz, K. Moe, G. Crescentini, and F.S. Rowland).
- The rate constant for the reaction of $\text{O}(^3\text{P})$ atoms with ClONO_2 . *Chem. Phys. Lett.*, **45**, 158 (with L.T. Molina and J.E. Spencer).
- Ultraviolet absorption spectrum of chlorine nitrite, ClONO . *Geophys. Res. Lett.*, **4**, 83 (with L.T. Molina).
- High resolution infrared absorptivities for gaseous chlorine nitrate. *Geophys. Res. Lett.*, **4**, 3 (with R.A. Graham, E.C. Tuazon, A.M. Winer, J.N. Pitts, L.T. Molina, and L. Beaman).
- Ultraviolet absorption spectrum of hydrogen peroxide vapor. *Geophys. Res. Lett.*, **4**, 580 (with L.T. Molina and S.D. Schinke).
- Upper limit for stratospheric ClONO_2 from balloon-borne infrared measurements. *Geophys. Res. Lett.*, **4**, 227 (with D.G. Murcray, A. Goldman, W.J. Williams, F.H. Murcray, F.S. Bonomo, C.M. Bradford, G.R. Cook, and P.L. Hanst).

- 1978: The rate constant for the reaction of $O(^3P)$ atoms with Cl_2 . *J. Phys. Chem.*, **82**, 1769 (with A.W. Miziolek).
- Stratospheric photodissociation of several saturated perhalo-chlorofluorocarbon compounds of current technological use. (Fluorocarbons - 13, 113, 114, 115). *J. Phys. Chem.*, **82**, 1 (with C.C. Chou, R.J. Milstein, W.S. Smith, H. Vera Ruiz, and F.S. Rowland).
- The ultraviolet spectrum of HOCl. *J. Phys. Chem.*, **82**, 2410 (with L.T. Molina).
- 1979: Chlorine nitrate ultraviolet absorption spectrum at stratospheric temperatures. *J. Photochemistry*, **11**, 39 (with L.T. Molina).
- Ultraviolet absorption spectrum of methylhydroperoxide. *Geophys. Res. Lett.*, **6**, 953 (with G. Arguello).
- 1980: Production of OH from photolysis of HOCl at 307-309 nm. *J. Phys. Chem.*, **84**, 821 (with T. Ishiwata and L.T. Molina).
- Kinetics of the $ClO + NO_2 + M$ reaction. *J. Phys. Chem.*, **84**, 3100 (with L.T. Molina and T. Ishiwata).
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- 1982: Ultraviolet absorption cross sections of several brominated methanes and ethanes of atmospheric interest. *J. Phys. Chem.*, **86**, 2672 (with L.T. Molina and F.S. Rowland).
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**SCIENTISTS' STATEMENT
GLOBAL CLIMATIC DISRUPTION
JUNE 18, 1997**

We are scientists who are familiar with the causes and effects of climatic change as summarized recently by the Intergovernmental Panel on Climate Change (IPCC). We endorse those reports and observe that the further accumulation of greenhouse gases commits the earth irreversibly to further global climatic change and consequent ecological, economic and social disruption. The risks associated with such changes justify preventive action through reductions in emissions of greenhouse gases. In ratifying the Framework Convention on Climate Change, the United States agreed in principle to reduce its emissions. It is time for the United States, as the largest emitter of greenhouse gases, to fulfill this commitment and demonstrate leadership in a global effort.

Human-induced global climatic change is under way. The IPCC concluded that global mean surface air temperature has increased by between about 0.5 and 1.1 degrees Fahrenheit in the last 100 years and anticipates a further continuing rise of 1.8 to 6.3 degrees Fahrenheit during the next century. Sea-level has risen on average 4-10 inches during the past 100 years and is expected to rise another 6 inches to 3 feet by 2100. Global warming from the increase in heat-trapping gases in the atmosphere causes an amplified hydrological cycle resulting in increased precipitation and flooding in some regions and more severe aridity in other areas. The IPCC concluded that "The balance of evidence suggests a discernible human influence on global climate." The warming is expected to expand the geographical ranges of malaria and dengue fever and to open large new areas to other human diseases and plant and animal pests. Effects of the disruption of climate are sufficiently complicated that it is appropriate to assume there will be effects not now anticipated.

Our familiarity with the scale, severity, and costs to human welfare of the disruptions that the climatic changes threaten leads us to introduce this note of urgency and to call for early domestic action to reduce U.S. emissions via the most cost-effective means. We encourage other nations to join in similar actions with the purpose of producing a substantial and progressive global reduction in greenhouse gas emissions beginning immediately. We call attention to the fact that there are financial as well as environmental advantages to reducing emissions. More than 2000 economists recently observed that there are many potential policies to reduce greenhouse-gas emissions for which total benefits outweigh the total costs.

The Framework Convention on Climate Change, ratified by the United States and more than 165 other nations, calls for stabilization of greenhouse gas concentrations in the atmosphere at levels that will protect human interests and nature. The Parties to the Convention will meet in December, 1997, in Kyoto, Japan to prepare a protocol implementing the convention. We urge that the United States enter that meeting with a clear national plan to limit emissions, and a recommendation as to how the U.S. will assist other nations in significant steps toward achieving the joint purpose of stabilization.

INITIAL SIGNATORIES

Dr. John P. Holdren
Dr. Jane Lubchenco
Dr. Harold A. Mooney

Dr. Peter H. Raven
Dr. F. Sherwood Rowland
Dr. George M. Woodwell

Signed by 2409 scientists as of 6:19 PM on June 17, 1997

Ozone Action 1636 Connecticut Avenue, NW Washington, DC 20009 Voice: (202) 265-6738 FAX: (202) 986-6041

July 22, 1997

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MEMORANDUM FOR TODD STERN

FROM: Fred DuVal *FDV*

SUBJECT: Global Climate Change Briefing: Suggested Invites

1. Governor Bob Miller (D-NV), Chair, National Governors' Association
2. Governor George Voinovich (R-OH), Vice Chair, National Governors' Association
3. Governor Christine Whitman (R-NJ), Chair, National Governors' Association Committee on Natural Resources
4. Governor E. Benjamin Nelson (D-NE), Vice-Chair, National Governors' Association Committee on Natural Resources
5. Mayor Paul Helmke (R-Fort Wayne, IN), President, U.S. Conference of Mayors
6. Mayor Deedee Corradini (D-Salt Lake City, UT), Vice President, U.S. Conference of Mayors
7. Commissioner Randy Johnson, (R-Hennepin County, MN), President, National Association of Counties
8. Commissioner Betty Lou Ward (D-Wake County, NC), President-elect, National Association of Counties
9. Council member C. Vernon Gray (D-Howard County, MD), First Vice President, National Association of Counties
10. Council member, Jane Hague (R-King County, WA)
11. Representative Michael Box (D-AL), President, National Conference of State Legislatures
12. Council member Marc Schwartz, (NP-Oklahoma City, OK), President, National League of Cities
13. Environmental Protection Agency Commissioner Harold Reheis (GA), President, Environmental Council of the State
14. Environmental Protection Agency Commissioner Robert Shinn (NJ), Vice President, Environmental Council of the State
15. Public Utilities Commissioner Ron Eachus (D-OR)
16. *Day* Gabe Johnson (OH) ?
17. Josephine Musser (WI), President, National Association of Insurance Commissioners
18. Glenn Pomeroy (ND), Vice President, National Association of Insurance Commissioners

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE & TECHNOLOGY POLICY

PRESIDENT CLINTON'S ROUNDTABLE ON CLIMATE CHANGE

East Room
The White House
Washington, DC
July 24, 1997

ANNOUNCER:

Ladies and gentlemen, Dr. Bob Shope, Dr. Henry Kendall, Dr. Jane Lubchenco, Dr. Sherry Rowland, Dr. John Holdren, Dr. Stephen Schneider, and Dr. Mario Molina.

Ladies and gentlemen, the President and Vice President of the United States.

THE VICE PRESIDENT:

Please be seated, ladies and gentlemen. On behalf of the President and the First Lady, it is my pleasure and honor to welcome all of you to the White House. I'm going to present the President in just a moment.

Before doing so, on his behalf, I would like to acknowledge the distinguished guests who are present. I will formally introduce our panel of Nobel laureates and university scientists in just a moment.

I want to acknowledge members of the President's Cabinet who are here, Administrator of the EPA, Carol Browner; Secretary of Commerce, Bill Daley; Secretary of Labor, Alexis Herman; Secretary of Energy, Federico Peña; Under-Secretary of the Treasury, Larry Summers; Director of the Federal Emergency Management Agency, James Lee Witt; Chair of the Council on Environmental Quality, Katie McGinty; the President's Science Advisor, Dr. Jack Gibbons; and other distinguished guests who are present.

We meet today to discuss the future of our planet and the realities of global climate disruption. I want to acknowledge one other person who is in the room somewhere, and I haven't had a chance to see him yet, but Charles David Keeling is here. And, Dr. Keeling, thank you very much for joining us.

And he was responsible, along with one other, in measuring carbon dioxide in the atmosphere for the very first time back in the late 1950's.

And my own introduction to this issue came about as a direct result of the measurements which showed the annual cycle of carbon dioxide and the steadily increasing peaks of concentrations of carbon dioxide. And now, of course, we know other greenhouse gases as well that resulted from those measurements.

Later, when I came to the Congress quite a few years after that, in holding hearings I saw that those concentrations had increased dramatically and, of course, all around the world scientists were studying it intensively.

And now we will soon hear from these scientists about what the world's scientific conclusion is about what this means for increased droughts and floods, dramatic changes in the distribution of forests and crop lands.

And all of this gives rise to great concern that we are committing future generations to a planet that is altered in profound ways that can cause great harm to future generations.

This Administration has always worked on a simple principle, when addressing problems of a scientific and technical nature, and that principle is science must inform policy decisions.

Scientists are by nature a cautious group, but the world's scientific community is telling us in many ways that they believe that we as a civilization are disrupting the balance of the world's climate.

In the words of the 2,000 scientists who participated in the intergovernmental panel on climate change, and I quote, "There is a discernible human influence on global climate."

More than 2,600 scientists have signed a letter about global climatic disruption which we'll be hearing more about in just a few minutes.

Today we hear about the concerns of scientists. They speak as eminent experts, and as U.S. citizens who care about the future of this planet. Each has a resume far too long to recount, but let me briefly introduce those who are with us today.

Dr. Sherry Rowland won the 1995 Nobel Prize for Chemistry for his pioneering research in atmospheric chemistry, explaining the destruction of the stratospheric ozone layer. He is also a professor at the University of California at Irvine and an official with the National Academy of Sciences.

Dr. Mario Molina shares the 1995 Nobel Prize with Sherry Rowland. He is the Lee and Geraldine Martin Professor of Environmental Science at MIT.

Dr. Jane Lubchenco is an eminent ecologist, past president of the American Association for the Advancement of Science, very active with the AAAS, and also past president of the Ecological Society of America. She is currently the Wayne and Gladys Valley Professor of

Marine Biology, and a distinguished Professor of Zoology at Oregon State University.

Dr. Stephen Schneider is a climate scientist and professor at Stanford University, recipient of a MacArthur Fellowship, and winner of the American Association for the Advancement of Science's Westinghouse Award for Public Understanding of Science and Technology.

Dr. Bob Shope has devoted his professional life to the study of viruses carried by biting insects. He is currently a professor in the Departments of Pathology and Microbiology and Immunology at the University of Texas.

Dr. Henry Kendall won the Nobel Prize for Physics in 1990. He is Chairman of the Board of the Union of Concerned Scientists and the J. A. Stratton Professor of Physics at the Massachusetts Institute of Technology.

And John Holdren is an expert on energy and environmental science, and delivered the Nobel Peace Prize acceptance lecture on behalf of the Pugwash Conferences. He is currently the Director of the Program on Science, Technology, and Public Policy at the John F. Kennedy School of Government and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences at Harvard.

And now I would like to introduce the person who is leading our country and the world towards a recognition of what must be done to deal with this issue. It is my honor, ladies and gentlemen, to present the President of the United States, President Bill Clinton.

THE PRESIDENT:

Thank you very much. Thank you. Ladies and gentlemen, first let me thank you for being here, members of the administration, and concerned members of the public, the scientists and other experts that are here.

I would also like to say a special word of thanks to the Vice President. In one of our earliest meetings together -- we meet once a week and have lunch -- he went over the whole history of greenhouse gas emissions and climatic change. And I became convinced first that he was convinced that something was wrong. Then I became convinced something was wrong.

And it's been a great help to me and, I believe, to the people of the United States to have him in the position that he's in, not only with the convictions that he has but with the knowledge that he has, and I'm very grateful to him for what he has done to help me come to grips with this issue.

To me, we have to see this whole issue of climate change in terms of our deepest obligations to future generations. I have spent most of my time in the last 4½ years trying to prepare the American people for a new century and a new millennium.

It is also very important that we protect the Earth for that new millennium, to make sure that people will be able to take advantage of all the things we are trying to do, the opportunities we are trying to create, the problems we are trying to solve.

It is obvious that we can not fulfill our responsibilities to future generations unless we deal responsibly with the challenge of climate change. Whenever the security of our country has been threatened, we have led the world to a better resolution. That is what is at stake here, and the scientists have come here to explain why.

As the Vice President said, the overwhelming balance of evidence and scientific opinion is that it is no longer a theory but now a fact that global warming is for real.

The world's scientists believe that, if we don't cut our emissions of greenhouse gases, we will disrupt the global climate; in fact, there is ample evidence that human activities are already disrupting the global climate and that, if we stay on our current course, the average global temperatures may rise 2 to 6 degrees Fahrenheit during the next century.

To put that in some context, the difference in average temperature between the last ice age, which was 10,000 to 12,000 years ago, and today, is about 9 degrees Fahrenheit. So we could have two-thirds of that change in 100 years unless we do something.

If we fail to act, scientists expect that our seas will rise one to three feet, and thousands of square miles here in the United States in Florida, Louisiana, and other coastal areas will be flooded.

Infectious diseases will spread to new regions. Severe heat waves will claim lives. Agriculture will suffer. Severe droughts and floods will be more common. These are the things that are reasonably predictable.

In the face of this, the United States must confront a challenge that in some ways is the most difficult of all democracy's challenges to face; that is, we have evidence, we see the train coming, but most ordinary Americans in their day-to-day lives can't hear the whistle blowing.

Unless they have lived in a place where they have experienced severe and unusual and completely atypical weather disruptions in the last five years or so, the degree of the challenge is inconsistent with the actual perceived experience of most ordinary Americans. And this is true, indeed throughout the world, and that presents us our challenge.

A democracy is premised on the proposition that, if the American people or any people in any democracy know what the facts are and believe them, way more than half the time they will do the right thing.

And so what we are doing today is beginning a process in which we ask the American

people to listen to the evidence, to measure it against their own experience, but not to discount the weight of scientific authority if their own experience does not yet confirm what the overwhelming percentage of scientists believes to be fact today. This is a great exercise and great test for our democracy.

I do want to say that I am convinced that, when the nations of the world meet in Kyoto, Japan in December on this issue, the United States has got to be committed to realistic and binding limits on our emissions of greenhouse gases.

Between now and then we have to work with the American people to get them to share that commitment. We have to emphasize flexible, market-based approaches. We have to embrace research and development efforts in technology that will help us to improve the environment while permitting our economy to grow. We have to ask all nations, both industrial and developing, to participate in this process.

But if we do this together, we can defuse this threat, and we can make the 21st century what it ought to be, not only for our children but for all the children of the world. I believe the science demands that we face this challenge now. I'm positive that we owe it to our children. And I hope that we can find the wisdom and the skill to do democracy's work in the next few months to build the consensus necessary to actually make action, as opposed to rhetoric, possible.

And for all of you, for your commitment to that, I thank you. And now I'd like to ask Dr. Rowland to be the first of our distinguished scientists to lead off.

Doctor.

DR. ROWLAND:

Mr. President and Mr. Vice President, global climatic change is underway. Carbon dioxide from the combustion of coal, oil, and natural gas has risen by 15 percent in the atmosphere since 1958. Methane, some of which is emitted from cattle and rice paddies, has risen by 16 percent since 1978. The air now holds four times as much chlorofluorocarbons or CFCs as it did 25 years ago.

The amount of ozone in the stratosphere over the United States is 6 to 10 percent lower than it was in the 1960s. Many other changes are occurring as well. The global average surface temperature has risen about 1 degree Fahrenheit during the past century, and sea level has risen from 4 to 10 inches.

Land use patterns have been greatly altered as forests are burned for use as agricultural land. Many of the biological species formerly in these forests are disappearing. The geographical ranges of tropical diseases are moving northward. Human activities are the chief cause of many of these changes.

During the 20th century the developed countries have changed from the agricultural societies of 1900 and to the highly industrialized urban environments of the present. Great forward progress has occurred in the comfort and well being of significant segments of the global population, although not for all.

Enormous strides have been made in health. Death rates are lower, life spans are much longer. The last century has also seen a tremendous growth in the global population from about 1½ billion in 1900 to 6 billion in the year 2,000 and 8 billion in the year 2025.

Much of the progress and affluence has resulted from the substitution of non-living sources of energy for human and animal energies. The availability of engines, of electricity, most of this energy comes from the burning of coal, gas, and oil.

These energies bring with them environmental consequences, carbon dioxide from the fossil fuels, the radioactivity of nuclear waste.

In Japan in 1959, I encountered bullock carts on the road to a nuclear research center. In China in 1980, humans propelled wheelbarrows to move dirt from road construction sites. In contrast, the City of Shanghai alone now has 20,000 major construction projects going simultaneously. And much of the world is moving as fast as possible into a more affluent, energy-intensive era.

This combination of a rapidly growing world population with an increase in per capita use of energy carries with it great pressures on the environment and on the atmosphere. Because the wind circles the earth within a few weeks, greenhouse gases emitted from each country quickly become a global problem requiring a global solution.

Our earlier experience in dealing with the destruction of stratospheric ozone by the CFCs has taught us that humans can collectively interfere with natural processes on a global scale.

Further, despite the immense amount already known about the atmosphere and the oceans, these are complicated systems with uncertainties going in both directions. Surprises can happen. Witness the devastating losses of ozone over Antarctica every spring.

However, the United Nations' Montreal Protocol, which is now successfully controlling the emissions of CFCs into the atmosphere, demonstrates that the nations of the world can agree to act when it's for the mutual benefit of all.

During the 1990's, these countries have called upon the world's scientists to evaluate the question of global warming from the accumulation of greenhouse gases. In response, the authoritative IPCC has estimated a probable increase in global and surface air temperature of about 3½ degrees Fahrenheit by the year 2100 with a possible range from 2 to 6½ degrees Fahrenheit.

They further stated, as you heard from the Vice President, that the balance of evidence suggests a discernible human influence on global climate, and they warned that the average rate of warming will probably be greater than any experienced in the past 10,000 years.

Much of the variations in outcomes depends upon what the countries of the world do to control the emissions of carbon dioxide and other greenhouse gases in the intervening years. More than 2600 scientists have now signed this scientist statement on global climatic disruption in which as scientists and as concerned citizens we ask that the United States demonstrate strong leadership in the global effort with a firm proposal for reducing U.S. emissions of greenhouse gases.

THE VICE PRESIDENT:

Mr. President, I would like to ask a question. The scientists' statement uses the term "disruption" and uses the word "irreversible." Those are strong words for scientists, who, as I mentioned, are by nature cautious.

How do the risks that we face from global warming compare to the risks from the destruction of the stratospheric ozone layer that you and Dr. Molina described several years ago?

DR. ROWLAND:

Both of these are very serious problems for the environment. In the case of the CFCs, these are gases that were manufactured by about 20 companies globally and all of them science-based, and the uses were almost entirely in affluent aspects of society.

In the case of the fossil fuels, everybody uses energy from fossil fuels nearly everyday in every activity that they do, so it is a global problem that requires actions, both by the rich countries and by the poor countries.

We need strong leadership from countries such as ours which have the powerful science and technology base with which we can try to solve these problems. We can do it, but we have to have the commitment.

THE VICE PRESIDENT:

Well, thank you very much. Mr. President, with your permission, I'd like to ask Dr. Mario Molina to give us an overview of the science of climate change.

To set this up for you, Dr. Molina, I just wanted to say that one of the most compelling pieces of evidence for many people is the record of climate over a long period of time, 160,000 years, that is, taken from the ice core in Antarctica and also in Greenland.

As others here can explain better than I, they measure the atmosphere in these bubbles trapped in the ice, and each year is easy to record. And they pull out a very accurate record of temperature and carbon dioxide concentration. Why don't you take it from there, Dr. Molina,

and correct any mistakes I made along the way there?

DR. MOLINA:

I'd be pleased to do that, Mr. Vice President. First of all, let me just summarize. The greenhouse effect is a name of a process, a process which affects the heat patterns of our planet.

Our earth receives energy from the sun which passes relatively freely through the atmosphere. But the energy that the earth emits to outer space is actually trapped. It's emitted mostly in the form of infra-red radiation, and there are certain gases in the earth's atmosphere that trap some of this radiation affecting these heat patterns.

One of these gases is carbon dioxide. It's a very important so-called greenhouse gas. And what we have in this graph is a representation of the amount of carbon dioxide going back in time that we heard from the Vice President earlier on mention about some recent record set involved with of changes in carbon dioxide in this century.

But what we have here going back in time is 160,000 years, and we have levels of carbon dioxide that range between about 190 and 280 parts per million. How do we know this? Well, it turns out that one can measure the composition of air bubbles that are trapped in ice. Ice Cores, particularly in Antarctica, like as shown here, but also Greenland. From that we can really get information about the amount of carbon dioxide, not just locally but the amount that exists globally at that time.

What we have down here, the yellow curve, is a similar record of temperature, temperature going from the present back 160,000 years. And what is very remarkable is, of course, a very large correlation between these two curves.

