CLIMATE CHANGE

Statement of

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Madam Chairman and members, thank you for the opportunity to appear before the Committee on Environment and Public Works to testify on Climate Change. My name is William Happer, and I am the Cyrus Fogg Bracket Professor of Physics at Princeton University. I am not a climatologist, but I don't think any of the other witnesses are either. I do work in the related field of atomic, molecular and optical physics. I have spent my professional life studying the interactions of visible and infrared radiation with

gases – one of the main physical phenomena behind the greenhouse effect. I have published over 200 papers in peer reviewed scientific journals. I am a member of a number of professional organizations, including the American Physical Society and the National Academy of Sciences. I have done extensive consulting work for the US Government and Industry. I also served as the Director of Energy Research at the Department of Energy (DOE) from 1990 to 1993, where I supervised all of DOE's work on climate change. I have come here today as a concerned citizen to express my personal views, and those of many like me, about US climate-change policy. These are not official views of my main employer, Princeton University, nor of any other organization with which I am associated.

Let me state clearly where I probably agree with the other witnesses. We have been in a period of global warming over the past 200 years, but there have been several periods, like the last ten years, when the warming has ceased, and there have even been periods of substantial cooling, as from 1940 to 1970. Atmospheric concentrations of carbon dioxide (CO2) have increased from about 280 to 380 parts per million over past 100 years. The combustion of fossil fuels, coal, oil and natural gas, has contributed to the increase of CO2 in the atmosphere. And finally, increasing concentrations of CO2 in the atmosphere will cause the earth's surface to warm. The key question is: will the net effect of the warming, and any other effects of the CO2, be good or bad for humanity?

I believe that the increase of CO2 is not a cause for alarm and will be good for mankind. I predict that future historians will look back on this period much as we now view the period just before the passage of the 18th Amendment to the US Constitution to prohibit "the manufacturing, sale or transportation of intoxicating liquors." At the time, the 18th amendment seemed to be exactly the right thing to do – who wanted to be in league with demon rum? It was the 1917 version of saving the planet. More than half the states enacted prohibition laws before the 18th amendment was ratified. Only one state, Rhode Island, voted against the 18th amendment. Two states, Illinois and Indiana, never got around to voting and all the rest voted for it. There were many thoughtful people, including a majority of Rhode Islanders, who thought that prohibition might do more harm than good. But they were completely outmatched by the temperance

movement, whose motives and methods had much in common with the movement to stop climate change. Deeply sincere people thought they were saving humanity from the evils of alcohol, just as many people now sincerely think they are saving humanity from the evils of CO2. Prohibition was a mistake, and our country has probably still not fully recovered from the damage it did. Institutions like organized crime got their start in that era. Drastic limitations on CO2 are likely to damage our country in analogous ways.

But what about the frightening consequences of increasing levels of CO2 that we keep hearing about? In a word, they are wildly exaggerated, just as the purported benefits of prohibition were wildly exaggerated. Let me turn now to the science and try to explain why I and many scientists like me are not alarmed by increasing levels of CO2.

The earth's climate really is strongly affected by the greenhouse effect, although the physics is not the same as that which makes real, glassed-in greenhouses work. Without greenhouse warming, the earth would be much too cold to sustain its current abundance of life. However, at least 90% of greenhouse warming is due to water vapor and clouds. Carbon dioxide is a bit player. There is little argument in the scientific community that a direct effect of doubling the CO2 concentration will be a small increase of the earth's temperature -- on the order of one degree. Additional increments of CO2 will cause relatively less direct warming because we already have so much CO2 in the atmosphere that it has blocked most of the infrared radiation that it can. It is like putting an additional ski hat on your head when you already have a nice warm one below it, but your are only wearing a windbreaker. To really get warmer, you need to add a warmer jacket. The IPCC thinks that this extra jacket is water vapor and clouds.

