

Testimony before the Committee on Environment and Public Works

United States Senate

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December 6, 2006

Thank you very much.

It is an honor to have the opportunity to speak to you today about the history of climate science.

I am a professor of history at the University of California, San Diego, where I teach, and research, the history of modern science. I hold a Bachelor of Science in Mining Geology from the Royal School of Mines, part of the University of London, and a Ph.D. from Stanford University, where I completed a graduate special program in geological research and history of science.

In recent months, the suggestion has been made that concern over anthropogenic global warming is a just a fad or a fashion. The history of science shows otherwise. Scientific attention to global warming has lasted over a century, involved thousands of scientists, and extended across six continents. It has spanned the disciplines of physics, chemistry, meteorology, and oceanography,

and included some of the most illustrious and trusted scientists of the 20th century. And it has included scientific advisors to several U.S. Presidents--both Democratic and Republican.

Let me explain.

Scientists have been studying carbon dioxide and climate for a long time. John Tyndall first established in 1859 that carbon dioxide is a greenhouse gas. From this, Swedish geochemist Svante Arrhenius deduced in the 1890s that CO₂ released to the atmosphere by burning fossil fuels could alter Earth's climate. By the 1930s British engineer Guy Callendar had compiled empirical evidence that this effect was already discernible.¹

Callendar's concern was pursued in the 1950s by American physicist Gilbert Plass, a pioneer in upper atmosphere spectroscopy, by geochemist Hans Suess, a pioneer of radiocarbon dating who worked closely with the U.S. Atomic Energy Commission, and by oceanographer Roger Revelle, a one-time commander in the U.S. Navy Hydrographic Office. By the 1960s, Charles David Keeling's systematic measurements demonstrated that atmospheric CO₂ was, indeed, steadily rising. (For this work, Keeling was awarded the National Medal of Science in 2002).

These basic facts of history are well known.²

What is less well known is that by the mid 1960s, a number of scientific advisory panels had expressed concern about global warming, and this concern was communicated by some of America's most illustrious scientists to Presidents Lyndon Johnson, Richard Nixon, and Jimmy Carter.

One early warning came in 1965 from the Environmental Pollution Board of the President's Science Advisory Committee, who warned that "by the year 2000 there will be about 25% more CO₂ in our atmosphere than at present [and] this will modify the heat balance of the atmosphere to such an extent that marked changes in climate...could occur."³ Accordingly, President Lyndon Johnson stated in a Special Message to the Congress: "This generation has altered the composition of the atmosphere on a global scale through...a steady increase in carbon dioxide from the burning of fossil fuels."⁴

A second warning came in 1966 from the U.S. National Academy of Sciences Panel on Weather and Climate Modification, headed by geophysicist Gordon MacDonald, who later served on President Nixon's Council on Environmental Quality (1970-1972).⁵

In 1974, in the wake of the Arab Oil Embargo, Alvin Weinberg, Director of the Oak Ridge National Laboratory, realized that climatological impacts might limit oil production before geology did.⁶ In 1978, Robert M. White, the first administrator of NOAA and later President of the National Academy of Engineering, put it this way:

We now understand that ... carbon dioxide released during the burning of fossil fuels, can have consequences for climate that pose a considerable threat to future society....The potential...impacts [are] ominous."⁷

In 1979 the subject was addressed by the JASON committee—the reclusive group of highly cleared scientists who gather annually to evaluate scientific and technical problems for the U.S. government—and whose members have included some of the most brilliant scientists of our era, including physics Nobel Laureates Hans Bethe and Murray Gell-Mann.

The JASON scientists predicted that atmospheric CO₂ might double by the year 2035, resulting in mean global temperature increases of 2-3° C, and polar warming of as much as 10-12° C. This report also reached the White House, where Frank Press, Science Advisor to President Carter, asked the National Academy of Sciences for a second opinion. An Academy committee, headed by MIT meteorologist Jule Charney, affirmed the JASON conclusion: “If carbon dioxide continues to increase,

[we] find no reason to doubt that climate changes will result, and no reason to believe that these changes will be negligible.”