What I'd like to do is to point out where we are now. What we have here are just amounts. You can see the pre-industrial amounts below 300 parts per million. If we can show the rest of the second panel here, this is to indicate where we are now, which is roughly 365 parts per million of carbon dioxide.

And what is striking is this is a level that we haven't seen before, certainly not in this 160,000 years. And what is also very striking is how fast we're getting there.

Let me point out also that besides these very striking correlations between these two curves there is an important physical mechanism that ties in now, and that's precisely the greenhouse effect. To explain that a little bit more in detail, the way we understand climate often is by doing computer simulations, to sort of synthesize knowledge that we have, because climate is a very complicated system.

These computer simulations are by no means perfect, but we understand, for example, that ice ages come about from changes in the way the energy from the sun reaches the earth,

changes between the way it reaches the poles versus the equator, changes between summer and winter, and that explains to some extent the appearance of ice ages.

But it's not enough to look at those changes. It turns out that it's important to also consider other effects such as the greenhouse effect from carbon dioxide, low levels when the temperatures are low, high levels when the temperatures are much larger.

The next question is where are heading? And for that we need to look at one more panel. What happens in the future, that, of course, is a prediction. That depends on what we do. But if we just continue with the so-called business-as-usual scenario, we can predict that we are going to reach levels way up there, about 700 parts per million.

And what is pretty remarkable is really how fast this would occur on a geological time scale or an evolutionary time scale. It's really like the blink of an eye.

I should point out that the earth has actually seen such high levels of carbon dioxide in the past, but that was some 50 million years ago, and, believe me, the earth was a very different place from what it is now 50 million years ago.

So, from this sort of evidence, it's what the scientific community really considers this to be a serious problem. All the magnitude and the pace of change is what makes us really worry and take this problem very seriously.

THE VICE PRESIDENT:

Thank you very much. Could you briefly point out the last two ice ages on that temperature record going back into the past?

DR. MOLINA:

Yes, the ice ages are forced when the temperature is low. We have low temperatures here. This is in degrees centigrade, 6 degrees centigrade, about 8 or 9 degrees Fahrenheit. And the previous one, as the President pointed out, was about 10,000 years ago. I should point out that even though this appears to be just a small temperature change, for example, for people like myself living in Boston, that represents a change from the nice weather we have today and a whole mile of ice above the surface.

THE PRESIDENT:

Thank you very much. Now, I'd like to call on Jane Lubchenco, our expert on ecology, and see what such significant changes in greenhouse gas levels might mean for natural resources.

Jane.

DR. LUBCHENCO:

Mr. President, Mr. Vice President, as both of you are aware, the ecological systems of the

world, the forests, the wetlands, the coral reefs, provide the life support systems for all of life on earth.

Most people are aware that we derive goods from these systems, food, fiber, genes, medicines what most people are unaware of are the services that are provided to us free of charge by these ecological systems of the world.

These services include things like the control of floods, the purification of air and water, and even the creation of beautiful places that provide us with recreation and inspiration. These eco-system services are largely outside our economic systems, but their value is estimated to be well in the trillions of dollars annually.

These eco-system services are provided to us by the functioning of intact ecological systems, and when those systems are disrupted or when those systems are lost, then we lose the goods and services that are provided by those systems.

Climate change will undoubtedly affect the continued provision of these goods and services, although we can not always predict exactly what the details will be. To provide a few vignettes of the ecological consequences of climate change, in the optimistic scenario of a doubled CO₂ world, let me invite you on a brief field trip to different parts of our country.

Let's begin in the forests of New England. As the earth warms and climatic zones move northward or toward the poles, existing forests will be stranded and their processes disrupted. The forests of New England, like probably a third of the forests around the globe, will undergo major changes.

For example, we would probably lose sugar maples from the New England Forests. Can you imagine going to watch the gorgeous fall foliage in New England without sugar maples?

Let's move to the southern parts of our country. Salt marshes in Louisiana are already being submerged. Climatic change would exacerbate this problem as sea level rises between six inches and three feet.

Sea level rise will also affect other coastal ecosystems; for example, the salt marshes and mangroves of the Florida Everglades. A sea level rise of just one foot would result in loss of one third of the Florida Everglades.

The loss of mangroves and salt marshes would result in the loss of the services provided by these systems, and those services include things such as nursery areas, natural hatcheries for important fish and shellfish, the detoxification of pollutants, the trapping of sediments, the creation of a habitat for unique plants and animals, and protection of shores against the battering of waves.

These ecosystem services are vitally important, and when we lose systems we lose those

services.

Now let's move to the Midwest. While these highly managed agricultural systems are thought to be quite adaptable, climate change is likely to increase demands on water use to ameliorate soil drying, and pesticide use to combat increases in the incidents of pests and diseases.

Drought is no stranger to these regions. In the heat wave in 1988, drought resulted in a drop in U.S. agricultural production by a third. Flying up to Glacier National Park in Montana, we would be dismayed to find out that fully 73 percent of the glacial areas has already been lost since 1850 because of climate warming.

In fact, climate change is predicted to result in loss of all of the glaciers in the park by the year 2030, well within many of our lifetimes. Even greater ecological changes are predicted to occur in polar regions.

As an ecologist, I must emphasize that the slower the rate of change in climate, the less catastrophic the results. Let me repeat that: The slower the rate of climate change, the less catastrophic the results.

Species are more likely to be able to migrate, to grow and evolve if rates of change are slower. At slower rates of warming more trees could migrate effectively, more corals could keep up with sea level rise, and more species could evolve adaptations.

Climate change is only one of many environmental changes that are occurring around the world today. These multiple stresses include familiar things like urbanization, over-fishing, pollution, and the loss of biological diversity.

Taken together, these stresses are reducing the ecosystem goods and services that we depend upon for our quality of life. As a scientist, I know enough to appreciate how serious and urgent the problem of climate change is.

In addition to that, as a mother I care especially about the prospects of the world that my children will inherit. I do not wish them to have a world that is disrupted.

The quality of their future depends upon our willingness to act and to act quickly.

THE VICE PRESIDENT:

Let me call now on Dr. Steve Schneider to discuss the risks of severe weather events, extreme weather events, which have been predicted to accompany global warming, droughts, floods, hurricanes, and we'd be interested in your thoughts on those and also the interaction of those with rising sea level.

DR. SCHNEIDER:

Thank you very much, Mr. Vice President, Mr. President. We're really talking now about the issue of so what if the climate changes? That's what we're addressing at the moment. This is a question that scientists have spent a long time on. There are quite literally hundreds of studies, some suggesting catastrophic outcomes, some mild. It gets confusing. The economists, of course, want to know how much it costs, what we call climate damage.

In that process of trying to sort through that confusion, a survey was taken a number of years ago by a Yale economist, William Nordhouse. Included in the survey were people as Under-Secretary of Treasury Summers, I was one of them. And we were asked what kind of damages to the economy might occur from this wide range of impact.

And, of course, all the uncertainties were put in. As the Vice President said, scientists can not avoid that. We observe those uncertainties. But our best guesses I can summarize briefly from perspective: In a nutshell, the economists in the group gave a number like something like 1 percent of gross domestic product would be their best guess with lots of uncertainty. And in the natural scientists it's something in the order of 10 percent. You might wonder why such a difference?

Well, it comes out from the natural scientists having a higher degree of concern over the kinds of ecological services that Jane Lubchenco referred to not being simply replaced and the economists who are optimistic about human substitution for that.

But I don't want to get into who's right or who's wrong, just put some perspective on it. If we took the lower of those two numbers, remember, 1 percent of GDP in today's terms for the world is \$200 billion.

So, it's not a trivial question in terms of climate damage. Now, where would a number like that come from? And that's the issue that you asked me. Let's take a look at it in just two examples, the sea level question and the question of hydrologic extremes, by which we mean droughts, and floods. Let's do sea level first.

We all remember the terrible pictures from hurricane Andrew. If one costs that, it was something on the order of \$40 billion lost in Florida and in other parts around the Caribbean. And physical reasoning says could we have had something to do with that? I mean, after all, if you increase the temperature of the oceans, it increases evaporation, it might make storms stronger.

That debate takes place, but that's very controversial. But one thing we know that isn't controversial is that before 1987 there were no losses larger than \$1 billion. And now the insurance industries are very concerned that there are several in the tens of billions of dollars. What else do we know that's not controversial?

Sea levels have gone up, as we've heard several times. Between about 4 and 10 inches are projected typically to go up about 6 inches to maybe 3 feet, depending upon how things turn out in the next century.

And what we know is, whatever the damage that storms do when they go by, whether they're augmented in strength by global warming or they remain natural at their levels that we're used to, they'll be causing flooding from a higher sea-level base. As a result of that, the damages would go further inland. And that part contributes to that number referred to in the other studies.

What about the hydrologic extremes? Well, we all saw the pictures of the 1988 drought. We know about the seemingly endless stories of floods now. And the question is has nature rolled us a double snake eyes, or have we started to load the dice?

And that's what the scientific debate is about. And, again, they're some well-known physics which says if you increase the heating of something that has water in it, more water will evaporate. Well, it doesn't require a Ph.D. to figure that out. Almost every farmer knows it, and anybody who's ever tried to water a lawn knows that, when it's hotter, the water comes out of the lawn quicker. You have to water more. So, what that suggests is more water in the air means when it's going to rain the rainfall can be more intense. When it's dry you can have more evaporation. That's where this whole idea comes from.

Well, this is out of physics. The question is what's happening. A line that we have often in science is, well, in God we trust, but for the rest of us please show data.

And the data in this case have been coming out quite a lot lately. And Dr. Tom Karl, for example, has been studying and his colleagues in North Carolina have been studying this for a long time. And they've concluded that there's about a 10-percent increase in precipitation across the United States since 1910. But that's not the interesting part to me. And I want to quote this to make sure I get it correct. The interesting part, as Tom says, is, "The increase in precipitation is reflected primarily in the heavy and extreme daily events." Translate that: Gully washes. The bulk of the rain fall increase has been in those kinds of damaging, extreme events.

So, is this a natural oddity or is it us? I think we still can't answer that question definitively. All we can say is it's consistent with what our understanding. It's consistent with our computer simulations, but it's still circumstantial evidence.

The problem is this experiment is being performed while we speak on a laboratory, but it's laboratory earth, and we're along for the ride with all the other living creatures on earth.

Finally, we've heard everyone say that this is a very complex system, very difficult to forecast. It's an atmosphere ocean, land, ice, biosphere system, all coupled. Scientists use the fancy word "nonlinear." The IPCC was referred to several times here, concluded with a paragraph. I know it well as a lead author of the IPCC, and I'll quote what it said in its last

paragraph of the summary for policy makers. "When rapidly forced, nonlinear systems are especially subject to unexpected behavior." I translate that again. In my words that means reducing the pressures humans put on nature is insurance against potential nasty surprises.

THE VICE PRESIDENT:

I want to acknowledge Senator Max Baucus, who I neglected to acknowledge earlier. We're glad you are here.

Dr. Schneider, before we move on, let me just ask a question that I think has been on the minds of a number of people around our country in the last few years. We had a really unusual flooding event in North Dakota, South Dakota, Minnesota earlier this year.

We also had a really unusual flooding event in the Ohio River Valley and in the San Joaquin River valley and up around Seattle. And a couple of years before that we had that very unusual flooding event in the Midwest which created a new shallow great lake for a while before it went away.

And all around the United States there are people who are saying to their neighbors didn't we just have a hundred-year flood just a few years ago. And how come we're having another one so quickly? And how does this anecdotal evidence and the tragic experiences of so many Americans relate to what you just said about loading the dice?

DR. SCHNEIDER:

I'm trying to resist the temptation to retreat into the usual scientists caution.

THE VICE PRESIDENT:

Well, you got an award for not doing that.

THE PRESIDENT:

Is that what you got that for?

DR. SCHNEIDER:

I was about to say -- we won't argue. The best that I can say is there's that evidence that you cite. There's also the fact that in the 1990's, we had the longest *El Niño* events on record which had a major impact on weather all around the world.

And there is a whole series of these coincidences, these events, which appear to be unusual, any one of which you would argue is just a simple piece of circumstantial luck, where nature is being perverse. But a pattern is emerging, and the pattern is consistent with the expectations from our models; and, therefore, those combinations of factors led the IPCC to make the discernible statement that you said before.

So, while no one event certainly could be laid to the doorstep of global warming, the

increasing frequency and magnitude of these could very well be the first signs of the canary in the cage that's starting to quiver.

THE PRESIDENT:

"The canary in the cage is starting to quiver." Thank you very much. Now, I'd like to ask Dr. Robert Shope, who has studied infectious diseases extensively, to discuss how human health might be affected by climate change.

MR. SHOPE:

Thank you, Mr. President. Health and the environment are closely linked. You've heard about the selective warming, especially at night, changes in rainfall patterns, and more frequent storms. If there is a 6 degree Fahrenheit warming, the heat alone in North American cities such as Washington, D.C. will result in a excess of deaths, especially in elderly people, who do not adapt well to severe warmth. We had an example in July of 1995 in Chicago, Illinois. There the temperature exceeded 90 degrees Fahrenheit both at night and day during a prolonged period, and there were recorded 465 deaths in Chicago related to the heat.

My own personal experiences is with diseases transmitted by ticks, mosquitoes, and other biting insects. The agents that cause these disease are viruses, they're bacteria, and parasites. For the viruses, especially, we have no specific treatment, and for the parasites such as malaria, we have drugs, but the organism is rapidly overcoming and becoming resistant to the drugs.

Let me talk about dengue virus. This causes a disease in people which is typically a high fever, headache, muscle aches, and pains, sometimes a rash. There is a severe form of dengue, which we call dengue-hemorrhagic fever which, when you have this disease, the case fatality rate or the mortality rate is about 10 percent.

The virus is transmitted by a mosquito that lives in and around homes in tropics and warm climates and tropics and subtropics. The mosquito is killed by a hard freeze; therefore, it's northern limit is about Memphis, Tennessee at the present time.

We've seen in the last decade a steady increase in the numbers of cases of dengue in tropical America, including Mexico. This disease is now literally on our southern border. In 1995 there were recorded in excess of 4,000 cases in Reynosa and some of the other Mexican cities along the Rio Grande river.

I cannot tell you whether dengue epidemics will occur in the United States, and perhaps air conditioning and screened homes may protect us. On the other hand, with climate change and warming, I will predict and many of us predict that the mosquito will thrive further north. As the climate warms, the virus will multiply in the mosquito more rapidly. The mosquito will be able to feed more frequently.

These same factors apply to the vector of malaria, also a mosquito. Malaria is a disease

that worldwide kills approximately 2 million people each year. It's a tropical disease. The disease recently has occurred in small outbreaks in the United States, in New Jersey, New York, and also in Texas, and with warming we can expect these epidemics to continue or small outbreaks to continue and to enlarge.

The factors that I've talked about and other factors that we can demonstrate in the laboratory argue for controlling the environment while we still have time, and I will say that the best insurance is preparedness.

There are many other such diseases directly affected by rainfall and warming. I'll mention St. Louis encephalitis in the western part of the United States, the tick-borne Lyme disease, which many of you are familiar with, the newly recognized rodent-associated Hanta virus pulmonary syndrome, which broke out in 1993 in the southwestern part of the United States.

Each nation in the world has its own set of diseases, some of which affect Americans abroad or can be transported and introduced into the United States. Therefore, the problem of climate change and health is of common interest among nations as are the solutions. Thank you.

THE VICE PRESIDENT:

So, if we get the kind of warming that the scientists are now predicting and a change in climate so that a place like Boston has a climate that we now more nearly associate with Atlanta or even farther south, you would also see a change in the distribution of diseases and the pests and insects that carry diseases. Is that the basic point?

DR. SHOPE:

That's the basic point. That's the take-home message, yes.

THE VICE PRESIDENT:

All right. All right. In the south, we saw kudzu come in. We're talking about microbial kudzu, as far as I can tell. I'd like to ask Dr. Henry Kendall, Nobel laureate and chairman of the Union of Concerned Scientists to speak to the international dimensions of the issue.

MR. KENDALL:

Yes. Mr. President, Mr. Vice President, thank you for this opportunity. Disruption of the climate is linked and can aggravate many other human problems, and you've heard some samples today, and they're just samples of a wide spectrum.

But one link I'd like to talk to is the connection with world food production. There are developing troubles in this sector independent of the climate, and they're little known.

Agriculture, as widely recognized, needs a stable climate in order to be highly productive,

yet look at 1988. It was one of what appears to be a series of the hottest years on record, but in that year in the central North American continent we had a combination of high temperatures and drought. And both Canada and the United States lost one-third of their grain supplies.

The United States, it was the first time in 200 years that current production was not adequate to feed us. In the years since Australia and Mexico have had somewhat similar events. It would be really scary if this becomes a pattern.

Now, food demand is expected to double in the next 30 years, which is almost no time at all. Fresh water, which is vital for irrigation, is already short. The human race uses nearly one half of the available fresh water, and 40 percent of the world's population lives in areas that are water-short.

Expansion into new arable land is highly constrained, and, let me say, the last thing we need are climatic changes and disruptions putting additional pressures on a system which is already becoming considerably stressed.

Of course, it's the bottom tier of the developing nations that will get hit directly by shortages, a large number of people, nearly 1 billion, one in six of everyone living. Many of those nations will have great trouble, and some, I believe, will find it impossible to feed themselves.

What this is doing, and it has already started along with some other factors, is to generate increasing numbers of hungry migrants, environmental refugees, streaming across national borders.

Now, these migrants do not wish to be dislocated, and they've discovered that their destinations don't always welcome them as the reactions both in Europe, in the wealthy nations there, and in the United States have demonstrated to us.

The result is that no nation will be sheltered from dislocation of food supplies, altered trade balances, fresh water difficulties. These are already surfacing in the Middle East, where the United States has vital interests, and have engendered more than a half a dozen wars out there. Flow of migrants which may at worst increase into the hundreds of millions of people. And even though the wealthy nations will remain able to feed themselves, and remain well fed into the future, no nation will escape the troubles from pressures on the food supply.

Mr. President, it is not the case that one end of the boat can sink, so let me say that this is a developing problem in national security, and we have to deal with it. The best way to deal with problems of that sort is to stop them at the outset and not wait until the results are presented to us and the great troubles develop. Thank you.

THE PRESIDENT:

Let me ask you something: I don't really want to take you afield from the subject, but one of the things that has perplexed me about this is won't there be serious problems of water quantity and quality almost no matter what we do?

DR. KENDALL:

Well, there will certainly be developing problems, and I think it is slated to get worse, but we have it under control at some level to keep them from getting extraordinarily harsh and severe. Disruption of the ecosystems does interrupt the purification of water in wetlands, and as these disappear, as they're doing here, it will hurt water quality.

If there are shifts in patterns of rainfall, it will upset ecosystems, it will upset agriculture, and this will certainly develop because some of the greenhouse warming is now at some level irreversible. The hope is to keep it from developing to unacceptable levels of severity.

THE PRESIDENT:

Thank you.

I'd like to now turn to Dr. John Holdren, who's worked on many global issues, energy, the arms race, plutonium disposition. He's done a lot of work for us on that, and I thank him for that. I'd like to say that, to go back to my opening remarks, you signed the scientist statement. You clearly see this as a big threat.

Many people here and around the world seem unconcerned. Why do you think people are underrating the importance of the issue, and what do you think we can do about it? And secondly, one of the things all the developing countries are saying is well, right now, you rich countries are the biggest part of the problem, and, when you want to include us in this, you are basically just trying to keep us poor. So, let us pollute a while and get rich, and then lecture us about fixing the environment.

What is the responsible way for the wealthier countries to do what we should do and still get the developing countries to do what they can do within the context of their legitimate aspirations for their people?

I know I'm asking you a political question here, but you must have thought about it in the context of what you're trying to achieve.

DR. HOLDREN:

Well, Mr. President, given the second part of that question, I assume my time has been doubled.

THE PRESIDENT:

I notice you speak fast when you're excited about something.

DR. HOLDREN:

I'll try to do that. I think, Mr. President, Mr. Vice President, there are at least six reasons why most people underrate the seriousness of the climate disruption problem, and running through those six reasons gives us a way to revisit in a way many of the most important points that were made this afternoon, and I'll end up right at the second part of your question.

I think the first reason that people tend to underrate this problem is that human well being is a lot more dependent on climate than most people think. As you heard today, we're talking about the productivity of farms and forests and fisheries. We're talking about the frequency and intensity of floods and droughts and heat waves. We're talking about the geographic pattern of disease. We're talking about sea level rise and associated destruction of coastal property. And we're talking about the potential for political tension and conflict over these consequences, and out of disputes over who's responsible and who should pay, which is part of the last problem you were mentioning.

The second reason people tend to underrate this problem is that climate disruption is a lot further along than most people think. As we've seen, atmospheric carbon dioxide is already higher than it's been in the last 160,000 years.

The global surface temperature, which is expected to lag behind increasing carbon dioxide concentration, is higher than it's been in the last thousand years.

And the evidence of this, the indicators of this climate change, are apparent in rising sea level, in increasing precipitation, in changing patterns of disease, and in a lot more.

The third reason that many people are more complacent than they should be is that the climate implications of future growth in population and future growth in energy consumption are a lot bigger than most people think.

We're going to have in the year 2050, barring near disaster, something like 9 billion people compared to less than 6 billion today. We're going to have energy use under business as usual that will be three times higher than today's worldwide. We're going to have carbon dioxide emissions that are two to two and a half times today's worldwide. And remember that today's are already in the process of getting us into serious climatic difficulty.

We're going to be in the year 2050, if we don't change business as usual, a long way down the path toward a climate regime that hasn't been seen on this planet in 50 million years.

The fourth point is that scientific uncertainties are not grounds for complacency, in spite of what many people think about that. There are uncertainties about many of the details of timing and magnitude and regional variation in the consequences of climate change, but there is no uncertainty at all that humans have altered significantly the global atmospheric concentrations of gases we know to be critical in controlling climate.

And there's a solid consensus among the scientists who have studied these matters seriously that the chances of significant impacts on human well being from climate change over the next few decades are substantial.