Since most of the greenhouse effect for the earth is due to water vapor and clouds, added CO2 must substantially increase water's contribution to lead to the frightening scenarios that are bandied about. The buzz word here is that there is "positive feedback." With each passing year, experimental observations further undermine the claim of a large positive feedback from water. In fact, observations suggest that the feedback is close to zero and may even be negative. That is, water vapor and clouds may actually diminish the already small global warming expected from CO2, not amplify it. The evidence here comes from satellite measurements of infrared

radiation escaping from the earth into outer space, from measurements of sunlight reflected from clouds and from measurements of the temperature the earth's surface or of the troposphere, the roughly 10 km thick layer of the atmosphere above the earth's surface that is filled with churning air and clouds, heated from below at the earth's surface, and cooled at the top by radiation into space.

But the climate is warming and CO2 is increasing. Doesn't this prove that CO2 is causing global warming through the greenhouse effect? No, the current warming period began about 1800 at the end of the little ice age, long before there was an appreciable increase of CO2. There have been similar and even larger warmings several times in the 10,000 years since the end of the last ice age. These earlier warmings clearly had nothing to do with the combustion of fossil fuels. The current warming also seems to be due mostly to natural causes, not to increasing levels of carbon dioxide. Over the past ten years there has been no global warming, and in fact a slight cooling. This is not at all what was predicted by the IPCC models.

The climate has changed many times in the past with no help by mankind. Recall that the Romans grew grapes in Britain around the year 100, and Viking settlers prospered on small farms in Greenland for several centuries during the Medieval Climate Optimum around 1100. People have had an urge to control the climate throughout history so I suppose it is no surprise that we are at it again today. For example, in June of 1644, the Bishop of Geneva led a flock of believers to the face of a glacier that was advancing "by over a musket shot" every day. The glacier would soon destroy a village. The Bishop and his flock prayed over the glacier, and it is said to have stopped. The poor Vikings had long since abandoned Greenland where the advancing glaciers and cooling climate proved much less susceptible to prayer. Sometimes the obsession for control of the climate got a bit out of hand, as in the Aztec state, where the local scientific/religious establishment of the year 1500 had long since announced that the debate was over and that at least 20,000 human sacrifices a year were needed to keep the sun moving, the rain falling, and to stop climate change. The widespread dissatisfaction of the people who were unfortunate enough to be the source of these sacrifices played an important part in the success of the Spanish conquest of Mexico.

The existence of climate variability in the past has long been an embarrassment to those who claim that all climate change is due to man and that man can control it. When I was a schoolboy, my textbooks on earth science showed a prominent “medieval warm period” at the time the Vikings settled Greenland, followed by a vicious “little ice age” that drove them out. So I was very surprised when I first saw the celebrated “hockey stick curve,” in the Third Assessment Report of the IPCC. I could hardly believe my eyes. Both the little ice age and the Medieval Warm Period were gone, and the newly revised temperature of the world since the year 1000 had suddenly become absolutely flat until the last hundred years when it shot up like the blade on a hockey stick. This was far from an obscure detail, and the hockey stick was trumpeted around the world as evidence that the end was near. We now know that the hockey stick has nothing to do with reality but was the result of incorrect handling of proxy temperature records and incorrect statistical analysis. There really was a little ice age and there really was a medieval warm period that was as warm or warmer than today. I bring up the hockey stick as a particularly clear example that the IPCC summaries for policy makers are not dispassionate statements of the facts of climate change. It is a shame, because many of the IPCC chapters are quite good. The whole hockey-stick episode reminds me of the motto of Orwell’s Ministry of Information in the novel “1984:” “He who controls the present, controls the past. He who controls the past, controls the future.” The IPCC has made no serious attempt to model the natural variations of the earth’s temperature in the past. Whatever caused these large past variations, it was not due to people burning coal and oil. If you can’t model the past, where you know the answer pretty well, how can you model the future?