It was precisely these concerns that led in 1992 to the U.N. Framework Convention on Climate Change, which called for immediate action to reverse the trend of mounting greenhouse gas emissions. One early signatory was U.S. President George H. W. Bush, who called on world leaders to translate the written document into “concrete action to protect the planet.” Three months later, the Convention was unanimously ratified by the U.S. Senate.

Since then, scientists around the world have worked assiduously to flesh out the details of this broadly affirmed picture. The purpose of my 2004 study of the scientific literature, published in the peer-reviewed journal *Science*, was to assess how much disagreement remained in the scientific community about the basic reality of global warming and its human causes. The answer surprised me: not one scientific paper in the random sample disagreed with the consensus position. Scientists, my study showed, are still arguing about the details, but the overall picture is clear. There *is* a consensus among both the leaders of climate science and the rank and file of active climate researchers.

I should acknowledge that one skeptic has challenged my study, and others have repeated his claim. This man is a social anthropologist in Liverpool, who, to my

knowledge, has never published his arguments regarding my study in a peer-reviewed journal. This past October, he admitted that he made significant mistakes in his criticisms, and he now agrees with my general conclusion about the state of climate science.⁸ In an interview with the Australian Broadcasting Commission, he acknowledged, "I do not think anyone is questioning that we are in a period of global warming. Neither do I doubt that the overwhelming majority of climatologists is agreed that the current warming period is mostly due to human impact."

The scientific evidence is clear: the predictions made decades ago by Arrhenius, Callendar, Plass, Suess, Revelle, Charney, MacDonald, Weinberg, White, the JASON committee, and many others, have come true.

One prediction, however, did not come true.

In 1983, the National Academy formed a committee chaired by physicist William Nierenberg to look in greater detail at the issues raised by the JASON and Charney reports. The Nierenberg committee accepted their scientific conclusions, but declined to view global warming as a *problem*, predicting that any adverse effects would be adequately remedied by technological innovation driven by market forces.

This prediction, I think it is fair to say, has not come true. Technological innovation has not saved the homes of the citizens of Shishmaref, Alaska, nor stopped the acidification of the world's oceans, nor prevented the melting of polar ice.

Thank you very much for your time.

¹ Callendar, G.S. (1938). "The Artificial Production of Carbon Dioxide and Its Influence on Temperature." *Quarterly J. Royal Meteorological Society* 64: 223-40. See also James Roger Fleming (2006). *The Callendar Effect: The Life and Work of Guy Stewart Callendar, the Scientist Who Established the Carbon Dioxide Theory of Climate Change*, Boston: American Meteorological Society.

² James Rodger Fleming (1998). *Historical Perspectives on Climate Change*. New York: Oxford University Press; Weart, Spencer R. (2004). *The Discovery of Global Warming*. Cambridge, MA: Harvard University Press.

³ "Restoring the Quality of Our Environment, *Report of the Environmental Pollution Panel, President's Science Advisory Committee*, The White House, December 1965, on p. 9.

⁴ President Lyndon B. Johnson's "Special Message to the Congress on Conservation and Restoration of Natural Beauty" on Feb. 8, 1965. see: <http://www.presidency.ucsb.edu/ws/index.php?pid=27285>. This appears to be the first time "carbon dioxide" appeared in a presidential speech; thanks to Professor Zuoyue Wang of California State University, Pomona, for drawing my attention to this.

⁵ "Weather and Climate Modification Problems and Prospects," Vol I. *Final report of the Panel on Weather and Climate Modification, NAS-NRC Publication 1350*, Washington DC: NAS Press, 1966, particularly discussion on p. 10. See also "Scientific Problems of Weather Modification," *A report of the Panel on Weather and Climate Modification, Committee on Atmospheric Sciences, NAS-NRC Publication 1236*, Washington DC: NAS Press, 1964. On Gordon MacDonald, see Munk, Walter, Naomi Oreskes, and Richard Muller, 2004. "Gordon J.F. MacDonald," *National Academy of Sciences Biographical Memoirs* 84: 3-26.

⁶ Weinberg, Alvin (1974). "Global Effects of Man's Production of Energy." *Science* 186: 205.

⁷ White, Robert M. (1978). *Oceans and Climate : An Introduction*, *Oceanus* 21: 2-3.

⁸ This was recently reported by the Australian Broadcasting Commission, see <http://www.abc.net.au/mediawatch/transcripts/s1777013.htm>