We also need to remember that uncertainties, such as they are, cut in both directions. It could turn out that disruption to human well being from climate change is coming at us more slowly and in smaller magnitudes than today's best estimates predict.

But it also could turn out that those disruptions are coming at us faster and in bigger magnitudes than today's best estimates predict. And, indeed, in looking at what most of the computer simulations of the consequences of climate change leave out, I personally would bet on worse rather than better estimates.

The fifth reason that people underrate the problem is that the time lags between cause and effect and between effect and remedy are longer than most people think. Those time lags and above all the several decades that it will take to substantially successfully transform the world's fossil fuel- dependent energy supply system mean that doing nothing is a very dangerous course of action.

The world's energy-economic system is a lot like a supertanker, very hard to steer and very bad brakes, and we know from the science that has been reviewed here today that supertanker is heading for a reef. And we can see the water under the hull getting shallower and shallower as we go along.

Now, even though we can't say exactly when we're going to get to the point where that reef rips the bottom out of the supertanker, it's a bad idea in these circumstances to keep on a course of full speed ahead.

In fact, in this situation, pointing to uncertainties about the details, pointing to areas of ignorance, and saying well, it's fine is like saying, since this whole supertanker business is proceeding in the fog, we should feel better about it.

The last reason that I'll mention here that people tend to underrate this problem gets to your second part of your question is that the fate of industrialized and less developed countries is a lot more interconnected than most people think.

Now, it is true that the industrial nations like the United States, because of their wealth of capital and technology and infrastructure, are in a better position than the less developed countries to change and adapt and adjust.

We'll still suffer from climate change, but the developing countries will probably suffer more. Should that make us happy? Should that make us complacent? Certainly not. We all live on this planet under one atmosphere.

We all live on the shores of one global ocean. Our countries are linked by flows of people, of money, of goods, of ideas, of images, of drugs, of weapons. It should be clear, as Dr. Kendall already said, you can't have one end of the boat sinking while the other end floats.

If we are to enjoy in the industrialized countries a stable and sustainable prosperity, we are only going to be able to manage that if we can achieve for the rest of the world now less fortunate a stable and sustainable prosperity as well.

And the only way to do that is going to include addressing the danger of global climate disruption in a cooperative way. That cooperation in everybody's mutual interest is the key to the second part of your question.

And I really want to say, Mr. President and Mr. Vice President, all of us applaud your initiative and your leadership in stepping up to the challenge that this global problem and the need for global cooperation to address it represent. Thank you.

THE VICE PRESIDENT:

I have one brief question. There are some people who say, "Why don't we just wait a little while longer before we take any action?" This year, incidentally, marks the 40th anniversary of the first measurements of CO₂ in the atmosphere by Charles David Keeling and the late Roger Revelle. And in that 40 years, we've seen all this science emerge.

Some people ask, "Why not wait a little longer before taking any action?" What's your response to that?

DR. HOLDREN:

Well, my response to that is above all that this supertanker is hard to steer and it's hard to stop. And every additional year, every additional decade, that we keep on with business as usual, that we keep on building additional energy systems that are, as today's are, three-quarters dependent on fossil fuels without control of their greenhouse gas emissions, the more difficult it's going to be to change that path.

The supertanker is gaining momentum, it's getting harder to steer every year that we fail to do anything about it. So we are committing ourselves more and more to higher and higher atmospheric concentrations, larger and larger degrees of climatic disruption with every year that we delay. That's a bad idea.

THE VICE PRESIDENT:

Thank you.

THE PRESIDENT:

Thank you very much. Let me again thank you all for your patience, and your interests,

and I think we should give our panelists of scientists another hand.

(Applause)

THE PRESIDENT:

I wish every American could hear what we've heard today, but, thanks to our friends in the media, a good number of them will hear at least a portion of what we have heard today.

And this is the beginning of a consistent, long-term effort that we all have to make to involve the people of this country in this decision. And I thank you all for the points you've made because in different ways each of them will resonate with citizens of this country in a way that I believe will give us the support we need to take the action that has to be taken.

In the weeks and months ahead, the Vice President, the Cabinet, other members of the administration, and I will be out in the country discussing this. We'll be working with the American people; we'll be talking about solutions as well as problems.

The truth is it's like anything else, and another answer Dr. Holdren might have given is that the quicker you get after this, the less extreme the remedy you have to embrace to have a measurable effect to avoid an undesirable outcome, and the longer you wait, the more disruptive the ultimate resolution will be. So, that's another thing that I'd like to emphasize.

Before we close I hope you will permit me to make a brief statement. Just before I came in here to this meeting I learned that today and not very long ago retired Supreme Court Justice William Brennan passed away.

He was a remarkable human being, one of the finest and most influential jurists in our nation's history. He served on the Supreme Court for 34 years. He was perhaps during that period the staunchest, most effective defender of individual freedom against government intrusion.

His devotion to the Bill of Rights inspired millions of Americans and countless young law students, including myself, and one of the great honors I have had as President was to be able to award him the presidential medal of freedom in my first year in office.

He once said the role of the Constitution is the protection of the dignity of every human being and the recognition that every individual has fundamental rights which government cannot deny.

He spent a lifetime upholding those rights, and he authored some of the most enduring constitutional decisions of this century, including *Baker v. Carr* on one person, one vote; *New York Times v. Sullivan*, which brought the free-speech doctrine into the latter half of the 20th century.

The force of his ideas, the strength of his leadership, and his character have safeguarded freedom and widened the circle of quality for every single one of us.

We will miss him greatly, and I know you will join me in sending our best wishes and our prayers to his family and friends and our gratitude for his life.

Thank you very much.

(Applause)

(Whereupon, at 3:05 p.m., the transcribed PROCEEDINGS were adjourned.)

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Events - July 24

Same

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE & TECHNOLOGY POLICY

PRESIDENT CLINTON'S ROUNDTABLE ON CLIMATE CHANGE

East Room
The White House
Washington, DC
July 24, 1997

ANNOUNCER:

Ladies and gentlemen, Dr. Bob Shope, Dr. Henry Kendall, Dr. Jane Lubchenco, Dr. Sherry Rowland, Dr. John Holdren, Dr. Stephen Schneider, and Dr. Mario Molina.

Ladies and gentlemen, the President and Vice President of the United States.

THE VICE PRESIDENT:

Please be seated, ladies and gentlemen. On behalf of the President and the First Lady, it is my pleasure and honor to welcome all of you to the White House. I'm going to present the President in just a moment.

Before doing so, on his behalf, I would like to acknowledge the distinguished guests who are present. I will formally introduce our panel of Nobel laureates and university scientists in just a moment.

I want to acknowledge members of the President's Cabinet who are here, Administrator of the EPA, Carol Browner; Secretary of Commerce, Bill Daley; Secretary of Labor, Alexis Herman; Secretary of Energy, Federico Peña; Under-Secretary of the Treasury, Larry Summers; Director of the Federal Emergency Management Agency, James Lee Witt; Chair of the Council on Environmental Quality, Katie McGinty; the President's Science Advisor, Dr. Jack Gibbons; and other distinguished guests who are present.

We meet today to discuss the future of our planet and the realities of global climate disruption. I want to acknowledge one other person who is in the room somewhere, and I haven't had a chance to see him yet, but Charles David Keeling is here. And, Dr. Keeling, thank you very much for joining us.

And he was responsible, along with one other, in measuring carbon dioxide in the atmosphere for the very first time back in the late 1950's.

And my own introduction to this issue came about as a direct result of the measurements which showed the annual cycle of carbon dioxide and the steadily increasing peaks of concentrations of carbon dioxide. And now, of course, we know other greenhouse gases as well that resulted from those measurements.

Later, when I came to the Congress quite a few years after that, in holding hearings I saw that those concentrations had increased dramatically and, of course, all around the world scientists were studying it intensively.

And now we will soon hear from these scientists about what the world's scientific conclusion is about what this means for increased droughts and floods, dramatic changes in the distribution of forests and crop lands.

And all of this gives rise to great concern that we are committing future generations to a planet that is altered in profound ways that can cause great harm to future generations.

This Administration has always worked on a simple principle, when addressing problems of a scientific and technical nature, and that principle is science must inform policy decisions.

Scientists are by nature a cautious group, but the world's scientific community is telling us in many ways that they believe that we as a civilization are disrupting the balance of the world's climate.

In the words of the 2,000 scientists who participated in the intergovernmental panel on climate change, and I quote, "There is a discernible human influence on global climate."

More than 2,600 scientists have signed a letter about global climatic disruption which we'll be hearing more about in just a few minutes.

Today we hear about the concerns of scientists. They speak as eminent experts, and as U.S. citizens who care about the future of this planet. Each has a resume far too long to recount, but let me briefly introduce those who are with us today.

Dr. Sherry Rowland won the 1995 Nobel Prize for Chemistry for his pioneering research in atmospheric chemistry, explaining the destruction of the stratospheric ozone layer. He is also a professor at the University of California at Irvine and an official with the National Academy of Sciences.

Dr. Mario Molina shares the 1995 Nobel Prize with Sherry Rowland. He is the Lee and Geraldine Martin Professor of Environmental Science at MIT.

Dr. Jane Lubchenco is an eminent ecologist, past president of the American Association for the Advancement of Science, very active with the AAAS, and also past president of the Ecological Society of America. She is currently the Wayne and Gladys Valley Professor of

Marine Biology, and a distinguished Professor of Zoology at Oregon State University.

Dr. Stephen Schneider is a climate scientist and professor at Stanford University, recipient of a MacArthur Fellowship, and winner of the American Association for the Advancement of Science's Westinghouse Award for Public Understanding of Science and Technology.

Dr. Bob Shope has devoted his professional life to the study of viruses carried by biting insects. He is currently a professor in the Departments of Pathology and Microbiology and Immunology at the University of Texas.

Dr. Henry Kendall won the Nobel Prize for Physics in 1990. He is Chairman of the Board of the Union of Concerned Scientists and the J. A. Stratton Professor of Physics at the Massachusetts Institute of Technology.

And John Holdren is an expert on energy and environmental science, and delivered the Nobel Peace Prize acceptance lecture on behalf of the Pugwash Conferences. He is currently the Director of the Program on Science, Technology, and Public Policy at the John F. Kennedy School of Government and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences at Harvard.

And now I would like to introduce the person who is leading our country and the world towards a recognition of what must be done to deal with this issue. It is my honor, ladies and gentlemen, to present the President of the United States, President Bill Clinton.

THE PRESIDENT:

Thank you very much. Thank you. Ladies and gentlemen, first let me thank you for being here, members of the administration, and concerned members of the public, the scientists and other experts that are here.

I would also like to say a special word of thanks to the Vice President. In one of our earliest meetings together -- we meet once a week and have lunch -- he went over the whole history of greenhouse gas emissions and climatic change. And I became convinced first that he was convinced that something was wrong. Then I became convinced something was wrong.

And it's been a great help to me and, I believe, to the people of the United States to have him in the position that he's in, not only with the convictions that he has but with the knowledge that he has, and I'm very grateful to him for what he has done to help me come to grips with this issue.

To me, we have to see this whole issue of climate change in terms of our deepest obligations to future generations. I have spent most of my time in the last 4½ years trying to prepare the American people for a new century and a new millennium.

It is also very important that we protect the Earth for that new millennium, to make sure that people will be able to take advantage of all the things we are trying to do, the opportunities we are trying to create, the problems we are trying to solve.

It is obvious that we can not fulfill our responsibilities to future generations unless we deal responsibly with the challenge of climate change. Whenever the security of our country has been threatened, we have led the world to a better resolution. That is what is at stake here, and the scientists have come here to explain why.

As the Vice President said, the overwhelming balance of evidence and scientific opinion is that it is no longer a theory but now a fact that global warming is for real.

The world's scientists believe that, if we don't cut our emissions of greenhouse gases, we will disrupt the global climate; in fact, there is ample evidence that human activities are already disrupting the global climate and that, if we stay on our current course, the average global temperatures may rise 2 to 6 degrees Fahrenheit during the next century.

To put that in some context, the difference in average temperature between the last ice age, which was 10,000 to 12,000 years ago, and today, is about 9 degrees Fahrenheit. So we could have two-thirds of that change in 100 years unless we do something.

If we fail to act, scientists expect that our seas will rise one to three feet, and thousands of square miles here in the United States in Florida, Louisiana, and other coastal areas will be flooded.

Infectious diseases will spread to new regions. Severe heat waves will claim lives. Agriculture will suffer. Severe droughts and floods will be more common. These are the things that are reasonably predictable.

In the face of this, the United States must confront a challenge that in some ways is the most difficult of all democracy's challenges to face; that is, we have evidence, we see the train coming, but most ordinary Americans in their day-to-day lives can't hear the whistle blowing.

Unless they have lived in a place where they have experienced severe and unusual and completely atypical weather disruptions in the last five years or so, the degree of the challenge is inconsistent with the actual perceived experience of most ordinary Americans. And this is true, indeed throughout the world, and that presents us our challenge.

A democracy is premised on the proposition that, if the American people or any people in any democracy know what the facts are and believe them, way more than half the time they will do the right thing.

And so what we are doing today is beginning a process in which we ask the American

people to listen to the evidence, to measure it against their own experience, but not to discount the weight of scientific authority if their own experience does not yet confirm what the overwhelming percentage of scientists believes to be fact today. This is a great exercise and great test for our democracy.

I do want to say that I am convinced that, when the nations of the world meet in Kyoto, Japan in December on this issue, the United States has got to be committed to realistic and binding limits on our emissions of greenhouse gases.

Between now and then we have to work with the American people to get them to share that commitment. We have to emphasize flexible, market-based approaches. We have to embrace research and development efforts in technology that will help us to improve the environment while permitting our economy to grow. We have to ask all nations, both industrial and developing, to participate in this process.

But if we do this together, we can defuse this threat, and we can make the 21st century what it ought to be, not only for our children but for all the children of the world. I believe the science demands that we face this challenge now. I'm positive that we owe it to our children. And I hope that we can find the wisdom and the skill to do democracy's work in the next few months to build the consensus necessary to actually make action, as opposed to rhetoric, possible.

And for all of you, for your commitment to that, I thank you. And now I'd like to ask Dr. Rowland to be the first of our distinguished scientists to lead off.

Doctor.

DR. ROWLAND:

Mr. President and Mr. Vice President, global climatic change is underway. Carbon dioxide from the combustion of coal, oil, and natural gas has risen by 15 percent in the atmosphere since 1958. Methane, some of which is emitted from cattle and rice paddies, has risen by 16 percent since 1978. The air now holds four times as much chlorofluorocarbons or CFCs as it did 25 years ago.

The amount of ozone in the stratosphere over the United States is 6 to 10 percent lower than it was in the 1960s. Many other changes are occurring as well. The global average surface temperature has risen about 1 degree Fahrenheit during the past century, and sea level has risen from 4 to 10 inches.

Land use patterns have been greatly altered as forests are burned for use as agricultural land. Many of the biological species formerly in these forests are disappearing. The geographical ranges of tropical diseases are moving northward. Human activities are the chief cause of many of these changes.

During the 20th century the developed countries have changed from the agricultural societies of 1900 and to the highly industrialized urban environments of the present. Great forward progress has occurred in the comfort and well being of significant segments of the global population, although not for all.

Enormous strides have been made in health. Death rates are lower, life spans are much longer. The last century has also seen a tremendous growth in the global population from about 1½ billion in 1900 to 6 billion in the year 2000 and 8 billion in the year 2025.

Much of the progress and affluence has resulted from the substitution of non-living sources of energy for human and animal energies. The availability of engines, of electricity, most of this energy comes from the burning of coal, gas, and oil.

These energies bring with them environmental consequences, carbon dioxide from the fossil fuels, the radioactivity of nuclear waste.

In Japan in 1959, I encountered bullock carts on the road to a nuclear research center. In China in 1980, humans propelled wheelbarrows to move dirt from road construction sites. In contrast, the City of Shanghai alone now has 20,000 major construction projects going simultaneously. And much of the world is moving as fast as possible into a more affluent, energy-intensive era.

This combination of a rapidly growing world population with an increase in per capita use of energy carries with it great pressures on the environment and on the atmosphere. Because the wind circles the earth within a few weeks, greenhouse gases emitted from each country quickly become a global problem requiring a global solution.

Our earlier experience in dealing with the destruction of stratospheric ozone by the CFCs has taught us that humans can collectively interfere with natural processes on a global scale.

Further, despite the immense amount already known about the atmosphere and the oceans, these are complicated systems with uncertainties going in both directions. Surprises can happen. Witness the devastating losses of ozone over Antarctica every spring.

However, the United Nations' Montreal Protocol, which is now successfully controlling the emissions of CFCs into the atmosphere, demonstrates that the nations of the world can agree to act when it's for the mutual benefit of all.

During the 1990's, these countries have called upon the world's scientists to evaluate the question of global warming from the accumulation of greenhouse gases. In response, the authoritative IPCC has estimated a probable increase in global and surface air temperature of about 3½ degrees Fahrenheit by the year 2100 with a possible range from 2 to 6½ degrees Fahrenheit.

They further stated, as you heard from the Vice President, that the balance of evidence suggests a discernible human influence on global climate, and they warned that the average rate of warming will probably be greater than any experienced in the past 10,000 years.

Much of the variations in outcomes depends upon what the countries of the world do to control the emissions of carbon dioxide and other greenhouse gases in the intervening years. More than 2600 scientists have now signed this scientist statement on global climatic disruption in which as scientists and as concerned citizens we ask that the United States demonstrate strong leadership in the global effort with a firm proposal for reducing U.S. emissions of greenhouse gases.

THE VICE PRESIDENT:

Mr. President, I would like to ask a question. The scientists' statement uses the term "disruption" and uses the word "irreversible." Those are strong words for scientists, who, as I mentioned, are by nature cautious.

How do the risks that we face from global warming compare to the risks from the destruction of the stratospheric ozone layer that you and Dr. Molina described several years ago?

DR. ROWLAND:

Both of these are very serious problems for the environment. In the case of the CFCs, these are gases that were manufactured by about 20 companies globally and all of them science-based, and the uses were almost entirely in affluent aspects of society.

In the case of the fossil fuels, everybody uses energy from fossil fuels nearly everyday in every activity that they do, so it is a global problem that requires actions, both by the rich countries and by the poor countries.

We need strong leadership from countries such as ours which have the powerful science and technology base with which we can try to solve these problems. We can do it, but we have to have the commitment.

THE VICE PRESIDENT:

Well, thank you very much. Mr. President, with your permission, I'd like to ask Dr. Mario Molina to give us an overview of the science of climate change.

To set this up for you, Dr. Molina, I just wanted to say that one of the most compelling pieces of evidence for many people is the record of climate over a long period of time, 160,000 years, that is, taken from the ice core in Antarctica and also in Greenland.

As others here can explain better than I, they measure the atmosphere in these bubbles trapped in the ice, and each year is easy to record. And they pull out a very accurate record of temperature and carbon dioxide concentration. Why don't you take it from there, Dr. Molina,

and correct any mistakes I made along the way there?

DR. MOLINA:

I'd be pleased to do that, Mr. Vice President. First of all, let me just summarize. The greenhouse effect is a name of a process, a process which affects the heat patterns of our planet.

Our earth receives energy from the sun which passes relatively freely through the atmosphere. But the energy that the earth emits to outer space is actually trapped. It's emitted mostly in the form of infra-red radiation, and there are certain gases in the earth's atmosphere that trap some of this radiation affecting these heat patterns.

One of these gases is carbon dioxide. It's a very important so-called greenhouse gas. And what we have in this graph is a representation of the amount of carbon dioxide going back in time that we heard from the Vice President earlier on mention about some recent record set involved with of changes in carbon dioxide in this century.

But what we have here going back in time is 160,000 years, and we have levels of carbon dioxide that range between about 190 and 280 parts per million. How do we know this? Well, it turns out that one can measure the composition of air bubbles that are trapped in ice. Ice Cores, particularly in Antarctica, like as shown here, but also Greenland. From that we can really get information about the amount of carbon dioxide, not just locally but the amount that exists globally at that time.

What we have down here, the yellow curve, is a similar record of temperature, temperature going from the present back 160,000 years. And what is very remarkable is, of course, a very large correlation between these two curves.

What I'd like to do is to point out where we are now. What we have here are just amounts. You can see the pre-industrial amounts below 300 parts per million. If we can show the rest of the second panel here, this is to indicate where we are now, which is roughly 365 parts per million of carbon dioxide.

And what is striking is this is a level that we haven't seen before, certainly not in this 160,000 years. And what is also very striking is how fast we're getting there.

Let me point out also that besides these very striking correlations between these two curves there is an important physical mechanism that ties in now, and that's precisely the greenhouse effect. To explain that a little bit more in detail, the way we understand climate often is by doing computer simulations, to sort of synthesize knowledge that we have, because climate is a very complicated system.

These computer simulations are by no means perfect, but we understand, for example, that ice ages come about from changes in the way the energy from the sun reaches the earth,

changes between the way it reaches the poles versus the equator, changes between summer and winter, and that explains to some extent the appearance of ice ages.

But it's not enough to look at those changes. It turns out that it's important to also consider other effects such as the greenhouse effect from carbon dioxide, low levels when the temperatures are low, high levels when the temperatures are much larger.

The next question is where are heading? And for that we need to look at one more panel. What happens in the future, that, of course, is a prediction. That depends on what we do. But if we just continue with the so-called business-as-usual scenario, we can predict that we are going to reach levels way up there, about 700 parts per million.

And what is pretty remarkable is really how fast this would occur on a geological time scale or an evolutionary time scale. It's really like the blink of an eye.

I should point out that the earth has actually seen such high levels of carbon dioxide in the past, but that was some 50 million years ago, and, believe me, the earth was a very different place from what it is now 50 million years ago.

So, from this sort of evidence, it's what the scientific community really considers this to be a serious problem. All the magnitude and the pace of change is what makes us really worry and take this problem very seriously.