Many of us are aware that we are living in an ice age, where we have hundred-thousand-year intervals of big continental glaciers that cover much of the land area of the northern hemisphere, interspersed with relative short interglacial intervals like the one we are living in now. By looking at ice cores from the Greenland and Antarctic ice sheets, one can estimate past temperatures and atmospheric concentrations of CO2. Al Gore likes to display graphs of temperature and CO2 concentrations over the past million years or so, showing that when CO2 rises, the temperature also rises. Doesn’t

this prove that the temperature is driven by CO2? Absolutely not! If you look carefully at these records, you find that first the temperature goes up, and then the CO2 concentration of the atmosphere goes up. There is a delay between a temperature increase and a CO2 increase of about 800 years. This casts serious doubt on CO2 as a climate driver because of the fundamental concept of causality. A cause must precede its effect. For example, I hear my furnace go on in the morning about six o'clock, and by about 7 o'clock, I notice that my house is now so warm that I have too many covers on my bed. It is time to get up. It would never occur to me to assume that the furnace started burning gas at 6 o'clock because the house got warm at 7 o'clock. Sure, temperature and gas burning are correlated, just like temperature and atmospheric levels of CO2. But the thing that changes first is the cause. In the case of the ice cores, the cause of increased CO2 is almost certainly the warming of the oceans. The oceans release dissolved CO2 when they warm up, just like a glass of beer rapidly goes flat in a warm room. If not CO2, then what really causes the warming at the end of the cold periods of ice ages? A great question and one of the reasons I strongly support research in climate.

I keep hearing about the "pollutant CO2," or about "poisoning the atmosphere" with CO2, or about minimizing our "carbon footprint." This brings to mind another Orwellian pronouncement that is worth pondering: "But if thought corrupts language, language can also corrupt thought." CO2 is not a pollutant and it is not a poison and we should not corrupt the English language by depriving "pollutant" and "poison" of their original meaning. Our exhaled breath contains about 4% CO2. That is 40,000 parts per million, or about 100 times the current atmospheric concentration. CO2 is absolutely essential for life on earth. Commercial greenhouse operators often use CO2 as a fertilizer to improve the health and growth rate of their plants. Plants, and our own primate ancestors evolved when the levels of atmospheric CO2 were about 1000 ppm, a level that we will probably not reach by burning fossil fuels, and far above our current level of about 380 ppm. We try to keep CO2 levels in our US Navy submarines no higher than 8,000 parts per million, about 20 time current atmospheric levels. Few adverse effects are observed at even higher levels.

We are all aware that “the green revolution” has increased crop yields around the world. Part of this wonderful development is due to improved crop varieties, better use of mineral fertilizers, herbicides, etc. But no small part of the yield improvement has come from increased atmospheric levels of CO2. Plants photosynthesize more carbohydrates when they have more CO2. Plants are also more drought-tolerant with more CO2, because they need not “inhale” as much air to get the CO2 needed for photosynthesis. At the same time, the plants need not “exhale” as much water vapor when they are using air enriched in CO2. Plants decrease the number of stomata or air pores on their leaf surfaces in response to increasing atmospheric levels of CO2. They are adapted to changing CO2 levels and they prefer higher levels than those we have at present. If we really were to decrease our current level of CO2 of around 400 ppm to the 270 ppm that prevailed a few hundred years ago, we would lose some of the benefits of the green revolution. Crop yields will continue to increase as CO2 levels go up, since we are far from the optimum levels for plant growth. Commercial greenhouse operators are advised to add enough CO2 to maintain about 1000 ppm around their plants. Indeed, economic studies like those of Dr. Robert Mendelsohn at Yale University project that moderate warming is an overall benefit to mankind because of higher agricultural yields and many other reasons.

I remember being forced to read Voltaire’s novel, Candide, when I was young. You recall that Dr. Pangloss repeatedly assured young Candide that he was living in “the best of all possible worlds,” presumably also with the best of all CO2 concentrations. That we are (or were) living at the best of all CO2 concentrations seems to be a tacit assumption of the IPCC executive summaries for policy makers. Enormous effort and imagination have gone into showing that increasing concentrations of CO2 will be catastrophic, cities will be flooded by sea-level rises that are ten or more times bigger than even IPCC predicts, there will be mass extinctions of species, billions of people will die, tipping points will render the planet a desert. A few months ago I read that global warming will soon bring on a devastating epidemic of kidney stones. If you write down all the ills attributed to global warming you fill up a very thick book.