THE VICE PRESIDENT:

Thank you very much. Could you briefly point out the last two ice ages on that temperature record going back into the past?

DR. MOLINA:

Yes, the ice ages are forced when the temperature is low. We have low temperatures here. This is in degrees centigrade, 6 degrees centigrade, about 8 or 9 degrees Fahrenheit. And the previous one, as the President pointed out, was about 10,000 years ago. I should point out that even though this appears to be just a small temperature change, for example, for people like myself living in Boston, that represents a change from the nice weather we have today and a whole mile of ice above the surface.

THE PRESIDENT:

Thank you very much. Now, I'd like to call on Jane Lubchenco, our expert on ecology, and see what such significant changes in greenhouse gas levels might mean for natural resources.

Jane.

DR. LUBCHENCO:

Mr. President, Mr. Vice President, as both of you are aware, the ecological systems of the

world, the forests, the wetlands, the coral reefs, provide the life support systems for all of life on earth.

Most people are aware that we derive goods from these systems, food, fiber, genes, medicines what most people are unaware of are the services that are provided to us free of charge by these ecological systems of the world.

These services include things like the control of floods, the purification of air and water, and even the creation of beautiful places that provide us with recreation and inspiration. These eco-system services are largely outside our economic systems, but their value is estimated to be well in the trillions of dollars annually.

These eco-system services are provided to us by the functioning of intact ecological systems, and when those systems are disrupted or when those systems are lost, then we lose the goods and services that are provided by those systems.

Climate change will undoubtedly affect the continued provision of these goods and services, although we can not always predict exactly what the details will be. To provide a few vignettes of the ecological consequences of climate change, in the optimistic scenario of a doubled CO₂ world, let me invite you on a brief field trip to different parts of our country.

Let's begin in the forests of New England. As the earth warms and climatic zones move northward or toward the poles, existing forests will be stranded and their processes disrupted. The forests of New England, like probably a third of the forests around the globe, will undergo major changes.

For example, we would probably lose sugar maples from the New England Forests. Can you imagine going to watch the gorgeous fall foliage in New England without sugar maples?

Let's move to the southern parts of our country. Salt marshes in Louisiana are already being submerged. Climatic change would exacerbate this problem as sea level rises between six inches and three feet.

Sea level rise will also affect other coastal ecosystems; for example, the salt marshes and mangroves of the Florida Everglades. A sea level rise of just one foot would result in loss of one third of the Florida Everglades.

The loss of mangroves and salt marshes would result in the loss of the services provided by these systems, and those services include things such as nursery areas, natural hatcheries for important fish and shellfish, the detoxification of pollutants, the trapping of sediments, the creation of a habitat for unique plants and animals, and protection of shores against the battering of waves.

These ecosystem services are vitally important, and when we lose systems we lose those

services.

Now let's move to the Midwest. While these highly managed agricultural systems are thought to be quite adaptable, climate change is likely to increase demands on water use to ameliorate soil drying, and pesticide use to combat increases in the incidents of pests and diseases.

Drought is no stranger to these regions. In the heat wave in 1988, drought resulted in a drop in U.S. agricultural production by a third. Flying up to Glacier National Park in Montana, we would be dismayed to find out that fully 73 percent of the glacial areas has already been lost since 1850 because of climate warming.

In fact, climate change is predicted to result in loss of all of the glaciers in the park by the year 2030, well within many of our lifetimes. Even greater ecological changes are predicted to occur in polar regions.

As an ecologist, I must emphasize that the slower the rate of change in climate, the less catastrophic the results. Let me repeat that: The slower the rate of climate change, the less catastrophic the results.

Species are more likely to be able to migrate, to grow and evolve if rates of change are slower. At slower rates of warming more trees could migrate effectively, more corals could keep up with sea level rise, and more species could evolve adaptations.

Climate change is only one of many environmental changes that are occurring around the world today. These multiple stresses include familiar things like urbanization, over-fishing, pollution, and the loss of biological diversity.

Taken together, these stresses are reducing the ecosystem goods and services that we depend upon for our quality of life. As a scientist, I know enough to appreciate how serious and urgent the problem of climate change is.

In addition to that, as a mother I care especially about the prospects of the world that my children will inherit. I do not wish them to have a world that is disrupted.

The quality of their future depends upon our willingness to act and to act quickly.

THE VICE PRESIDENT:

Let me call now on Dr. Steve Schneider to discuss the risks of severe weather events, extreme weather events, which have been predicted to accompany global warming, droughts, floods, hurricanes, and we'd be interested in your thoughts on those and also the interaction of those with rising sea level.

DR. SCHNEIDER:

Thank you very much, Mr. Vice President, Mr. President. We're really talking now about the issue of so what if the climate changes? That's what we're addressing at the moment. This is a question that scientists have spent a long time on. There are quite literally hundreds of studies, some suggesting catastrophic outcomes, some mild. It gets confusing. The economists, of course, want to know how much it costs, what we call climate damage.

In that process of trying to sort through that confusion, a survey was taken a number of years ago by a Yale economist, William Nordhouse. Included in the survey were people as Under-Secretary of Treasury Summers, I was one of them. And we were asked what kind of damages to the economy might occur from this wide range of impact.

And, of course, all the uncertainties were put in. As the Vice President said, scientists can not avoid that. We observe those uncertainties. But our best guesses I can summarize briefly from perspective: In a nutshell, the economists in the group gave a number like something like 1 percent of gross domestic product would be their best guess with lots of uncertainty. And in the natural scientists it's something in the order of 10 percent. You might wonder why such a difference?

Well, it comes out from the natural scientists having a higher degree of concern over the kinds of ecological services that Jane Lubchenco referred to not being simply replaced and the economists who are optimistic about human substitution for that.

But I don't want to get into who's right or who's wrong, just put some perspective on it. If we took the lower of those two numbers, remember, 1 percent of GDP in today's terms for the world is \$200 billion.

So, it's not a trivial question in terms of climate damage. Now, where would a number like that come from? And that's the issue that you asked me. Let's take a look at it in just two examples, the sea level question and the question of hydrologic extremes, by which we mean droughts, and floods. Let's do sea level first.

We all remember the terrible pictures from hurricane Andrew. If one costs that, it was something on the order of \$40 billion lost in Florida and in other parts around the Caribbean. And physical reasoning says could we have had something to do with that? I mean, after all, if you increase the temperature of the oceans, it increases evaporation, it might make storms stronger.

That debate takes place, but that's very controversial. But one thing we know that isn't controversial is that before 1987 there were no losses larger than \$1 billion. And now the insurance industries are very concerned that there are several in the tens of billions of dollars. What else do we know that's not controversial?

Sea levels have gone up, as we've heard several times. Between about 4 and 10 inches are projected typically to go up about 6 inches to maybe 3 feet, depending upon how things turn out in the next century.

And what we know is, whatever the damage that storms do when they go by, whether they're augmented in strength by global warming or they remain natural at their levels that we're used to, they'll be causing flooding from a higher sea-level base. As a result of that, the damages would go further inland. And that part contributes to that number referred to in the other studies.

What about the hydrologic extremes? Well, we all saw the pictures of the 1988 drought. We know about the seemingly endless stories of floods now. And the question is has nature rolled us a double snake eyes, or have we started to load the dice?

And that's what the scientific debate is about. And, again, they're some well-known physics which says if you increase the heating of something that has water in it, more water will evaporate. Well, it doesn't require a Ph.D. to figure that out. Almost every farmer knows it, and anybody who's ever tried to water a lawn knows that, when it's hotter, the water comes out of the lawn quicker. You have to water more. So, what that suggests is more water in the air means when it's going to rain the rainfall can be more intense. When it's dry you can have more evaporation. That's where this whole idea comes from.

Well, this is out of physics. The question is what's happening. A line that we have often in science is, well, in God we trust, but for the rest of us please show data.

And the data in this case have been coming out quite a lot lately. And Dr. Tom Karl, for example, has been studying and his colleagues in North Carolina have been studying this for a long time. And they've concluded that there's about a 10-percent increase in precipitation across the United States since 1910. But that's not the interesting part to me. And I want to quote this to make sure I get it correct. The interesting part, as Tom says, is, "The increase in precipitation is reflected primarily in the heavy and extreme daily events." Translate that: Gully washes. The bulk of the rain fall increase has been in those kinds of damaging, extreme events.

So, is this a natural oddity or is it us? I think we still can't answer that question definitively. All we can say is it's consistent with what our understanding. It's consistent with our computer simulations, but it's still circumstantial evidence.

The problem is this experiment is being performed while we speak on a laboratory, but it's laboratory earth, and we're along for the ride with all the other living creatures on earth.

Finally, we've heard everyone say that this is a very complex system, very difficult to forecast. It's an atmosphere ocean, land, ice, biosphere system, all coupled. Scientists use the fancy word "nonlinear." The IPCC was referred to several times here, concluded with a paragraph. I know it well as a lead author of the IPCC, and I'll quote what it said in its last

paragraph of the summary for policy makers. "When rapidly forced, nonlinear systems are especially subject to unexpected behavior." I translate that again. In my words that means reducing the pressures humans put on nature is insurance against potential nasty surprises.

THE VICE PRESIDENT:

I want to acknowledge Senator Max Baucus, who I neglected to acknowledge earlier. We're glad you are here.

Dr. Schneider, before we move on, let me just ask a question that I think has been on the minds of a number of people around our country in the last few years. We had a really unusual flooding event in North Dakota, South Dakota, Minnesota earlier this year.

We also had a really unusual flooding event in the Ohio River Valley and in the San Joaquin River valley and up around Seattle. And a couple of years before that we had that very unusual flooding event in the Midwest which created a new shallow great lake for a while before it went away.

And all around the United States there are people who are saying to their neighbors didn't we just have a hundred-year flood just a few years ago. And how come we're having another one so quickly? And how does this anecdotal evidence and the tragic experiences of so many Americans relate to what you just said about loading the dice?

DR. SCHNEIDER:

I'm trying to resist the temptation to retreat into the usual scientists caution.

THE VICE PRESIDENT:

Well, you got an award for not doing that.

THE PRESIDENT:

Is that what you got that for?

DR. SCHNEIDER:

I was about to say -- we won't argue. The best that I can say is there's that evidence that you cite. There's also the fact that in the 1990's, we had the longest *El Niño* events on record which had a major impact on weather all around the world.

And there is a whole series of these coincidences, these events, which appear to be unusual, any one of which you would argue is just a simple piece of circumstantial luck, where nature is being perverse. But a pattern is emerging, and the pattern is consistent with the expectations from our models; and, therefore, those combinations of factors led the IPCC to make the discernible statement that you said before.

So, while no one event certainly could be laid to the doorstep of global warming, the

increasing frequency and magnitude of these could very well be the first signs of the canary in the cage that's starting to quiver.

THE PRESIDENT:

"The canary in the cage is starting to quiver." Thank you very much. Now, I'd like to ask Dr. Robert Shope, who has studied infectious diseases extensively, to discuss how human health might be affected by climate change.

MR. SHOPE:

Thank you, Mr. President. Health and the environment are closely linked. You've heard about the selective warming, especially at night, changes in rainfall patterns, and more frequent storms. If there is a 6 degree Fahrenheit warming, the heat alone in North American cities such as Washington, D.C. will result in an excess of deaths, especially in elderly people, who do not adapt well to severe warmth. We had an example in July of 1995 in Chicago, Illinois. There the temperature exceeded 90 degrees Fahrenheit both at night and day during a prolonged period, and there were recorded 465 deaths in Chicago related to the heat.

My own personal experiences is with diseases transmitted by ticks, mosquitoes, and other biting insects. The agents that cause these diseases are viruses, they're bacteria, and parasites. For the viruses, especially, we have no specific treatment, and for the parasites such as malaria, we have drugs, but the organism is rapidly overcoming and becoming resistant to the drugs.

Let me talk about dengue virus. This causes a disease in people which is typically a high fever, headache, muscle aches, and pains, sometimes a rash. There is a severe form of dengue, which we call dengue-hemorrhagic fever which, when you have this disease, the case fatality rate or the mortality rate is about 10 percent.

The virus is transmitted by a mosquito that lives in and around homes in tropics and warm climates and tropics and subtropics. The mosquito is killed by a hard freeze; therefore, its northern limit is about Memphis, Tennessee at the present time.

We've seen in the last decade a steady increase in the numbers of cases of dengue in tropical America, including Mexico. This disease is now literally on our southern border. In 1995 there were recorded in excess of 4,000 cases in Reynosa and some of the other Mexican cities along the Rio Grande river.

I cannot tell you whether dengue epidemics will occur in the United States, and perhaps air conditioning and screened homes may protect us. On the other hand, with climate change and warming, I will predict and many of us predict that the mosquito will thrive further north. As the climate warms, the virus will multiply in the mosquito more rapidly. The mosquito will be able to feed more frequently.

These same factors apply to the vector of malaria, also a mosquito. Malaria is a disease

that worldwide kills approximately 2 million people each year. It's a tropical disease. The disease recently has occurred in small outbreaks in the United States, in New Jersey, New York, and also in Texas, and with warming we can expect these epidemics to continue or small outbreaks to continue and to enlarge.

The factors that I've talked about and other factors that we can demonstrate in the laboratory argue for controlling the environment while we still have time, and I will say that the best insurance is preparedness.

There are many other such diseases directly affected by rainfall and warming. I'll mention St. Louis encephalitis in the western part of the United States, the tick-borne Lyme disease, which many of you are familiar with, the newly recognized rodent-associated Hanta virus pulmonary syndrome, which broke out in 1993 in the southwestern part of the United States.

Each nation in the world has its own set of diseases, some of which affect Americans abroad or can be transported and introduced into the United States. Therefore, the problem of climate change and health is of common interest among nations as are the solutions. Thank you.

THE VICE PRESIDENT:

So, if we get the kind of warming that the scientists are now predicting and a change in climate so that a place like Boston has a climate that we now more nearly associate with Atlanta or even farther south, you would also see a change in the distribution of diseases and the pests and insects that carry diseases. Is that the basic point?

DR. SHOPE:

That's the basic point. That's the take-home message, yes.

THE VICE PRESIDENT:

All right. All right. In the south, we saw kudzu come in. We're talking about microbial kudzu, as far as I can tell. I'd like to ask Dr. Henry Kendall, Nobel laureate and chairman of the Union of Concerned Scientists to speak to the international dimensions of the issue.

MR. KENDALL:

Yes. Mr. President, Mr. Vice President, thank you for this opportunity. Disruption of the climate is linked and can aggravate many other human problems, and you've heard some samples today, and they're just samples of a wide spectrum.

But one link I'd like to talk to is the connection with world food production. There are developing troubles in this sector independent of the climate, and they're little known.

Agriculture, as widely recognized, needs a stable climate in order to be highly productive,

yet look at 1988. It was one of what appears to be a series of the hottest years on record, but in that year in the central North American continent we had a combination of high temperatures and drought. And both Canada and the United States lost one-third of their grain supplies.

The United States, it was the first time in 200 years that current production was not adequate to feed us. In the years since Australia and Mexico have had somewhat similar events. It would be really scary if this becomes a pattern.

Now, food demand is expected to double in the next 30 years, which is almost no time at all. Fresh water, which is vital for irrigation, is already short. The human race uses nearly one half of the available fresh water, and 40 percent of the world's population lives in areas that are water-short.

Expansion into new arable land is highly constrained, and, let me say, the last thing we need are climatic changes and disruptions putting additional pressures on a system which is already becoming considerably stressed.

Of course, it's the bottom tier of the developing nations that will get hit directly by shortages, a large number of people, nearly 1 billion, one in six of everyone living. Many of those nations will have great trouble, and some, I believe, will find it impossible to feed themselves.

What this is doing, and it has already started along with some other factors, is to generate increasing numbers of hungry migrants, environmental refugees, streaming across national borders.

Now, these migrants do not wish to be dislocated, and they've discovered that their destinations don't always welcome them as the reactions both in Europe, in the wealthy nations there, and in the United States have demonstrated to us.

The result is that no nation will be sheltered from dislocation of food supplies, altered trade balances, fresh water difficulties. These are already surfacing in the Middle East, where the United States has vital interests, and have engendered more than a half a dozen wars out there. Flow of migrants which may at worst increase into the hundreds of millions of people. And even though the wealthy nations will remain able to feed themselves, and remain well fed into the future, no nation will escape the troubles from pressures on the food supply.

Mr. President, it is not the case that one end of the boat can sink, so let me say that this is a developing problem in national security, and we have to deal with it. The best way to deal with problems of that sort is to stop them at the outset and not wait until the results are presented to us and the great troubles develop. Thank you.

THE PRESIDENT:

Let me ask you something: I don't really want to take you afield from the subject, but one of the things that has perplexed me about this is won't there be serious problems of water quantity and quality almost no matter what we do?

DR. KENDALL:

Well, there will certainly be developing problems, and I think it is slated to get worse, but we have it under control at some level to keep them from getting extraordinarily harsh and severe. Disruption of the ecosystems does interrupt the purification of water in wetlands, and as these disappear, as they're doing here, it will hurt water quality.

If there are shifts in patterns of rainfall, it will upset ecosystems, it will upset agriculture, and this will certainly develop because some of the greenhouse warming is now at some level irreversible. The hope is to keep it from developing to unacceptable levels of severity.

THE PRESIDENT:

Thank you.

I'd like to now turn to Dr. John Holdren, who's worked on many global issues, energy, the arms race, plutonium disposition. He's done a lot of work for us on that, and I thank him for that. I'd like to say that, to go back to my opening remarks, you signed the scientist statement. You clearly see this as a big threat.

Many people here and around the world seem unconcerned. Why do you think people are underrating the importance of the issue, and what do you think we can do about it? And secondly, one of the things all the developing countries are saying is well, right now, you rich countries are the biggest part of the problem, and, when you want to include us in this, you are basically just trying to keep us poor. So, let us pollute a while and get rich, and then lecture us about fixing the environment.

What is the responsible way for the wealthier countries to do what we should do and still get the developing countries to do what they can do within the context of their legitimate aspirations for their people?

I know I'm asking you a political question here, but you must have thought about it in the context of what you're trying to achieve.

DR. HOLDREN:

Well, Mr. President, given the second part of that question, I assume my time has been doubled.

THE PRESIDENT:

I notice you speak fast when you're excited about something.

DR. HOLDREN:

I'll try to do that. I think, Mr. President, Mr. Vice President, there are at least six reasons why most people underrate the seriousness of the climate disruption problem, and running through those six reasons gives us a way to revisit in a way many of the most important points that were made this afternoon, and I'll end up right at the second part of your question.

I think the first reason that people tend to underrate this problem is that human well being is a lot more dependent on climate than most people think. As you heard today, we're talking about the productivity of farms and forests and fisheries. We're talking about the frequency and intensity of floods and droughts and heat waves. We're talking about the geographic pattern of disease. We're talking about sea level rise and associated destruction of coastal property. And we're talking about the potential for political tension and conflict over these consequences, and out of disputes over who's responsible and who should pay, which is part of the last problem you were mentioning.

The second reason people tend to underrate this problem is that climate disruption is a lot further along than most people think. As we've seen, atmospheric carbon dioxide is already higher than it's been in the last 160,000 years.

The global surface temperature, which is expected to lag behind increasing carbon dioxide concentration, is higher than it's been in the last thousand years.

And the evidence of this, the indicators of this climate change, are apparent in rising sea level, in increasing precipitation, in changing patterns of disease, and in a lot more.

The third reason that many people are more complacent than they should be is that the climate implications of future growth in population and future growth in energy consumption are a lot bigger than most people think.

We're going to have in the year 2050, barring near disaster, something like 9 billion people compared to less than 6 billion today. We're going to have energy use under business as usual that will be three times higher than today's worldwide. We're going to have carbon dioxide emissions that are two to two and a half times today's worldwide. And remember that today's are already in the process of getting us into serious climatic difficulty.

We're going to be in the year 2050, if we don't change business as usual, a long way down the path toward a climate regime that hasn't been seen on this planet in 50 million years.

The fourth point is that scientific uncertainties are not grounds for complacency, in spite of what many people think about that. There are uncertainties about many of the details of timing and magnitude and regional variation in the consequences of climate change, but there is no uncertainty at all that humans have altered significantly the global atmospheric concentrations of gases we know to be critical in controlling climate.

And there's a solid consensus among the scientists who have studied these matters seriously that the chances of significant impacts on human well being from climate change over the next few decades are substantial.

We also need to remember that uncertainties, such as they are, cut in both directions. It could turn out that disruption to human well being from climate change is coming at us more slowly and in smaller magnitudes than today's best estimates predict.

But it also could turn out that those disruptions are coming at us faster and in bigger magnitudes than today's best estimates predict. And, indeed, in looking at what most of the computer simulations of the consequences of climate change leave out, I personally would bet on worse rather than better estimates.

The fifth reason that people underrate the problem is that the time lags between cause and effect and between effect and remedy are longer than most people think. Those time lags and above all the several decades that it will take to substantially successfully transform the world's fossil fuel- dependent energy supply system mean that doing nothing is a very dangerous course of action.

The world's energy-economic system is a lot like a supertanker, very hard to steer and very bad brakes, and we know from the science that has been reviewed here today that supertanker is heading for a reef. And we can see the water under the hull getting shallower and shallower as we go along.

Now, even though we can't say exactly when we're going to get to the point where that reef rips the bottom out of the supertanker, it's a bad idea in these circumstances to keep on a course of full speed ahead.

In fact, in this situation, pointing to uncertainties about the details, pointing to areas of ignorance, and saying well, it's fine is like saying, since this whole supertanker business is proceeding in the fog, we should feel better about it.

The last reason that I'll mention here that people tend to underrate this problem gets to your second part of your question is that the fate of industrialized and less developed countries is a lot more interconnected than most people think.

Now, it is true that the industrial nations like the United States, because of their wealth of capital and technology and infrastructure, are in a better position than the less developed countries to change and adapt and adjust.

We'll still suffer from climate change, but the developing countries will probably suffer more. Should that make us happy? Should that make us complacent? Certainly not. We all live on this planet under one atmosphere.

We all live on the shores of one global ocean. Our countries are linked by flows of people, of money, of goods, of ideas, of images, of drugs, of weapons. It should be clear, as Dr. Kendall already said, you can't have one end of the boat sinking while the other end floats.

If we are to enjoy in the industrialized countries a stable and sustainable prosperity, we are only going to be able to manage that if we can achieve for the rest of the world now less fortunate a stable and sustainable prosperity as well.

And the only way to do that is going to include addressing the danger of global climate disruption in a cooperative way. That cooperation in everybody's mutual interest is the key to the second part of your question.

And I really want to say, Mr. President and Mr. Vice President, all of us applaud your initiative and your leadership in stepping up to the challenge that this global problem and the need for global cooperation to address it represent. Thank you.

THE VICE PRESIDENT:

I have one brief question. There are some people who say, "Why don't we just wait a little while longer before we take any action?" This year, incidentally, marks the 40th anniversary of the first measurements of CO₂ in the atmosphere by Charles David Keeling and the late Roger Revelle. And in that 40 years, we've seen all this science emerge.

Some people ask, "Why not wait a little longer before taking any action?" What's your response to that?

DR. HOLDREN:

Well, my response to that is above all that this supertanker is hard to steer and it's hard to stop. And every additional year, every additional decade, that we keep on with business as usual, that we keep on building additional energy systems that are, as today's are, three-quarters dependent on fossil fuels without control of their greenhouse gas emissions, the more difficult it's going to be to change that path.

The supertanker is gaining momentum, it's getting harder to steer every year that we fail to do anything about it. So we are committing ourselves more and more to higher and higher atmospheric concentrations, larger and larger degrees of climatic disruption with every year that we delay. That's a bad idea.

THE VICE PRESIDENT:

Thank you.

THE PRESIDENT:

Thank you very much. Let me again thank you all for your patience, and your interests,

and I think we should give our panelists of scientists another hand.

(Applause)

THE PRESIDENT:

I wish every American could hear what we've heard today, but, thanks to our friends in the media, a good number of them will hear at least a portion of what we have heard today.

And this is the beginning of a consistent, long-term effort that we all have to make to involve the people of this country in this decision. And I thank you all for the points you've made because in different ways each of them will resonate with citizens of this country in a way that I believe will give us the support we need to take the action that has to be taken.

In the weeks and months ahead, the Vice President, the Cabinet, other members of the administration, and I will be out in the country discussing this. We'll be working with the American people; we'll be talking about solutions as well as problems.

The truth is it's like anything else, and another answer Dr. Holdren might have given is that the quicker you get after this, the less extreme the remedy you have to embrace to have a measurable effect to avoid an undesirable outcome, and the longer you wait, the more disruptive the ultimate resolution will be. So, that's another thing that I'd like to emphasize.

Before we close I hope you will permit me to make a brief statement. Just before I came in here to this meeting I learned that today and not very long ago retired Supreme Court Justice William Brennan passed away.

He was a remarkable human being, one of the finest and most influential jurists in our nation's history. He served on the Supreme Court for 34 years. He was perhaps during that period the staunchest, most effective defender of individual freedom against government intrusion.

His devotion to the Bill of Rights inspired millions of Americans and countless young law students, including myself, and one of the great honors I have had as President was to be able to award him the presidential medal of freedom in my first year in office.

He once said the role of the Constitution is the protection of the dignity of every human being and the recognition that every individual has fundamental rights which government cannot deny.

He spent a lifetime upholding those rights, and he authored some of the most enduring constitutional decisions of this century, including *Baker v. Carr* on one person, one vote; *New York Times v. Sullivan*, which brought the free-speech doctrine into the latter half of the 20th century.

The force of his ideas, the strength of his leadership, and his character have safeguarded freedom and widened the circle of quality for every single one of us.

We will miss him greatly, and I know you will join me in sending our best wishes and our prayers to his family and friends and our gratitude for his life.

Thank you very much.

(Applause)

(Whereupon, at 3:05 p.m., the transcribed PROCEEDINGS were adjourned.)

* * * * *

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Comments to
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THE WHITE HOUSE

WASHINGTON

July 22, 1997

TO: Shelley Fidler
David Sandalow
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FROM: Carol Cleveland

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draft of 7/22/97, 10:45 am

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CLIMATE CHANGE EVENT
THE WHITE HOUSE
JULY 23, 1997

Acknowledgments: TK

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And let me be clear: We will not make commitments that will curb our economic growth. As we have shown over the past four and a half years, environmental protection and economic growth can go hand in hand. In Kyoto, we will emphasize flexible, market-based approaches, not government regulation. We will embrace research and development efforts that can help provide the technology to meet the new goals. And, of course, we will ask all nations -- industrial and developing -- to participate in a common solution.

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WASHINGTON

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FROM: Carol Cleveland

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JUL-22-97 15:40

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THE WHITE HOUSE

WASHINGTON

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JUL-22-97 15:35

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THE WHITE HOUSE

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July 22, 1997

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FROM: Todd Stern

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THE WHITE HOUSE

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July 22, 1997

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FROM: **Todd Stern**

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THE WHITE HOUSE

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July 22, 1997

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JULY 23, 1997

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MESSAGE CONFIRMATION

JUL-22-97 15:24

FAX NUMBER : 2024562215

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PAGE : 04

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THE WHITE HOUSE
WASHINGTON

OFFICE OF THE STAFF SECRETARY

Fax Transmittal Sheet

TO: Bob Boorstin

Fax Number: 622-9373

Phone Number:

FROM: Todd Stern

SUBJECT:

DATE: 7/22/97

NUMBER OF PAGES (including cover sheet): 4

MESSAGE:

If all pages are not received, please call 202/456-2702

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THE WHITE HOUSE

WASHINGTON

July 22, 1997

TO: Shelley Fidler
David Sandalow
Brian Johnson
Gene Sperling
Katie McGinty
Dan Tarullo
Bob Boorstin
Dirk Forrister
Natalie Wymer
Rosina Bierbaum
Jeff Smith
Tim Wirth
Rafe Pomerance
Jim Steinberg
Mark Mazur

FROM: Carol Cleveland

Please forward your comments on the attached to Lowell Weiss, extension 62777. Please forward a copy of your comments to Todd Stern as well. Thank you.

draft of 7/22/97, 10:45 am

PRESIDENT WILLIAM J. CLINTON
CLIMATE CHANGE EVENT
THE WHITE HOUSE
JULY 23, 1997

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July 23rd event

THE WHITE HOUSE

WASHINGTON

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THE WHITE HOUSE
WASHINGTON

July 23, 1997

**Climate Science Roundtable
with Nobel Laureates and other Distinguished Scientists**

DATE: July 24, 1997
LOCATION: East Room
TIME: 1:50- 3:00 pm
FROM: Todd Stern/Katie McGinty/Jack Gibbons

I. PURPOSE

To begin your process of public education on climate change, leading up to the Kyoto Conference in December.

You and the Vice President will meet with a small group of eminent scientists, including three Nobel laureates, to discuss climate change. The audience will include a half-dozen members of your Cabinet, several members of Congress, about 40 stakeholders on this issue and open press. The dialogue will emphasize the many points of consensus on the science of climate change and potential impacts on the American people.

II. BACKGROUND

In your speech at the United Nations June 26, you said: "In the United States, to do our part, we have to first convince the American people that the climate change problem is real and imminent." This is the first of several media events to raise the public profile of this issue.

In recent polling, just over half of those polled said they believe global warming is a serious problem. Concern increases significantly when respondents are told that the President and Nobel scientists consider the problem to be serious and when possible consequences (e.g., disease, droughts and floods, etc.) are identified.

III. PARTICIPANTS

Pre-brief Participants:

The Vice President, Todd Stern, Katie McGinty, Jack Gibbons, Shelley Fidler, David Sandalow, Rosina Bierbaum.

Event Participants:

The participants in the roundtable will be you, the Vice President and seven eminent scientists: Sherry Rowland (University of California at Irvine, Nobel laureate), Mario Molina (MIT, Nobel laureate), Jane Lubchenco (Oregon State University), Stephen Schneider (Stanford University), Bob Shope (University of Texas), Henry Kendall (Emeritus MIT, Nobel laureate), John Holdren (Harvard University).

The audience will include a half-dozen members of your Cabinet, several members of Congress and about 40 stakeholders on this issue.

Members of your Cabinet in attendance: Carol Browner, Bill Daley, Alexis Herman, Fredrico Pena, Franklin Raines, Larry Summers

Members of Congress in attendance: Sen. John Kerry (D-MA) and Rep. Karen McCarthy (D-MO).

IV. PRESS PLAN

Open press.

V. SEQUENCE OF EVENTS

- You enter the Blue Room to greet the scientists.
- Scientists enter the East Room and are seated.
- You and the Vice President enter the East Room.
- Vice President makes remarks.
- President makes remarks.
- Dialogue with scientists. (Attached as Exhibit A).
- President makes closing remarks.
- President and Vice President depart.

VI. REMARKS

To be provided by speechwriters.

PRESIDENT WILLIAM J. CLINTON
CLIMATE CHANGE EVENT
THE WHITE HOUSE
JULY 24, 1997

As we approach the dawn of the 21st century, our great challenge is not only to prepare our children for the world but also to protect the world for our children. This challenge is part of a sacred pact between the generations to ensure that today's progress does not come at tomorrow's expense. And that is why we have no choice but to face up to the full reality of global climate change.

Whenever the security of our people has been threatened, the United States has led the world to action. Climate change poses a threat to all people -- one that is subtle today but which will grow in severity and significance in years to come. The world must act. And the United States must lead. I am determined that we will lead -- responsibly, flexibly, making sure that we promote prosperity as we protect the environment. We have no choice -- and the scientists gathered here today will explain why.

Years ago, scientists could not be sure that human activities would influence our climate. But today, the evidence is in, the science is solid, and what was once theory is now fact: Global warming is for real. On this fundamental issue, the scientific debate is over.

The world's scientists believe that if we do not cut our emissions of greenhouse gases, we will disrupt the global climate. In fact, the overwhelming majority of scientists take their conclusions one step further. They believe there is ample evidence that human activities are disrupting the global climate already today.

Our scientists are issuing clear warnings about what will result if we stick our heads in the sand and refuse to act. If we ^{stay} on our current course, average global temperatures may rise 2 to 6 degrees Fahrenheit in next ^{the} century. To put this in sobering context, the difference in average temperature between the last Ice Age and today is only 9 degrees Fahrenheit.

If we fail to act, scientists expect that our seas will rise 2 feet or more over the next century, and thousands of square miles of Florida, Louisiana, and other coastal areas will be flooded. Infectious diseases will spread to new regions. Severe heat waves will claim the lives of more of our citizens. Our agriculture will suffer, and severe droughts and floods will be more common than ever.

The United States must confront this challenge head-on. As I pointed out recently at a special session of the United Nations, we have only 4 percent of the world's population, and yet we produce more than 20 percent of its greenhouse gases. For the sake of the planet and our own people, we simply must act.

In December, the nations of the world will convene in Kyoto, Japan, to come up with an agreement on how best to achieve meaningful emission reductions worldwide. Working with the American people, this Administration will bring to the Kyoto conference a strong American commitment to realistic and binding limits on our emissions. And let me be clear: Environmental protection and economic growth go hand in hand.

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And now, it is my honor to introduce Dr. Sherwood Rowland, the first of the distinguished scientists we will be hearing from today.

EXHIBIT A DIALOGUE WITH SCIENTISTS

THE PRESIDENT:

And now, it is my honor to introduce Dr. Sherry Rowland, the first of the distinguished scientists we will be hearing from today.

Dr. Rowland, you warned us of another global problem--ozone depletion -- many years before the rest of the world recognized it. You and Dr. Molina are owed a great debt, for through your work, we have begun to heal the ozone layer. You are also one of the original co-signers of the Scientists Statement on Global Climatic Disruption. Could you please tell us about the scientific consensus on this issue and explain why you are so concerned?

Dr. Rowland gives statement. During his statement, Dr. Rowland will give you a copy of the Scientists Statement on Global Climatic Disruption, plus a printout list of the more than 2600 scientists who have signed.

Suggested question for the President or Vice President:

The Scientists Statement uses the term "disruption" and "irreversible"--strong words for cautious scientists. How do the risks we face from global warming compare to the risks from destruction of the ozone layer?

THE VICE PRESIDENT:

Let me now ask Dr. Mario Molina to give us an overview of the science of climate change. One of the most compelling pieces of evidence is the long-term ice core record from Antarctica and Greenland. I invite you to use my favorite chart and talk about the relationship of temperature and carbon dioxide.

Dr. Molina gives statement

After Dr. Molina has unfolded the chart, President stands up and walks to chart for photo op. President asks Dr Molina:

Where on this chart can we see the latest Ice Age?

THE PRESIDENT:

Thank you, Dr. Molina. Let's turn now to Jane Lubchenco, our expert on ecology and see what such significant in greenhouse gas levels might mean for our natural resources.

Dr. Lubchenco gives statement

Suggested questions for the President or Vice President:

How might climate change interact with other environmental problems (such as local air and water pollution)?

Millions of Americans enjoy our national parks every year. Can you tell me what global warming might do to our parks?

THE VICE PRESIDENT:

Thanks. Dr. Lubchenco. Now I'd like to turn to Dr. Steve Schneider, to discuss the risks of severe weather events, such as droughts, floods and hurricanes. I'd also be interested to hear your thoughts on rising sea-levels as a result of global warming.

Dr. Schneider gives statement

Suggested questions for the President or Vice President

Well, we certainly have had more than our share of 100 year floods and droughts lately. Do we think we are seeing the first signs of climate change?

OR: The Scientists' letter talks about climate "surprises" being likely. What kind of unanticipated effects might occur?

THE PRESIDENT:

Thank you Dr. Schneider. Let me now ask Dr. Robert Shope, who has studied infectious diseases extensively, how climate change may affect human health?

Dr. Shope gives statement

Suggested questions for the President or Vice President:

The Chicago heat wave killed more than 400 people several years ago. How might such deadly heat waves change as the climate changes?

OR: Many people say that we have been very effective in eradicating infectious diseases and that medical advances will continue. Can't we count on medical science to protect us against the effects of climate change?

THE VICE PRESIDENT:

Thank you Dr. Shope. I'd like to ask Dr. Henry Kendall, Nobel Laureate and Chairman of the Union of Concerned Scientists, to speak to the international dimensions of this issue.

Dr. Kendall gives statement

Suggested questions for the President or Vice President:

Water--either too much or too little, seems to be at the core of a changing climate. What problems in water quality and water quantity do you anticipate?

OR: Sea-level rise will flood delta areas around the world and many poorer countries will be unable to fortify against the rising seas. Do you expect that climate change will create "environmental refugees"?

THE PRESIDENT:

Thank you. Let's turn now to Dr. John Holdren who has worked on many global issues--energy, the arms race, plutonium disposition. As a signer of the Scientist's Statement, you clearly see global warming as a threat. But many people in this country and around the world seem unconcerned. Why do you think people underrate the importance of this issue?

Dr. Holdren gives statement

Suggested questions for the President or Vice President:

The long lifetimes of these gases make the issue particularly difficult to address. Some argue that delaying action for several decades won't make much difference? Do you agree?

OR: How do you think climate change will affect the average citizen?

THE CLOSING REMARKS
FOR THE CLIMATE CHANGE EVENT
WILL BE FORWARDED

**PRESIDENT WILLIAM J. CLINTON
TALKING POINTS FOR CLOSING STATEMENT
CLIMATE CHANGE EVENT
THE WHITE HOUSE
JULY 24, 1997**

I want to thank our seven distinguished scientists for joining us today to share their deep understanding of global climate change.

I wish every American could hear what we've heard today. We all must recognize that global warming is for real. If we ignore this science, we, our children, and future generations will pay a steep price. We must act -- and the United States must lead.

In the months ahead, the Vice President and I, along with members of the Cabinet and others in my Administration, will continue to speak to the American people about this issue. We will be talking not only about problems, but about solutions. We will be seeking input from those in this room and from all concerned about this problem. Working together, I am convinced we will meet this challenge.

Thank you.

Sherry Rowland (NOBEL)

(Professor at UC Irvine, Foreign Secretary for the NAS, Past President of AAAS)

In 1995, Sherry Rowland, along with two of his colleagues, won the Nobel Prize in Chemistry for their pioneering research in atmospheric chemistry of the destruction of the ozone layer. Since receiving his Ph.D. from the University of Chicago in 1952, he has climbed the academic ranks in Chemistry, and is currently the Donald Bren Research Professor of Chemistry and Earth System Science at the University of California at Irvine. He also currently serves as the Foreign Secretary of the National Academy of Sciences, and is a former President and Chairman of the Board of the American Association for the Advancement of Science.

Mario Molina (NOBEL)

(Professor at MIT, PCAST – President's Committee of Advisors on Science and Technology)

Dr. Mario Molina was awarded the Nobel Prize along with Sherry Rowland, for their research on the thinning of the ozone layer. Molina and colleagues demonstrated experimentally how ozone-destroying chlorine functioned in the atmosphere. He is currently the Lee and Geraldine Martin Professor of Environmental Science at MIT, and was formerly at the University of California at Berkeley. He has received many awards including being elected to the National Academy of Sciences, and awarded the Pew Scholar on Conservation and the Environment. He has also served as an advisor to NASA, NSF, and NIH.

Jane Lubchenco

(Oregon State University, Past President of AAAS and Ecological Society of America)

Jane Lubchenco is truly a remarkable scientist. She is currently the Wayne and Gladys Valley Professor of Marine Biology and a Distinguished Professor of Zoology at Oregon State University, and has been awarded a litany of prestigious honors. She has been selected as a Pew Scholar in Conservation and the Environment, a MacArthur Fellow, a member of the National Academy of Sciences, and a member of the National Science Board. She is also an American Academy of Arts and Sciences Fellow, a Fellow to the American Association for the Advancement of Science, and has received numerous teaching awards. She has accomplished all of this, as well as devoting much of her attention to her two sons, since receiving her Ph.D. from Harvard University in 1975.

Stephen Schneider

(Professor at Stanford University, MacArthur Fellowship, AAAS Westinghouse Award for Public Understanding of Science and Technology)

After receiving his Ph.D. in Mechanical Engineering and Plasma Physics from Columbia University in 1971, Stephen Schneider focused on the influence of greenhouse gases and suspended particles on the earth's climate as a postdoctoral researcher at NASA's Goddard Institute for Space Studies, and later the National Center for Atmospheric Research, where he remained until 1996. In 1992, Dr. Schneider was awarded a MacArthur Fellowship for his admirable ability to integrate and interpret the results of global climate research through public lectures, seminars, media appearances, and research. He was also honored with the American Association for the Advancement of Science, Westinghouse Award for Public Understanding of Science and Technology for his ability to express environmental science and its implication for public policy to the general public. Currently he is a Professor in the Department of Biological Sciences, a Senior Fellow at the Institute for International Studies at Stanford University.

Bob Shope

(Professor at University of Texas, Director of the Yale Arbovirus Research Unit for 24 years)

Robert Shope has devoted his career to the study of viruses carried by mosquitoes, ticks, and other biting insects. These viruses can cause life-threatening diseases in humans such as malaria, dengue and yellow fever, and encephalitis. Dr. Shope received his medical degree in 1954 from Cornell University. Since then, he spent many years in Malaysia, Brazil, and other tropical sites studying these insect-borne diseases. He has been a Professor of Epidemiology at Yale University's School of Medicine from 1975 – 1995, and served as the Director of the Yale Arbovirus Research Unit for much of that time. During that time he was awarded many honors, including the Walter Reed Award from the American Society of Tropical Medicine and Hygiene. He is presently a Professor in the Departments of Pathology and Microbiology and Immunology at the University of Texas Medical Branch.

Henry Kendall (NOBEL)

(Professor at MIT, Chairman of the Board of the Union for Concerned Scientists)

In 1990, Dr. Kendall won the Nobel Prize in Physics, along with two colleagues for his insightful work in particle physics. Henry Kendall is currently the J.A. Stratton Professor of Physics at the Massachusetts Institute of Technology. He has also served as the Chairman of the Board of the Union of Concerned Scientists, an organization of which he was a founding member. Throughout his impressive career, Dr. Kendall has focused on US energy and defense issues such as the nuclear arms race, nuclear power, and renewable energy. He has many other awards and honors including being elected to the National Academy of Sciences.

John Holdren

(Professor at Harvard University, PCAST)

John Holdren is a world-renowned expert on energy and environmental science. In 1995, he delivered the Nobel Peace Prize acceptance lecture on behalf of the Pugwash Conferences, on the occasion of that organization's sharing of the 1995 prize. He is currently the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy in the John F. Kennedy School of Government, and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences at Harvard University. From 1973 until 1996, he was a Professor of Energy and Resources at the University of California at Berkeley. Dr. Holdren is also a Distinguished Visiting Scientist at the Woods Hole Research Center. He has been elected to be a Fellow of the National Academy of Sciences, the American Physical Society, the American Association for the Advancement of Sciences, the California Academy of Sciences, and the American Academy of Sciences. He was also awarded the MacArthur Foundation Prize. He is currently chairing the Presidential Committee of Advisors on Science and Technology Study of the entire U.S. energy R&D portfolio in relation to the economic, environmental, and security challenges of the next century. Dr. Holdren received his Ph.D. from Stanford University in aeronautics, astronautics and theoretical plasma physics in 1970.

**SCIENTISTS' STATEMENT
GLOBAL CLIMATIC DISRUPTION
JUNE 18, 1997**

We are scientists who are familiar with the causes and effects of climatic change as summarized recently by the Intergovernmental Panel on Climate Change (IPCC). We endorse those reports and observe that the further accumulation of greenhouse gases commits the earth irreversibly to further global climatic change and consequent ecological, economic and social disruption. The risks associated with such changes justify preventive action through reductions in emissions of greenhouse gases. In ratifying the Framework Convention on Climate Change, the United States agreed in principle to reduce its emissions. It is time for the United States, as the largest emitter of greenhouse gases, to fulfill this commitment and demonstrate leadership in a global effort.