Much is made about tropical diseases like malaria and yellow fever devastating the populations of temperate climates because of the burning of fossil fuels and the subsequent warming of the earth. Many people who actually work with tropical diseases, notably Dr. Paul Reiter, a specialist on tropical diseases, have pointed out how silly all of this is. Perhaps I can add a few bits of history to illustrate this point. One of the first military expenditures of the Continental Congress in 1775 was $300 to purchase quinine for the Continental Army and to mitigate the effects of malaria. The Continental Congress moved from the then Capital of the United States , Philadelphia, to my home town of Princeton, New Jersey, in the summer of 1783 for two reasons. The first was that the Congress had not yet paid many soldiers of the Revolutionary War their promised wages, and disgruntled veterans were wandering up and down the streets of Philadelphia. Secondly, there were outbreaks of malaria in cities as far north as Boston. The Congress knew you were less likely to catch malaria in Princeton than in Philadelphia. In 1793 there was not only malaria, but a horrendous outbreak of yellow fever in Philadelphia. Many thousands of people died in a city with a population of about 50,000. And I should point out that Philadelphia was a bit cooler then than now, since the little ice age was just coming to an end. Controlling tropical diseases and many other diseases has little to do with temperature, and everything to do with curtailing the factors that cause the spread – notably mosquitoes in the case of malaria and yellow fever.

Many of the frightening scenarios about global warming come from large computer calculations, “general circulation models,” that try to mimic the behavior of the earth’s climate as more CO2 is added to the atmosphere. It is true that climate models use increasingly capable and increasingly expensive computers. But their predictions have not been very good. For example, none of them predicted the lack of warming that we have experienced during the past ten years. All the models assume the water feedback is positive, while satellite observations suggest that the feedback is zero or negative.

Modelers have been wrong before. One of the most famous modeling disputes involved the physicist William Thompson, later Lord Kelvin, and the naturalist Charles Darwin. Lord Kelvin was a great believer in models and differential equations. Charles

Darwin was not particularly facile with mathematics, but he took observations very seriously. For evolution to produce the variety of living and fossil species that Darwin had observed, the earth needed to have spent hundreds of millions of years with conditions not very different from now. With his mathematical models, Kelvin rather pompously demonstrated that the earth must have been a hellish ball of molten rock only a few tens of millions of years ago, and that the sun could not have been shining for more than about 30 million years. Kelvin was actually modeling what he thought was global and solar cooling. I am sorry to say that a majority of his fellow physicists supported Kelvin. Poor Darwin removed any reference to the age of the earth in later editions of the "Origin of the Species." But Darwin was right the first time, and Kelvin was wrong. Kelvin thought he knew everything but he did not know about the atomic nucleus, radioactivity and nuclear reactions, all of which invalidated his elegant modeling calculations.

This brings up the frequent assertion that there is a consensus behind the idea that there is an impending disaster from climate change, and that it may already be too late to avert this catastrophe, even if we stop burning fossil fuels now. We are told that only a few flat-earthers still have any doubt about the calamitous effects of continued CO2 emissions. There are a number of answers to this assertion.

First, what is correct in science is not determined by consensus but by experiment and observations. Historically, the consensus is often wrong, and I just mentioned the incorrect consensus of modelers about the age of the earth and the sun. During the yellow fever epidemic of 1793 in Philadelphia the medical consensus was that you could cure almost anything by bleeding the patient. Benjamin Rush, George Washington's Surgeon General during the War of Independence, and a brave man, stayed in Philadelphia throughout the yellow fever epidemic. He worked tirelessly to save the stricken by bleeding them, the consensus treatment of the day. A few cautious observers noticed that you were more likely to survive the yellow fever without the services of the great man. But Dr. Rush had plenty of high level-friends and he was backed up by the self-evident consensus, so he went ahead with his ministrations. In summary, a consensus is often wrong.