Human-induced global climatic change is under way. The IPCC concluded that global mean surface air temperature has increased by between about 0.5 and 1.1 degrees Fahrenheit in the last 100 years and anticipates a further continuing rise of 1.8 to 6.3 degrees Fahrenheit during the next century. Sea-level has risen on average 4-10 inches during the past 100 years and is expected to rise another 6 inches to 3 feet by 2100. Global warming from the increase in heat-trapping gases in the atmosphere causes an amplified hydrological cycle resulting in increased precipitation and flooding in some regions and more severe aridity in other areas. The IPCC concluded that "The balance of evidence suggests a discernible human influence on global climate." The warming is expected to expand the geographical ranges of malaria and dengue fever and to open large new areas to other human diseases and plant and animal pests. Effects of the disruption of climate are sufficiently complicated that it is appropriate to assume there will be effects not now anticipated.

Our familiarity with the scale, severity, and costs to human welfare of the disruptions that the climatic changes threaten leads us to introduce this note of urgency and to call for early domestic action to reduce U.S. emissions via the most cost-effective means. We encourage other nations to join in similar actions with the purpose of producing a substantial and progressive global reduction in greenhouse gas emissions beginning immediately. We call attention to the fact that there are financial as well as environmental advantages to reducing emissions. More than 2000 economists recently observed that there are many potential policies to reduce greenhouse-gas emissions for which total benefits outweigh the total costs.

The Framework Convention on Climate Change, ratified by the United States and more than 165 other nations, calls for stabilization of greenhouse gas concentrations in the atmosphere at levels that will protect human interests and nature. The Parties to the Convention will meet in December, 1997, in Kyoto, Japan to prepare a protocol implementing the convention. We urge that the United States enter that meeting with a clear national plan to limit emissions, and a recommendation as to how the U.S. will assist other nations in significant steps toward achieving the joint purpose of stabilization.

INITIAL SIGNATORIES

Dr. John P. Holdren
Dr. Jane Lubchenco
Dr. Harold A. Mooney

Dr. Peter H. Raven
Dr. F. Sherwood Rowland
Dr. George M. Woodwell

Signed by 2409 scientists as of 6:19 PM on June 17, 1997

Ozone Action 1636 Connecticut Avenue, NW Washington, DC 20009 Voice: (202) 265-6738 FAX: (202) 986-6041

Biographies
June 18, 1997 - Washington, DC
Press Conference

John P. Holdren

Dr. Holdren is the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology, and Public Policy in the John F. Kennedy School of Government, and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences, at Harvard University. Previously he was Professor of Energy and Resources in U.C. Berkeley's campus-wide interdisciplinary graduate program in energy and resources, which he co-founded in 1973 and co-led until 1996. Dr. Holdren is also Distinguished Visiting Scientist at the Woods Hole Research Center, Chair of the Committee on International Security and Arms Control of the National Academy of Sciences, Chair of the Executive Committee of the Pugwash Conferences on Science and World Affairs, and a member of President Clinton's Committee of Advisors on Science and Technology (PCAST). He is currently chairing a PCAST study of the entire U.S. energy R&D portfolio in relation to the economic, environmental, and security challenges of the next century. Holdren earned bachelors and masters degrees from M.I.T. and the Ph.D. from Stanford University in aeronautics, astronautics and theoretical plasma physics (1970). He is the author of about 300 articles and reports, and he has co-authored and co-edited thirteen books on these topics. Holdren is a member of the National Academy of Sciences, the AAAS, and the California Academy of Sciences, among others. In 1981 he received one of the first MacArthur Foundation Prize Fellowships; in 1993 he shared the Volvo Environment Prize; and in 1994 he received the Forum Award of the American Physical Society ("for promoting public understanding of the relation of physics to society"). In December 1995 he delivered the Nobel Peace Prize acceptance lecture on behalf of the Pugwash Conferences, on the occasion of that organization's sharing the 1995 prize with Professor Joseph Rotblat. (617) 495-1464

HENRY W. KENDALL

Dr. Henry W. Kendall is currently J. A. Stratton Professor of Physics at the Massachusetts Institute of Technology. He has served as the Chairman of the Board of the Union of Concerned Scientists since 1974 and was a founding member of the organization. A particle physicist, he was, along with two colleagues, awarded the Nobel prize in physics in 1990.

Dr. Kendall has been active in writing, analysis and public activities on US energy and defense issues and in the global issues of environmental pressures, resource management and population growth. He is co-author of numerous studies and books related to the nuclear arms race, nuclear power and renewable energy. His works include "Population, Environment and Resource Problems -- A Warning from World Scientists," prepared for the United Nations International Conference on Population and Development in September 1994, *The Fallacy of Star Wars* (1984), "No First Use" (*Scientific American*, March 1984), "Anti-satellite Weapons" (*Scientific American*, June 1984), "Space-based Missile Defense" (*Scientific American*, October 1984), "Accidental Missile Launch" (*Scientific American*, December 1990), *Beyond the Freeze: The Road to Nuclear Sanity* (Beacon Press, 1982), *Energy Strategies: Toward a Solar Future* (Ballinger Publishing Company, 1980) and numerous reports from the Union of Concerned Scientists on safety and regulatory problems with nuclear power. He also co-authored "Constraints on the Expansion of the Global Food Supply" (AMBIO, 1994).

Dr. Kendall served for a decade as a consultant to the Defense Department on classified matters through membership in the Jason Group of the Institute for Defense Analyses. He was a panel Chair on the Secretary of Energy's Task Force on Alternative Futures for the National Laboratories (May 1995 - February 1996), organized expert panels for the World Bank, is Chair of the Panel on Transgenic Crops for the Bank and a member of the National Academy of Sciences' Panel on Inertial Confinement Fusion, concerned with matters relating to the US nuclear Stockpile Stewardship Program. He has testified numerous times before Congress on the threat of nuclear war, energy policy, nuclear power issues, controlling oil well fires, anti-personnel mine clearing and other matters. He has lectured widely and appeared on many national television programs.

He received his undergraduate degree from Amherst College (1950) and his PhD from the Massachusetts Institute of Technology (1955). He taught at Stanford University from 1956 to 1961 before returning to M.I.T., where he has remained since.

He has remained an active teacher and continues in physics research employing the Stanford Linear Accelerator at Stanford University.

JANE LUBCHENCO
Abbreviated Curriculum Vitae

CURRENT POSITION: Wayne and Gladys Valley Professor of Marine Biology and Distinguished Professor, Department of Zoology, Oregon State University, 3029 Cordley Hall, Corvallis, OR 97331-2914; phone 541-737-5337; fax 541-737-3360; email: lubchenj@bcc.orst.edu

PERSONAL INFORMATION: (b)(6) USA; U.S. Citizen; married to Bruce A. Menge, sons Alexei ('78) and Duncan ('81).

EDUCATION: B.A. 1969, Colorado College (Biology); M.S. 1971, University of Washington (Zoology); Ph.D. 1975, Harvard University (Ecology).

POSITIONS:

Assistant Professor, Harvard University, 1975-77

Assistant Professor 1977-1982, Associate Professor 1982-88, OSU

Research Associate, Smithsonian Institution, 1978-present

Professor 1988-; Chair, Department of Zoology 1989-92, OSU

OSU Distinguished Professor, 1993-; Valley Professor of Marine Biology 1995-.

Visiting Professor: University of the West Indies, Kingston, Jamaica, 1976; Universidad Catolica, Santiago, Chile, 1986; Institute of Oceanography, Academica Sinica, Qingdao, P.R. China, 1987; University of Canterbury, Christchurch, New Zealand, 1995-96.

N.B.: From 1977-1989, Dr. Lubchenco worked part-time, by choice, so she could spend more time with her two young sons. She held a 0.5 FTE appointment for ten years, then a 0.75 appointment for two years; in 1989, she returned to full time.

INTERESTS/EXPERTISE:

Science and the environment; public understanding of science; marine conservation biology; ecosystem services; ecological causes and consequences of global change; biodiversity; sustainable ecological systems; rocky intertidal shores; evolutionary community ecology; marine biology; plant-herbivore interactions; chemical ecology; biogeography; molluscs; echinoderms; seaweeds.

HONORS AND AWARDS:

Science Citation Classic Paper, ISI Current Contents (1978 *American Naturalist* 112:23-39), 1978; George Mercer Award, Ecological Society of America, 1979 (co-recipient Bruce A. Menge); Outstanding Teacher Award, OSU Alpha Lambda Delta (freshman honor society), 1986; National Lecturer, Phycological Society of America, 1987-89; American Association for the Advancement of Science Fellow, 1990; Honorary D.S. degree, Drexel University, 1992; Pew Scholar in Conservation and the Environment, Pew Charitable Trusts, 1992-1995; Honorary D.S. degree, Colorado College, 1993; Distinguished Professor, Oregon State University, 1993; American Academy of Arts and Sciences Fellow, 1993; MacArthur Fellow, John D. and Catherine T. MacArthur Foundation, 1993; Oregon Scientist of the Year, Oregon Academy of Science, 1994; Golden Eagle Award, Council for International Nontheatrical Events (CINE), Washington, D.C. (for National Geographic film *Diversity of Life*), 1994, co-recipients James and Elaine Larison; Science Citation Classic Paper, ISI Current Contents (1991 *Ecology* 72: 371-412), 1994; National Academy of Sciences, member, 1996; National Science Board, member 1996 - 2000, nominated by President Clinton and confirmed by the U.S. Senate; AWIS Fellow, Association for Women in Science, 1997; Honorary D.S. degree, Bates College, 1997.

OFFICES HELD:

American Association for the Advancement of Science, President, Chair of Board of Directors (1996-1998); Ecological Society of America, President (1993); International Council of Scientific Union's Scientific Committee on Problems of the Environment = SCOPE, Executive Committee, 1992-1995; American Institute of Biological Sciences, Board of Directors, 1991.

EDITORIAL BOARDS:

American Naturalist, 1978-1981; *Oecologia*, 1985-1988; *Journal of Phycology*, 1987-1990; *Ecological Applications*, 1989-1993; *The Northwest Environmental Journal*, 1991-1993; *Trends in Ecology & Evolution*, 1991-present; *Ecological Issues*, 1995-present; *Ecosystems*, 1997-1999; Associate Editor, Academic Press *Encyclopedia of Biodiversity*, 1997-present; Advisory Editor, *Ecological Studies*, Springer-Verlag, 1993-present; *Conservation Ecology*, 1995-present.

BOARDS OF DIRECTORS OR TRUSTEES (current):

The Nature Conservancy, Science Advisory Board, 1993-present; World Resources Institute, Board of Directors, 1993-present; Environmental Defense Fund, Board of Trustees and Science Advisory Committee, 1995-present; Monterey Bay Aquarium, Board of Trustees and Program Committee, 1995-present.

OTHER CURRENT SERVICE:

Activities intended to communicate scientific knowledge to policy makers and the public, and to promote research on critical environmental topics include:

National Academy of Sciences/National Research Council (NRC) Committee on Ecosystem Management and Sustainable Fisheries, 1995-1997; NRC, Committee on Biodiversity Forum, 1995-97; NAS Committee on Creationism, 1996;

United Nations Environment Programme (UNEP), Scientific and Technical Advisory Panel (STAP), Roster of Experts, 1993-present;

Pew Fellows Program in Conservation and the Environment, Advisory Committee, 1995-1998;

Corvallis City Council, Advisory Commission on Open Space, 1995-present;

Living On Earth PBS radio show, Scientific Advisory Board, 1997-present;

Sustainable Biosphere Project, SCOPE, Planning Committee, 1992, Scientific Advisory Committee, Co-Chair, 1992-present;

Religion, Science and the Environment: The Black Sea as a Paradigm, Executive Chair of Scientific and Religious Steering Committee, 1996-1998;

UNESCO (United Nations Educational, Scientific, and Cultural Organization), Scientific Advisory Board, 1996-present;

IMAX film on biodiversity, advisory committee, 1996 - 98;

Sea Web, Spokesteam member (sponsored by the Pew Charitable Trusts to promote knowledge about marine issues), 1996 - 97.

SELECTED PUBLICATIONS - CITATION CLASSICS AND AWARD WINNERS

- 1978 Lubchenco, J. Plant species diversity in a marine intertidal community: importance of herbivore food preference and algal competitive abilities. *American Naturalist* 112:23-39. **ISI Citation Classic.**
- 1978 Lubchenco, J. and B.A. Menge. Community development and persistence in a low rocky intertidal zone. *Ecological Monographs* 48:67-94. **Mercer Award Winner, 1979.**
- 1991 Lubchenco, J., A.M. Olson, L.B. Brubaker, S.R. Carpenter, M.M. Holland, S.P. Hubbell, S.A. Levin, J.A. MacMahon, P.A. Matson, J.M. Melillo, H.A. Mooney, C.H. Peterson, H.R. Pulliam, L.A. Real, P.J. Regal, P.G. Risser. 1991. The Sustainable Biosphere Initiative: An Ecological Research Agenda. *Ecology* 72(2):371-412. **ISI Citation Classic.**

SELECTED RECENT PUBLICATIONS:

- 1995 Lubchenco, J., G.W. Allison, S.A. Navarrete, B.A. Menge, J.C. Castilla, O. Defeo, C. Folke, O. Kussakin, T. Norton, and A.M. Wood. Biodiversity and ecosystem functioning: Coastal systems. Pages 370-381 In: *Global Biodiversity Assessment*, Cambridge University Press, Cambridge, UK.
- 1995 Chapin, F.S., J. Lubchenco and H. Reynolds. Biodiversity effects on patterns and processes of communities and ecosystems. Pages 289-301 In: *Global Biodiversity Assessment*, *ibid*.
- 1995 Six additional multi-authored introductory and concluding chapters for Sections 5 and 6 on Biodiversity and Ecosystem Functioning, in the *Global Biodiversity Assessment*, *ibid*.
- 1995 Eisner, T., J. Lubchenco, E.O. Wilson, D.S. Wilcove and M.J. Bean. Building a scientifically sound policy for protecting endangered species. *Science* 269:1231-1232.
- 1996 Allison, G.W., B.A. Menge, J. Lubchenco and S.A. Navarrete. Predictability and uncertainty in community regulation: Consequences of reduced consumer diversity in coastal rocky ecosystems. Pages 371-392 In: Mooney *et al.* (eds.), *Functional Roles of Biodiversity: A Global Perspective*, John Wiley & Sons, Chichester, U.K.
- 1996 Lubchenco, J. The Endangered Species Act: Society presidents comment on scientific aspects of reauthorization bills. *Bulletin of the Ecological Society of America*, 77(2): 116-120 (includes multi-authored letters to members of Congress).
- 1996 Power, M.E., D. Tilman, J.A. Estes, B.A. Menge, W.J. Bond, L.S. Mills, G. Daily, J.C. Castilla, J. Lubchenco, and R.T. Paine. Challenges in the quest for keystones. *BioScience* 46: 609-620.
- 1997 Allison, G.W., J. Lubchenco, and M. Carr. Marine reserves are necessary but not sufficient for marine conservation. *Ecol. Applications* *In press*.
- 1997 Daily, G.C., S. Alexander, P.R. Ehrlich, L. Goulder, J. Lubchenco, P.A. Matson, H.A. Mooney, S. Postel, S.H. Schneider, D. Tilman, and G.M. Woodwell. Ecosystem Services: Benefits supplied to human societies by natural ecosystems. *Issues in Ecology* 2: 1-16.
- 1997 Peterson, C.H. and J. Lubchenco. Marine ecosystem services. Pp 177-194 in G. Daily (ed.), *Nature's Services: Societal Dependence on Natural Ecosystems*. Island Press, Washington, D.C.
- 1997 Vitousek, P.M., H.A. Mooney, J. Lubchenco, and J.M. Melillo. Human domination of earth's ecosystems. *Science*: *in press*.

1996

biography

F. Sherwood Rowland**Nobel Laureate in Chemistry, 1995**

F. Sherwood Rowland was born in Delaware, Ohio, in 1927, and received his B.A. degree from Ohio Wesleyan University. His "accelerated academy schedule" made him eligible for the final year of university in 1945, aged 18, but he then enlisted in the Navy, joining a programme to train radio operators and as a "Specialist in Athletics".

In 1948 he was admitted to the University of Chicago from which he received his M.S. and Ph.D. degrees. He taught at Princeton University and the University of Kansas before joining in 1964 the Department of Chemistry at the University of California, Irvine, where he is presently Donald Bren Research Professor of Chemistry and Earth System Science.

In 1973 his interest shifted from radiochemistry to atmospheric chemistry and focused on the chlorofluorocarbon-ozone problem which was soon to become a highly visible public concern. The paper he published with his co-worker Mario Molina in 1974 and their pioneering work subsequently led to the scientific understanding of the depletion of the ozone layer which has helped to shape far-reaching decisions on the prohibition of the release of gases that destroy ozone. It also led to the Nobel Prize in Chemistry of which he was co-recipient in 1995 together with P. Crutzen and M. Molina.

Sherwood Rowland is the author of over 330 scientific publications in the areas of atmospheric chemistry, radiochemistry, and chemical kinetics. He is an elected member of the US National Academy of Sciences, for which he is currently the Foreign Secretary, and has served as President and Chairman of the board of the American Association for the Advancement of Science.

His numerous international honours and awards include seven honorary doctorates of science and of laws, the Japan Prize in Environment Science and Technology, the Peter Debye Award in Physical Chemistry of the American Chemical Society, and the Roger Revelle Medal of the American Geophysical Union. In 1991, he was listed as one of the "1000 Makers of the Twentieth Century" by the London *Sunday Times*.

See also: <http://www.chem.uci.edu/research/faculty/rowland.html>

CURRICULUM VITAE

Frank Sherwood Rowland

Donald Bren Research Professor of Chemistry
University of California Irvine

Foreign Secretary
National Academy of Sciences

ADDRESS: Department of Chemistry
Irvine, California 92697-2025
Telephone: (714) 824-6016
FAX: (714) 824-2905

PERSONAL: Born Delaware, Ohio, June 28, 1927

DEGREES: B.A., Ohio Wesleyan University, 1948
M.S., University of Chicago, 1951
Ph.D., University of Chicago, 1952

EMPLOYMENT:

1994-present Foreign Secretary, United States National Academy of Sciences
1994-present Donald Bren Research Professor of Chemistry and Earth System Science,
University of California, Irvine
1964-1994 Professor of Chemistry, University of California, Irvine
1964-1970 Professor and Chairman of Chemistry, University of California, Irvine
1956-1964 Assistant Professor to Professor of Chemistry, University of Kansas
1952-1956 Instructor in Chemistry, Princeton University

POSITIONS: From July 1, 1994: Foreign Secretary of the National Academy of Sciences
1991-1993, (Successively) President-Elect, President, and Chairman of the Board of
the American Association for the Advancement of Science

HONORS AND AWARDS:

1995, Nobel Prize in Chemistry (with P. Crutzen and M. Molina)
"for their work in atmospheric chemistry, particularly concerning
the formation and decomposition of ozone."

1997, Alumni Medal, University of Chicago
1994, Roger Revelle Medal, American Geophysical Union
1993, Peter Debye Award in Physical Chemistry, American Chemical Society
1989, Japan Prize in Environmental Science and Technology
1988, Global 500 Role of Honour for Environmental Achievement, United Nations
Environment Programme
1987, Charles A. Dana Award for Pioneering Achievement in Health
1983, Tyler World Prize for Environmental Achievement
1979, Szilard Award, American Physical Society
1995, Member, American Philosophical Society
1994, Member, Institute of Medicine
1978, Member, National Academy of Sciences
1977, Member, American Academy of Arts and Sciences

**HONORARY
DEGREES:**

D.Sc., University of Chicago, 1989
D.Sc., Duke University, 1989
L.L.D., Ohio Wesleyan University, 1989
D.Sc., Whittier College, 1989
D.Sc., Princeton University, 1990
L.L.D., Simon Fraser University (Canada), 1991
D.Sc., Haverford College, 1992
D.Sc., University of East Anglia (U.K.), 1996
D.Sc., Clark University, 1996
L.L.D., Calgary University (Canada) 1997

PUBLICATIONS:

Approximately 350 research articles including:

"Stratospheric Sink for Chlorofluoromethanes: Chlorine Atom-Catalysed Destruction of Ozone", *Nature* 1974, 249, 810-812

Mario J. Molina and F. S. Rowland

"Chlorofluoromethanes in the Environment", *Review of Geophysics and Space Physics* 1975, 13, 1-35
F. S. Rowland and Mario J. Molina

STEPHEN H. SCHNEIDER

Stephen H. Schneider is a professor in the Department of Biological Sciences, a Senior Fellow at the Institute for International Studies, and Professor by Courtesy in the Department of Civil Engineering at Stanford University. He was honored in 1992 with a MacArthur Fellowship for his ability to integrate and interpret the results of global climate research through public lectures, seminars, classroom teaching, environmental assessment committees, media appearances, Congressional testimony, and research collaboration with colleagues. He has served as a consultant to Federal Agencies and/or White House staff in the Nixon, Carter, Reagan, Bush, and Clinton administrations. He also received, in 1991, the American Association for the Advancement of Science/Westinghouse Award for Public Understanding of Science and Technology, for furthering public understanding of environmental science and its implications for public policy.