Secondly, I do not think there is a consensus about an impending climate crisis. I personally certainly don't believe we are facing a crisis unless we create one for ourselves, as Benjamin Rush did by bleeding his patients. Many others, wiser than I am, share my view. The number of those with the courage to speak out is growing. There may be an illusion of consensus. Like the temperance movement one hundred years ago the climate-catastrophe movement has enlisted the mass media, the leadership of scientific societies, the trustees of charitable foundations, and many other influential people to their cause. Just as editorials used to fulminate about the slippery path to hell behind the tavern door, hysterical op-ed's lecture us today about the impending end of the planet and the need to stop climate change with bold political action. Many distinguished scientific journals now have editors who further the agenda of climate-change alarmism. Research papers with scientific findings contrary to the dogma of climate calamity are rejected by reviewers, many of whom fear that their research funding will be cut if any doubt is cast on the coming climate catastrophe. Speaking of the Romans, then invading Scotland in the year 83, the great Scottish chieftain Calgacus is quoted as saying "They make a desert and call it peace." If you have the power to stifle dissent, you can indeed create the illusion of peace or consensus. The Romans have made impressive inroads into climate science. Certainly, it is a bit unnerving to read statements of Dr. James Hansen in the Congressional Record that climate skeptics are guilty of "high crimes against humanity and nature."

Even elementary school teachers and writers of children's books are enlisted to terrify our children and to promote the idea of impending climate doom. Having observed the education of many children, including my own, I am not sure how effective the effort will be. Many children seem to do just the opposite of what they are taught. Nevertheless, children should not be force-fed propaganda, masquerading as science. Many of you may know that in 2007 a British Court ruled that if Al Gore's book, "An Inconvenient Truth," was used in public schools, the children had to be told of eleven particularly troubling inaccuracies. You can easily find a list of the inaccuracies on the internet, but I will mention one. The court ruled that it was not possible to attribute hurricane Katrina to CO2. Indeed, had we taken a few of the many billions of dollars we have been spending on climate change research and propaganda and fixed the dykes

and pumps around the New Orleans, most of the damage from Hurricane Katrina could have been avoided.

The sea level is indeed rising, just as it has for the past 20,000 years since the end of the last ice age. Fairly accurate measurements of sea level have been available since about 1800. These measurements show no sign of any acceleration. The rising sea level can be a serious local problem for heavily-populated, low-lying areas like New Orleans, where land subsidence compounds the problem. But to think that limiting CO2 emissions will stop sea level rise is a dangerous illusion. It is also possible that the warming seas around Antarctica will cause more snowfall over the continent and will counteract the sea-level rise. In any case, the rising sea level is a problem that needs quick local action for locations like New Orleans rather than slow action globally.

In closing, let me say again that we should provide adequate support to the many brilliant scientists, some at my own institution of Princeton University, who are trying to better understand the earth's climate, now, in the past, and what it may be in the future. I regret that the climate-change issue has become confused with serious problems like secure energy supplies, protecting our environment, and figuring out where future generations will get energy supplies after we have burned all the fossil fuel we can find. We should not confuse these laudable goals with hysterics about carbon footprints. For example, when weighing pluses and minuses of the continued or increased use of coal, the negative issue should not be increased atmospheric CO2, which is probably good for mankind. We should focus on real issues like damage to the land and waterways by strip mining, inadequate remediation, hazards to miners, the release of real pollutants and poisons like mercury, other heavy metals, organic carcinogens, etc. Life is about making decisions and decisions are about trade-offs. The Congress can choose to promote investment in technology that addresses real problems and scientific research that will let us cope with real problems more efficiently. Or they can act on unreasonable fears and suppress energy use, economic growth and the benefits that come from the creation of national wealth.