Dr. Schneider received his Ph.D. in Mechanical Engineering and Plasma Physics from Columbia University in 1971. He studied the role of greenhouse gases and suspended particulate material on climate as a postdoctoral fellow at NASA's Goddard Institute for Space Studies. He was awarded a postdoctoral fellowship at the National Center for Atmospheric Research and was a member of the scientific staff of NCAR from 1973 - 1996, where he co-founded the Climate Project. In 1975, he founded the interdisciplinary journal, *Climatic Change*, and continues to serve as its Editor. He is also the Editor-in-Chief of the *Encyclopedia of Climate and Weather* and author of *The Genesis Strategy: Climate and Global Survival*; *The Coevolution of Climate and Life*; *Global Warming: Are We Entering the Greenhouse Century?* and *Laboratory Earth: The Planetary Gamble We Can't Afford to Lose*, among others. He has authored or co-authored over 200 scientific papers, proceedings, legislative testimonies, edited books and book chapters; some 120 book reviews, editorials, published newspaper and magazine interviews and popularizations. He is a frequent contributor to commercial and non-commercial print and broadcast media on climate and environmental issues, e.g., NOVA, Planet Earth, Nightline, Today Show, Tonight Show, Dateline, Discovery Channel, British, Canadian and Australian Broadcasting Corporations, among many others. At Stanford University he teaches classes in a dozen different departments and courses in Earth Systems, Civil Engineering, Biological Sciences and a Senior Honors Seminar in Environmental Science, Technology and Policy.

Dr. Schneider's current global change research interests include: climatic change; global warming; food/climate and other environmental/science public policy issues; ecological and economic implications of climatic change; integrated assessment of global change; climatic modeling of paleoclimates and of human impacts on climate, e.g., carbon dioxide "greenhouse effect" or environmental consequences of nuclear war. He is also interested in advancing public understanding of science and in improving formal environmental education in primary and secondary schools.

Robert E. Shope, M.D.

Dr. Shope has devoted his career to study of viruses carried by mosquitoes, ticks and other biting arthropods. These viruses cause diseases that are ecologically sensitive, especially to temperature and rainfall as well as human disturbances of the environment.

He received his medical degree from Cornell University (1954), completed two years of medical residency at the Yale-New Haven Hospital, and served in the U.S. Army for two years. He served at Camp Detrick, Frederick, Maryland, then for about 18 months at the Institute for Medical Research, Kuala Lumpur, Malaya. There, working with British and U.S. scientists, he treated patients with tropical diseases such as scrub typhus, dengue, Japanese encephalitis, and leptospirosis.

In 1958, he became a staff member of The Rockefeller Foundation in the arbovirus research program. He worked for 6 years in Belem, Brazil studying arthropod-borne virus epidemiology during the period of discovery of over 50 new viruses of the Amazon forests. In 1965, he moved with the Rockefeller Foundation Laboratory to Yale University to continue research and teaching in arbovirus taxonomy and epidemiology. In 1971 he became Director of the Yale Arbovirus Research Unit (WHO Collaborating Centre for Arboviruses). He held these positions until retirement from Yale in 1995. During the stay at Yale, he did research on Rift Valley fever, Lassa fever and other arenaviruses, dengue, yellow fever, and rabies-related viruses. In 1992, he co-chaired with Joshua Lederberg the Institute of Medicine's study on Emerging Infections, which has stimulated the development of emerging infections programs of the U.S. NIH, CDC, and the World Health Organization.

Since 1995, he has been Professor of Pathology at the WHO Center for Tropical Diseases, University of Texas Medical Branch, Galveston, Texas. With Dr. Robert Tesh, he continues to direct the World Arbovirus Reference Center which holds the world's most extensive arbovirus collection (more than 500 types) moved to Texas from Yale University. His interest in climate and the environment stems from a life-long experience with the diseases carried by biting insects and the prediction that many of these illnesses will be enhanced in distribution and severity by climate change.

BIOGRAPHICAL SKETCH

Provide the following information for the key personnel in the order listed on Form Page 2.
Photocopy this page or follow this format for each person

NAME Robert E. Shope		POSITION TITLE Epidemiologist/Virologist	
EDUCATION/TRAINING (Begin with baccalaureate or other initial professional education, such as nursing, and include postdoctoral training)			
INSTITUTION AND LOCATION	DEGREE (if applicable)	YEAR(s)	FIELD OF STUDY
Cornell University, Ithaca, New York	B.A.	1951	Zoology
Cornell University Medical College, New York	M.D.	1954	Medicine

RESEARCH AND PROFESSIONAL EXPERIENCE: Concluding with present position, list, in chronological order, previous employment, experience, and honors. Include present membership on any Federal Government public advisory committee. List, in chronological order, the titles, all authors, and complete references to all publications during the past three years and to representative earlier publications pertinent to this application. If the list of publications in the last three years exceeds two pages, select the most pertinent publications. DO NOT EXCEED TWO PAGES.

RESEARCH AND PROFESSIONAL EXPERIENCE:

1995 - present Professor, Department of Pathology and Dept. of Microbiology and Immunology, University of Texas Medical Branch, Galveston, TX.

1975 - 1995 Professor of Epidemiology, Yale University School of Medicine.

1971 - 1995 Director, Yale Arbovirus Research Unit, Yale Univ. School of Medicine.

1967 - 1975 Associate Professor of Epidemiology, Yale Univ. School of Medicine.

1965 - 1967 Assistant Professor of Epidemiology, Dept. of Epidemiology & Public Health, Yale Univ. School of Medicine.

1963 - 1965 Director, Belem Virus Laboratory, Belem, Brazil.

1959 - 1965 Belem Virus Laboratory, Evandro Chagas Institute, Belem, Brazil.

1958 - 1974 The Rockefeller Foundation, Staff Member.

1957 - 1958 Assistant Resident, Internal Medicine, Yale Univ. (Grace-New Haven Hospital).

1955 - 1957 U.S. Army Medical Research Unit, Kuala Lumpur, Malaya.

1955 U.S. Army Medical Corps, Captain, Fort Detrick, Frederick, MD.

1954 - 1955 Intern, Internal Medicine, Yale University (Grace-New Haven Hospital).

HONORS

1974 Recipient Bailey K. Ashford Award, American Society of Tropical Medicine & Hygiene.

1980 President, American Society of Tropical Medicine & Hygiene.

1986 Fellow of the Queensland Institute of Medical Research.

1987 Recipient Richard M. Taylor Award, American Committee on Arboviruses.

1993 Walter Reed Award, American Society of Tropical Medicine and Hygiene.

SELECTED PUBLICATIONS: (>175 TOTAL)

Breiser-Wilke, J.M., Moenning, V., Kaaden, O-R and Shope, R.E. Detection of alphaviruses in a genus-specific antigen capture enzyme immunoassay using monoclonal antibodies. *J. Clin. Microbiol.* 29:131-137, 1991.

Mason, P.W., Pincus, S., Fournier, M.J., Mason, T.L., Shope, R.E. and Paoletti, E. Japanese encephalitis virus-vaccinia recombinants produce particulate forms of the structural membrane proteins and induce high levels of protection against lethal JEV infection. *Virology*. 180:294-305, 1991.

Fonseca, B.A.L., Khoshnood, K., Shope, R.E. and Mason, P.W. Flavivirus type-specific antigens produced from fusions of a portion of the E protein gene with the *Escherichia coli* TRPE gene. *Am. J. Trop. Med. Hyg.* 44:500-508, 1991.

Salas, R., Manzione, N., Tesh, R.B., Rico-Hesse, R., Shope, R.E., Betancourt, A., Gody, O., Bruzual, R., Pancheco, M.E., Ramos, J., Taibo, M.E., Garcia Tamayo, J., Jaimés, E., Vasquez, C., Araoz, F. and Querales, J. Venezuelan hemorrhagic fever. *Lancet* 338:1033-1036, 1991.

Howe, D.K., Vodkin, M.H., Noval, R.J., Shope, R.E. and McLaughlin, G.L.: Use of the polymerase chain reaction for the sensitive detection of St. Louis encephalitis viral RNA. *J. Virol. Methods* 36:101-110, 1991.

Pincus, S., Mason, P.W., Konishi, E., Fonseca, B.A.L., Shope, R.E., Rice, C.M. and Paoletti, E.: Recombinant vaccinia virus producing the prM and E proteins of yellow fever virus protects mice from lethal yellow fever encephalitis. *Virology* 187:290-297, 1992.

Konishi, E., Pincus, S., Paoletti, E., Laegreid, W.W., Shope, R.E. and Mason, P.W.: A highly attenuated host-range restricted vaccinia virus strain, NYVAC, encoding the prM, E, and NS1 genes of Japanese encephalitis virus prevents JEV viremia in swine. *Virology* 190:454-458, 1992.

Lederberg, J., Shope, R.E. and Oaks, Jr., S.C.: Emerging Infections. Microbial Threats to Human Health in the United States, National Academy Press, Washington, D.C., pp 294, 1992.

Pincus, S., Mason, P.W., Konishi, E., Fonseca, B.A.L., Shope, R.E., Rice, C.M. and Paoletti, E.: Recombinant vaccinia virus producing the prM and E proteins of yellow fever virus protects mice from lethal yellow fever encephalitis. *Virology* 187:290-297, 1992.

Konishi, E., Pincus, S., Fonseca, B.A.L., Shope, R.E., Paoletti, E. and Mason, P.W.: Comparison of protective immunity elicited by recombinant vaccinia viruses that synthesize E and NS1 of Japanese encephalitis virus. *Virology* 185:401-410, 1992.

Konishi, E., Pincus, S., Paoletti, E., Shope, R.E., Burrage, T. and Mason, P.W.: Mice immunized with a sub-viral particle containing the JEV M and E proteins are protected from lethal JEV infection. *Virology* 188:714-720, 1992.

Vodkin, M.H., McLaughlin, G.L., Day, J.F., Shope, R.E. and Novak, R.J.: A rapid diagnostic assay for eastern equine encephalomyelitis viral RNA. *Am. J. Trop. Med. Hyg.* 49:772-776, 1993.

Tesh, R.B., Jahrling, P.B., Salas, R.A. and Shope, R.E.: Description of Guanarito virus (Arenaviridae: Arenavirus), the etiologic agent of Venezuelan hemorrhagic fever. *Am. J. Trop. Med. Hyg.* 50:452-459, 1994.

Shope, R.E.: The discovery of arbovirus diseases. *Ann. N.Y. Acad. Sci.* 740:138-145, 1994.

Fonseca, B.A.L., Pincus, S., Shope, R.E., Paoletti, E. and Mason, P.W.: Recombinant vaccinia viruses co-expressing dengue-1 glycoproteins prM and E induce neutralizing antibodies in mice. *Vaccine* 12:279-285, 1994.

Sumiyoshi, H., Tignor, G.H. and Shope, R.E.: Characterization of a highly attenuated Japanese encephalitis virus generated from molecularly cloned cDNA. *J. Infect. Dis.* 171:1144-1151, 1995.

Konishi, E., Mason, P.W., Shope, R.E.: Enzyme-linked immunosorbent assay using recombinant antigens for serodiagnosis of Japanese encephalitis. *J. Med. Virol.* 48:76-79, 1998.

Perera, L.P., Peiris, J.S.M., Weigama, D.J., Calisher, C.H., Shope, R.E.: Nairobi sheep disease virus isolated from *Haemaphysalis intermedia* ticks collected in Sri Lanka. *Ann. Trop. Med. Parasitol.* 90:91-93, 1996.

Wang, E., Weaver, S.C., Shope, R.E., Tesh, R.B., Watts, D.M. and Barrett, D.T.: Genetic variation in wild-type yellow fever virus. *Virology* 225:274-281, 1996.

Helman, V.I., Tesh, R.B., Shope, R.E., Watts, D.M. and Barrett, A.D.T.: The small RNA of Oropouche virus: nucleotide sequence and comparison with other members of the genus *Bunyavirus*. *J. Gen. Virol.* (submitted)

RELEVANT RECENT PRIOR RESEARCH SUPPORT:

1. Support for World Reference Center for Arboviruses; R.B. Tesh, PI; NIH 2 R01 AI10984-26; R.E. Shope 10% time and effort.
2. World Reference Center for Arboviruses; R.E. Shope, PI, US Army DAMD17-87-G-7005 and DAMD17-94-J-4001; 40% time and effort to 06/30/95. Role in both projects: Identifying arboviruses and providing reagents to laboratories throughout the world.

Mario J. Molina is the Lee and Geraldine Martin Professor of Environmental Sciences at the Massachusetts Institute of Technology. He is a member of the National Academy of Sciences and the American Association for the Advancement of Science. He has served on federal advisory committees for the National Aeronautics and Space Administration, the National Science Foundation, and the National Institutes of Health.

Dr. Molina is a former Senior Research Scientist at the Jet Propulsion Lab. His area of expertise is chemistry of the stratosphere, and he is famous for his work on determining the sources of stratospheric ozone depletion.

Dr. Molina was an undergraduate at the Universidad Nacional Autonoma de Mexico, and he received his Ph.D. in physical chemistry from the University of California, Berkeley.

Dr. Molina won the Nobel Prize for Chemistry in 1995 with Dr. Sherwood Rowland for their work in explaining the thinning of the ozone.

MARIO J. MOLINA

B.S. Universidad Nacional Autonoma de Mexico
1965

Ph.D. University of California, Berkeley
1972

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Professor Molina's research interests lie in a field which is common to atmospheric chemistry and to chemical kinetics and photochemistry. The main objective of the research is the understanding of the potential implications of changes in the chemical composition of the earth's atmosphere: human activities are increasing the atmospheric concentrations of chlorofluorocarbons, methane, carbon dioxide and other gases on a global scale.

The atmospheric chemistry research involves reactions of small molecules and free radicals whose study permits testing of chemical dynamic theories at a fundamental level. New methods are being developed as extensions of discharge-flow techniques and the laser photolysis-kinetic spectroscopy. The concentrations of the transient species are directly monitored, for example, by chemical ionization mass spectrometry, resonance fluorescence, or laser induced fluorescence, to measure accurately absolute rate constants and reaction channel branching ratios for elementary processes.

Similar methods are employed to study photochemical processes: direct observation of the primary photodecomposition products' "commonly reactive radicals" is often the best, if not the only, way to elucidate the details of the photolytic mechanism.

Another field of research which is being developed involves heterogeneous atmospheric processes. This research has shown that polar stratospheric clouds which consist of ice-like particles are chemically very active. Exploring these processes and developing suitable techniques for their study is part of a program to elucidate the role of aerosols and clouds in the changing chemistry of the global atmosphere.



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CURRICULUM VITAE

September 1993

MARIO J. MOLINA Martin Professor of Atmospheric Chemistry

Education:

Universidad Nacional Autónoma de México; Ingeniero Químico (Chemical Engineer Degree)	1965
University of Freiburg, West Germany; Postgraduate (Polymerization Kinetics)	1967
University of California, Berkeley; Ph.D. (Physical Chemistry)	1972

Professional Positions:

Assistant Professor, Universidad Nacional Autónoma de México	1967-68
Postdoctoral Associate, University of California, Berkeley	1972-73
Postdoctoral Associate, University of California, Irvine	1973-75
Assistant Professor, University of California, Irvine	1975-79
Associate Professor, University of California, Irvine	1979-82
Member of Technical Staff, Jet Propulsion Laboratory, Caltech	1982-84
Senior Research Scientist, Jet Propulsion Laboratory, Caltech	1984-89
Professor, MIT Department of Earth, Atmospheric and Planetary Sciences and Department of Chemistry	1989-present
Martin Professor of Atmospheric Chemistry, MIT	1992-present

Honors and Awards:

UCI Alumni Association Special Recognition for Contributions in Basic Research	1976
Newport Democratic Club Public Service Award for Service to the Environment	1977
Alfred P. Sloan Foundation Fellow	1976-78
Camille and Henry Dreyfus Teacher-Scholar	1978-82
Tyler Ecology and Energy Award	1983
Society of Hispanic Professional Engineers Award for Achievement in Science and Technology	1983
Council for Recognition of Hispanics, Science Honoree	1984
American Chemical Society Esselen Award	1987
American Association for the Advancement of Science Newcomb-Cleveland Prize	1987-88
NASA Medal for Exceptional Scientific Achievement	1989
United Nations Environment Programme Global 500 Award	1989
Orange County Section of the American Chemical Society Service Through Chemistry Award	1989
Pew Scholar on Conservation and the Environment	1990-1992
Member (elected), National Academy of Sciences	1993

Major Research Interests:

Atmospheric Chemistry

Gas Phase Kinetics and Photochemistry; Heterogeneous Chemistry

Membership in Professional Societies:

American Chemical Society

American Physical Society

American Geophysical Union

Sigma Xi Scientific Research Society

American Association for the Advancement of Science

Selected Advisory Activities:

NSF Oversight Committee, Fluorocarbon Technology Assessment, Systems Control, Inc.	1976
NIH Advisory Committee to the Director, Recombinant DNA Research	1977
UCI Affirmative Action Committee, UCI Academic Senate	1978-79
NRC-NAS Commission on Human Resources	1978-81
NASA Panel for Chemical Kinetic and Photochemical Data Evaluation	1978-present
UCI Committee on Undergraduate Scholarships, Honors and Financial Awards UCI Academic Senate	1980-81
NCAR Scientific Programs Evaluation Committee, Panel Review of Atmospheric Chemistry Division, Boulder, CO	1986
UCR Ad Hoc Committee for Review of the Statewide Air Pollution Research Center, Riverside, CA	1988
NASA Advisory Committee to Oversee the Scientific Assessment of Atmospheric Effects Associated with Stratospheric Emissions from High Speed Civil Transports	1988-present
Editorial Advisory Board of the International Journal of Chemical Kinetics	1988-91
DOE Review Panel for the Molecular Science Research Center at the Pacific Northwest Laboratories, Batelle, Richland, WA	1988
NOAA Review Panel for the Aeronomy Laboratory (Chair)	1989
NSF Advisory Committee for Atmospheric Sciences	1989-present
NRC-NAS Steering Committee on Aeronautical Technologies	1990-present
NRC-NAS Committee on Atmospheric Chemistry	1991-present

Selected Professional Activities:

Testified by invitation at hearings before the House of Representatives Subcommittee on Public Health and Environment of the Committee on Interstate and Foreign Commerce, 93rd Congress; the U.S. Senate Subcommittee on Toxic Substances and Environmental Oversight of the Committee on Environment and Public Works; and before numerous state legislatures on the issue of chloro-fluorocarbons and stratospheric ozone depletion.	1974
	1981

TRW/NASA Consultant, Halogen Occultation Experiment (HALOE)	
Langley Research Center	1979-81
Co-chairman, 14th Informal Conference on Photochemistry	
Newport Beach, CA	1980
NRC/NAS Panelist, Postdoctoral Fellowships Program	1982-87
Organizer and Presider, Symposium on Antarctic Ozone Depletion	
AAAS Annual Meeting, Boston, MA	1988
Organizer and Presider, Symposium on Physical Chemical Problems	
in the Earth's Atmosphere, 196th National Meeting	
of the American Chemical Society, Los Angeles, CA	1988
Panelist, Annual Meeting of the National Academy of Sciences President's	
Circle on Issues Confronting the Global Future, Irvine, CA	1989
Co-organizer and lecturer, Atmospheric Chemistry Workshop	
Nat. Aut. Univ., Mexico City	1991
Co-chairman, Gordon Conference on Atmospheric Chemistry,	
New Hampton, NH	1991
Co-chairman, Atmospheric Chemistry Colloquium for Emerging Senior	
Scientists, MIT, Cambridge, MA	1991
Sigma Xi National Lecturer	1992-94

Studies/workshops which produced published proceedings:

1977	NASA Workshop	<i>"Chlorofluoromethanes and the Stratosphere"</i>
1979	NASA Workshop	<i>"The Stratosphere: Present and Future"</i>
1982	Dahlem Konferenzen	<i>"Atmospheric Chemistry"</i>
1985	NASA/WMO Workshop	<i>"Atmospheric Ozone Assessment Report"</i>
1987	NSF Workshop	<i>"Chemistry and the Environment 1988"</i>
1987	EPA & IGPA	<i>"Science, Universities and the Environment"</i>
1988	UNEP Workshop	<i>"Scientific Review of the Depletion of the Ozone Layer"</i>
1988	AFEAS Workshop	<i>"Alternative Fluorocarbon Environmental Acceptability Study"</i>
1989	UNEP/WMO Workshop	<i>"Scientific Assessment of Stratospheric Ozone: 1989"</i>

AAAS	=	American Association for the Advancement of Science
DOE	=	Department of Energy
EPA	=	Environmental Protection Agency
NAS	=	National Academy of Sciences
NASA	=	National Aeronautics and Space Administration
NCAR	=	National Center for Atmospheric Research
NIH	=	National Institutes of Health
NOAA	=	National Oceanic and Atmospheric Administration
NRC	=	National Research Council
NSF	=	National Science Foundation
UCI	=	University of California at Irvine
UCR	=	University of California at Riverside
UNEP	=	United Nations Environment Programme
WMO	=	World Meteorological Organization

SELECTED INVITED LECTURES

(which produced meeting proceedings or published abstracts)

- 1976: Stratospheric chemistry of chlorine compounds. In *Proceedings of the Joint Symposium on Atmospheric Ozone* (IAOCC/ICACGP, Dresden, German Democratic Republic).
- Stratospheric chemistry chlorofluorocarbons. In *Abstracts of the Symposium on Fluorine Compounds in the Environment* (172nd National Meeting, Amer. Chem. Soc., San Francisco).
- 1977: Atmospheric Chemistry of Chlorofluorocarbons. In *Proceedings of the XV International Congress of Entomology: Symposium on "The Impact of the Chlorofluorocarbons/Ozone Question on Insecticidal Aerosols"*, p. 399 (Academic Press, New York).
- 1980: Laboratory measurements of absorption cross sections. In *Proceedings of NATO Advanced Study Institute on Atmospheric Ozone, October 1979*. A. Aiken, Ed. (Report No. FAA-EE-80-20), p. 589.
- 1981: Kinetics of hydroxyl radical reactions of interest in the stratosphere. In *Abstracts of the 28th IUPAC Congress*. (Int. Union of Pure and Applied Chem., Vancouver, British Columbia, Canada).
- 1983: Laboratory chemistry and stratospheric ozone. In *Proceedings of the Indo-US Workshop on Global Ozone Problem* (New Delhi, India).
- Rates of reaction of OH with HNO₃ and with HCl. In *Abstracts of the Amer. Chem. Soc. 185th National Meeting, Div. of Environmental Chemistry* (Seattle, WA).
- 1987: Heterochemical studies on ice chemistry. In *Report of the Fluorocarbon Program Panel Meeting, Chemical Manufacturer's Association* (Edinburgh, Scotland).
- Ice chemistry and antarctic ozone. In *Abstracts of the Symposium on Heterogeneous Reactions in the Atmosphere, Pacific Conference on Chemistry and Spectroscopy*. (Irvine, CA).
- 1988: Heterogeneous chemical processes in ozone depletion. In *Proceedings of the Symposium on Ozone Depletion, Greenhouse Gases and Climate Change, Board on Atmospheric Sciences and Climate*. (National Academy of Sciences, Washington, DC).
- Chlorofluorocarbons in the environment: A review. In *Proceedings of the Symposium on Environmental Fate of Organochlorine Compounds in the Atmosphere, 36th ASMS Conference on Mass Spectroscopy and Allied Topics*. (ASMS, San Francisco, CA).
- The chemical mechanisms for ozone loss over Antarctica. In *Abstracts of the Symposium on Current Trends in Atmospheric Sciences, International Congress of Geochemistry and Cosmochemistry*. (Paris, France).
- 1989: The chemistry of some reactions believed to be important in ozone depletion over Antarctica. In *Proceedings of the International Ozone Symposium*. R. Bojkov and P. Fabian, Eds. (Deepak, Hampton, VA).
- Global atmospheric chemistry of halogens. In *Abstracts of the International Symposium on Global and Regional Environmental Atmospheric Chemistry*. (Beijing, China).

Laboratory chemistry and stratospheric clouds. In *Abstracts of the Symposium on the Role of Clouds in Atmospheric Chemistry and Global Climate*. (Amer. Met. Soc., Anaheim, CA).

Heterogeneous chemistry in the Antarctic stratosphere. In *Abstracts of the Symposium on Fundamental Kinetic Processes Linking CFC Release to Global Ozone Destruction in the Polar Stratosphere*. (Amer. Chem. Soc., Dallas, TX).

Heterogeneous chemistry on polar stratospheric clouds. In *Abstracts of the Symposium on the Climate Effects on Aerosols*. (Amer. Assoc. for Aerosol Res., Reno, NV).

Stratospheric ozone: Current Concerns. In *Abstracts of the Symposium on Global Environmental Chemistry - Challenges and Initiatives*. (Amer. Chem. Soc., Miami, FL).

Chemistry of Antarctic ozone depletion. In *Abstracts of the Third International Conference on Southern Hemisphere Meteorology and Oceanography*. (Amer. Met. Soc., Buenos Aires, Argentina).

SELECTED PUBLIC LECTURES

1976: *Protection of the Ozone Layer*, Institute of Higher Studies, Santa Barbara, CA.

Stratospheric Pollution Due to Man-Made Chemicals, Agricultural Research Center, US Dept. of Agriculture, Beltsville, MD.

1979: *The Aerosol Threat to the Environment*, Continuing Education Div., Santa Barbara City College, CA.

1980: *Química de la Estratósfera; Cinética Química Contemporánea: Teoría y Experimentos*, Córdoba, Argentina.

1987: *Chemistry of the Atmosphere and Ozone Layer*, National SACNAS Conference, El Paso, TX.

1988: *Chemistry of the Atmosphere*, MBRs/MARC Program Seminar Series, University of Texas at San Antonio.

The Changing Chemistry of the Global Atmosphere, Annual Meeting of the Caltech board of Trustees, Palm Springs, CA.

1989: *The Greenhouse Effect*, Caltech Assoc./Faculty Dinner, Pasadena, CA.

Ozone Depletion at the Poles, XVIII Reunión de Física Estadística, Oaxtepec, Morelos, Mexico.

Stratospheric Ozone Depletion, David French Lecture, Claremont College, CA.

1990: *The Antarctic Ozone Hole*, Featured Lecture, Celebration of the Sciences, Washington College, MD.

Our Endangered Atmosphere, Panelist, Earth Day, 1990: The Science Behind the Issues, Organized by the American Chemical Society and the University of Massachusetts, MA.

PUBLICATIONS

- 1972: Tandem chemical laser measurements of vibrational energy distribution in the dichloroethylene photoelimination reactions. *J. Chem. Phys.*, **56**, 3988 (with G.C. Pimentel).
- 1973: Chemical laser studies of vibrational energy distributions: The equal-gain and zero-gain temperature techniques. *IEEE J. Quantum Electronics*, **QE-9**, 64 (with G.C. Pimentel).
- 1974: Stratospheric sink for chlorofluoromethanes-chlorine atom catalyzed destruction of ozone. *Nature*, **249**, 810 (with F.S. Rowland).
- Predicted present stratospheric abundances of chlorine species from photodissociation of carbon tetrachloride. *Geophys. Res. Lett.*, **1**, 309 (with F.S. Rowland).
- 1975: Chlorofluoromethanes in the environment. *Rev. Geophys. and Space Phys.*, **13**, 1 (with F.S. Rowland).
- Some unmeasured chlorine atom reaction rates important for stratospheric modeling of chlorine atom catalyzed removal of ozone. *J. Phys. Chem.*, **79**, 667 (with F.S. Rowland).
- The ozone question. *Science*, **190**, 1038 (with F.S. Rowland).
- Natural halocarbons in air and sea. *Nature*, **258**, 775 (with F.S. Rowland and C.C. Chou).
- 1976: Estimated future atmospheric concentrations of CCl_3F (flouorocarbon-11) for various hypothetical tropospheric removal rates. *J. Phys. Chem.*, **80**, 2049 (with F.S. Rowland).
- Stratospheric formation and photolysis of chlorine nitrate, ClONO_2 . *J. Phys. Chem.*, **80**, 2711 (with F.S. Rowland and J.E. Spencer).
- Estimated stratospheric concentrations of chlorine nitrate, ClONO_2 . *J. Phys. Chem.*, **80**, 2713 (with F.S. Rowland and J.E. Spencer).
- 1977: The temperature dependences of the ultraviolet absorption cross-sections of CCl_2F_2 and CCl_3F , and their stratospheric significance. *J. Phys. Chem.*, **81**, 286 (with C.C. Chou, W.S. Smith, H. Vera Ruiz, K. Moe, G. Crescentini, and F.S. Rowland).
- The rate constant for the reaction of $\text{O}(^3\text{P})$ atoms with ClONO_2 . *Chem. Phys. Lett.*, **45**, 158 (with L.T. Molina and J.E. Spencer).
- Ultraviolet absorption spectrum of chlorine nitrite, ClONO . *Geophys. Res. Lett.*, **4**, 83 (with L.T. Molina).
- High resolution infrared absorptivities for gaseous chlorine nitrate. *Geophys. Res. Lett.*, **4**, 3 (with R.A. Graham, E.C. Tuazon, A.M. Winer, J.N. Pitts, L.T. Molina, and L. Beaman).
- Ultraviolet absorption spectrum of hydrogen peroxide vapor. *Geophys. Res. Lett.*, **4**, 580 (with L.T. Molina and S.D. Schinke).
- Upper limit for stratospheric ClONO_2 from balloon-borne infrared measurements. *Geophys. Res. Lett.*, **4**, 227 (with D.G. Murcray, A. Goldman, W.J. Williams, F.H. Murcray, F.S. Bonomo, C.M. Bradford, G.R. Cook, and P.L. Hanst).

- 1978: The rate constant for the reaction of O(³P) atoms with Cl₂). *J. Phys. Chem.*, **82**, 1769 (with A.W. Miziolek).
- Stratospheric photodissociation of several saturated perhalo-chlorofluorocarbon compounds of current technological use. (Fluorocarbons - 13, 113, 114, 115). *J. Phys. Chem.*, **82**, 1 (with C.C. Chou, R.J. Milstein, W.S. Smith, H. Vera Ruiz, and F.S. Rowland).
- The ultraviolet spectrum of HOCl. *J. Phys. Chem.*, **82**, 2410 (with L.T. Molina).
- 1979: Chlorine nitrate ultraviolet absorption spectrum at stratospheric temperatures. *J. Photochemistry*, **11**, 39 (with L.T. Molina).
- Ultraviolet absorption spectrum of methylhydroperoxide. *Geophys. Res. Lett.*, **6**, 953 (with G. Arguello).
- 1980: Production of OH from photolysis of HOCl at 307-309 nm. *J. Phys. Chem.*, **84**, 821 (with T. Ishiwata and L.T. Molina).
- Kinetics of the ClO + NO₂ + M reaction. *J. Phys. Chem.*, **84**, 3100 (with L.T. Molina and T. Ishiwata).
- 1981: Temperature dependent UV absorption cross sections of carbonyl sulfide. *Geophys. Res. Lett.*, **8**, 1008 (with L.T. Molina and J.J. Lamb).
- 1982: Ultraviolet absorption cross sections of several brominated methanes and ethanes of atmospheric interest. *J. Phys. Chem.*, **86**, 2672 (with L.T. Molina and F.S. Rowland).
- 1983: Quantum yields for photodissociation of CBr₂F₂ in the 200-300 nm region. *J. Phys. Chem.*, **87**, 1306 (with L.T. Molina).
- Rate constant of the OH + H₂O₂ → HO₂ + H₂O reaction. *J. Phys. Chem.*, **87**, 4467 (with J.J. Lamb, L.T. Molina, and C.A. Smith).
- 1984: Kinetics of the reaction of OH with pernitric and with nitric acids. *Inter. J. Chem. Kinetics*, **16**, 41 (with C.A. Smith, L.T. Molina, and J.J. Lamb).
- The rate of the reaction of OH with HCl. *Inter. J. Chem. Kinetics*, **16**, 1151 (with L.T. Molina and C.A. Smith).
- 1985: An upper limit to the rate of the HCl + ClONO₂ reaction. *J. Phys. Chem.*, **89**, 3779 (with L.T. Molina, R.A. Stachnik and R.D. Tom).
- 1986: Absolute absorption cross sections of ozone in the 185 to 350 nm wavelength range. *J. Geophys. Res.*, **91**, 14501 (with L.T. Molina).
- Pressure and temperature dependences of the reaction of OH with nitric acid. *J. Phys. Chem.*, **90**, 2777 (with R.A. Stachnik and L.T. Molina).
- 1987: Production of the Cl₂O₂ from the self-reaction of the ClO radical. *J. Phys. Chem.*, **91**, 433 (with L.T. Molina).
- Kinetics of the reactions of SH radicals with NO₂ and O₂. *J. Phys. Chem.*, **91**, 4603 (with R.A. Stachnik).
- Antarctic stratospheric chemistry of chlorine nitrate, hydrogen chloride, and ice: Release of active chlorine. *Science*, **238**, 1253 (with T.L. Tso, L.T. Molina and F.C.-Y. Wang).

- 1988: Interactions between HCl, NO_x, and H₂O ice in the antarctic stratosphere: implications for ozone. *J. Geophys. Res.*, **93**, 2442 (with S.C. Wofsy, R. J. Salawitch, L.E. Fox, and M.B. McElroy).

The antarctic ozone hole. *Oceanus*, **31**, 47.

- 1990: Quantum yield of chlorine-atom formation in the photodissociation of chlorine peroxide (ClOOCl) at 308 nm. *Chem. Phys. Lett.*, **173**, 310 (with A.J. Colussi, L.T. Molina, R.N. Schindler and T.L. Tso).

- 1991: Heterogeneous chemistry on polar stratospheric clouds. *Atm. Environment*, **25A**, 2535.

Chemistry of stratospheric ozone depletion. In *Atmospheric Chemistry: models and predictions for climate and air quality*, edited by C.S. Sloane and T.W. Tesche, Lewis Publishers, MI.

- 1992: The heterogeneous reaction HOCl + HCl → Cl₂ + H₂O on ice and nitric acid trihydrate: Reaction probabilities and stratospheric implications. *Geophys. Res. Lett.*, **19**, 461 (with J.P.D. Abbatt).

Stratospheric Ozone. In *The Science of Global Change: The Impact of Human Activities on the Environment*, edited by D.A. Dunnette and R.J. O'Brien, American Chemical Society, Washington, DC.

Interactions of HCl vapor with water-ice: Implications for the stratosphere. *J. Geophys. Res.*, **97**, 15819 (with J.P.D. Abbatt, K.D. Beyer, A.F. Fucaloro, J.R. McMahon, P.J. Wooldridge and R. Zhang).

- 1993: The probable role of stratospheric 'ice' clouds: Heterogeneous chemistry of the 'Ozone Hole', in *CHEMRAWN VII, The Chemistry of the Atmosphere: Its Impact on Global Change*, edited by J.G. Calvert, Blackwell, Oxford, U.K., in press.

Vapor pressure measurements for the H₂SO₄/HNO₃/H₂O and H₂SO₄/HCl/H₂O systems: Incorporation of stratospheric acids into background sulfate aerosols. *J. Phys. Chem.*, **97**, 8541 (with R. Zhang and P.J. Wooldridge).

High pressure fast-flow technique for gas phase kinetics studies. *Int. J. Chem. Kinetics*, **25**, 571 (with J.V. Seeley and J.T. Jayne).

Physical chemistry of the H₂SO₄/H₂O binary system at low temperatures: Stratospheric implications. *J. Phys. Chem.*, **97**, 7351 (with R. Zhang, P.J. Wooldridge, and J.P.D. Abbatt).

Status of stratospheric ozone depletion. *Ann. Rev. of Energy & Environment*, **18**, 1 (with J.P.D. Abbatt).

Laboratory studies of atmospheric heterogeneous chemistry. In *Current Problems and Progress in Atmospheric Chemistry*, edited by J.R. Barker, in *Advances in Physical Chemistry Series*, World Scientific Publishing, in press (with C.E. Kolb, D.R. Worsnop, M.S. Zahniser, P. Davidovits, C.F. Keyser, M.T. Leu, D.R. Hanson, A.R. Ravishankara, L.R. Williams, and M.A. Tolbert).

Physical chemistry of the H₂SO₄/HNO₃/H₂O system: Implications for polar stratospheric clouds. *Science*, in press (with R. Zhang, P.J. Wooldridge, J.R. McMahon, J.E. Kim, H.Y. Chang, and K.D. Beyer).

Quis Event

- Robin
Barbann

- David
Sandelov

- Shelley F.

- Julie
Green

REVISED

Please check
to see if it's
accurate.
TOD

PRESIDENT CLINTON MEETS WITH TOP SCIENTISTS TO DISCUSS CLIMATE CHANGE
July 24, 1997

"The science is clear and compelling: We humans are changing the global climate...No nation can escape this danger. None can evade its responsibility to confront it."

— President Clinton, Address to UN General Assembly
Special Session on the Environment, June 26, 1997

Following up on their remarks to the United Nations General Assembly Special Session on the Environment, today President Clinton and Vice President Gore will hold a round table discussion with eminent scientists, including three Nobel laureates, to discuss the science of climate change and the need to take action to mitigate this problem. Today's discussion begins a series of Administration efforts and events to increase public awareness of the seriousness of this problem and the consequences that are likely to result if we fail to act.

As a party to the 1992 Framework Convention on Climate Change, the United States is engaged in long-term negotiations on the mitigation of climate change, which are scheduled to culminate in Kyoto this December with a treaty setting a legally binding target and timetable for the reduction of greenhouse gas emissions. Today's meeting demonstrates the President's strong commitment to take action on climate change and to lay the scientific facts before the American people prior to the Kyoto Conference.

Why Climate Change is a Problem:

* Human activities are adding to the Earth's natural greenhouse effect by steadily increasing the atmospheric concentrations of greenhouse gases. Carbon dioxide (CO₂) is the largest part of this problem, accounting for about 85% of U.S. greenhouse gas emissions. Since about 1860, the atmospheric concentration of CO₂ has increased by about 30%. Other greenhouse gases, such as methane and nitrous oxide, amplify this problem. **Without intervention, emissions and concentrations of CO₂ will continue to increase, reaching the highest level in the last 50 million years by 2100 (over 700 parts per million by volume). Such concentrations are expected to push up average global temperatures by 2-6° F.**

* Scientists agree that global warming and disruptions in the world's climate could cause a substantial increase in infectious diseases such as malaria, increase the incidence and intensity of floods and droughts, raise sea level enough to inundate thousands of square miles along the U.S. coastline, decrease food production in some of the world's poorest nations, and threaten the survival of many plant and animal species.

Joining the President and Vice President today in the audience will be cabinet members and Administration representatives including Secretary Pena, Department of Energy; Secretary Shalala, Health and Human Services; Secretary Herman, Department of Labor; Secretary Daley, Department of Commerce; Carol Browner, Environmental Protection Agency; James Lee Witt, Director of the Federal Emergency Management Agency and others whose agencies could play a role in dealing with the impacts of climate change.

The following scientists will participate in today's round table discussion with the President and Vice President:

*** Dr. F. Sherwood Rowland, University of California at Irvine.** Dr. Rowland won the Nobel Prize in Chemistry in 1995 for his pioneering research in atmospheric chemistry of the destruction of the ozone layer. He currently serves as the Foreign Secretary of the National Academy of Sciences and is a former President and Chairman of the Board of the American Association for the Advancement of Science. Rowland received his Ph.D. from the University of Chicago in 1952 and is currently the Donald Bren Research Professor of Chemistry and Earth System Science at UC Irvine.

*** Dr. Mario Molina, Massachusetts Institute of Technology.** Dr. Molina was awarded the Nobel Prize along with Dr. Rowland for their research on the thinning of the ozone layer. Molina and his colleagues demonstrated experimentally how ozone-destroying chlorine functioned in the atmosphere. He is currently the Lee and Geraldine Martin Professor of Environmental Science at MIT. Dr. Molina serves on the President's Committee of Advisors on Science and Technology and has also served as an advisor to NASA, the National Science Foundation and the National Institutes of Health.

*** Dr. Jane Lubchenco, Oregon State University.** Dr. Lubchenco is currently the Wayne and Gladys Valley Professor of Marine Biology and a Distinguished Professor of Zoology at Oregon State University. She has received numerous teaching awards and is also an American Academy of Arts and Sciences Fellow and a Fellow to the American Association for the Advancement of Science. She received her Ph.D. from Harvard University in 1975.

*** Dr. Stephen Schneider, Stanford University.** As a postdoctoral researcher at NASA's Goddard Institute for Space Studies and later at the National Center for Atmospheric Research, Dr. Schneider's work focused on the influence of greenhouse gases and suspended particles on the earth's climate. In 1992, he was awarded a MacArthur Fellowship for his ability to integrate and interpret the results of global climate research to the public. Dr. Schneider is currently a professor in the Department of Biological Science and a Science Fellow at the Institute for International Studies at Stanford University.

*** Dr. Bob Shope, University of Texas.** Dr. Shope has devoted his career to the study of viruses carried by mosquitoes, ticks and other biting insects. Since receiving his medical degree from Cornell University in 1954, Dr. Shope has spent time in Malaysia, Brazil and other tropical sites studying insect-borne diseases. He was a Professor of Epidemiology at Yale University's School of Medicine from 1975-1995 and served as the Director of the Yale Arbovirus Research Unit for 24 years. Dr. Shope is presently a Professor in the Departments of Pathology and Microbiology and Immunology at the University of Texas Medical Branch.

*** Dr. Henry Kendall, Massachusetts Institute of Technology.** Dr. Kendall won a Nobel Prize in 1990 for his work in particle physics. Throughout his career, Dr. Kendall's work has focused on U.S. energy and defense issues including the nuclear arms race, nuclear power and renewable energy sources. Dr. Kendall is a founding member of the Union of Concerned Scientists and has been elected

to the National Academy of Sciences. He is currently the J.A. Stratton Professor of Physics at the Massachusetts Institute for Technology.

*** Dr. John Holdren, Harvard University.** Dr. Holdren is an expert on energy and environmental science. He is currently chairing the Presidential Committee of Advisors on Science and Technology Study of the entire U.S. energy research and development portfolio in relation to the economic, environmental and security challenges of the next century. He is presently the Teresa and John Heinz Professor of Environmental Policy and Director of the Program on Science, Technology and Public Policy in the John F. Kennedy School of Government and Professor of Environmental Science and Public Policy in the Department of Earth and Planetary Sciences at Harvard.

July 22, 1997

1997 JUL 22 PM2:15

MEMORANDUM FOR TODD STERN

FROM: Fred DuVal *FDV*

SUBJECT: Global Climate Change Briefing: Suggested Invites

1. Governor Bob Miller (D-NV), Chair, National Governors' Association
2. Governor George Voinovich (R-OH), Vice Chair, National Governors' Association
3. Governor Christine Whitman (R-NJ), Chair, National Governors' Association Committee on Natural Resources
4. Governor E. Benjamin Nelson (D-NE), Vice-Chair, National Governors' Association Committee on Natural Resources
5. Mayor Paul Helmke (R-Fort Wayne, IN), President, U.S. Conference of Mayors
6. Mayor Deedee Corradini (D-Salt Lake City, UT), Vice President, U.S. Conference of Mayors
7. Commissioner Randy Johnson, (R-Hennepin County, MN), President, National Association of Counties
8. Commissioner Betty Lou Ward (D-Wake County, NC), President-elect, National Association of Counties
9. Council member C. Vernon Gray (D-Howard County, MD), First Vice President, National Association of Counties
10. Council member, Jane Hague (R-King County, WA)
11. Representative Michael Box (D-AL), President, National Conference of State Legislatures
12. Council member Marc Schwartz, (NP-Oklahoma City, OK), President, National League of Cities
13. Environmental Protection Agency Commissioner Harold Reheis (GA), President, Environmental Council of the State
14. Environmental Protection Agency Commissioner Robert Shinn (NJ), Vice President, Environmental Council of the State
15. Public Utilities Commissioner Ron Eachus (D-OR)
16. Gabe Johnson (OH) ?
17. Josephine Musser (WI), President, National Association of Insurance Commissioners
18. Glenn Pomeroy (ND), Vice President, National Association of Insurance Commissioners