31. CLIMATE (CARBON DIOXIDE) AND THE CONSTITUTION #4

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July 19, 2010

For Immediate Release (See Related Releases Nos. **10**, **29** & **30** of February 22, July 2, & 14, 2010)

Former Senator Schmitt Summarizes History of Global Atmospheric Carbon Dioxide

Given how little we actually know about climate, and in particular about the bogeyman called "carbon dioxide," the President, the Environmental Protection Agency, Congress, and some ideological State governments and politically fearful corporations have chosen an extraordinarily dangerous path in attempting to stop natural change. The climate science establishment provides a continuous drumbeat of model-based rather than observation-based predictions in support of moving along this path of economic decline **[1]**. The scientific rationale behind this proposed massive intrusion into American life requires more than a "consensus" of ideologically like-minded climate analysts and bureaucrats **[2]**.

All of the political focus and almost all of the publicly reported scientific allegations related to present and future climate change centers on atmospheric carbon dioxide rather than on the immense complexity of natural climate. Not only do the legislative and regulatory proposals to control human production of carbon dioxide violate many provisions of the Constitution of the United States of America; but also the so-called scientific justifications for those proposals do not adhere to basic principles of scientific enquiry and analysis that require objectivity, skepticism about one's own ideas as well as those of others, hypothesis testing and re-testing, and debate. [See essays **10** and **29**].

After water, carbon dioxide constitutes the second most important greenhouse gas in the atmosphere, but still makes up only 0.05% by weight compared to about 2.7% for water. There remains, however, significant uncertainty about the relative effects of water and clouds versus carbon dioxide. The science of "radiative transfer physics" relates to the greenhouse contribution of any given atmospheric gas. Pure radiative physics considerations indicate that water dominates by about a factor of 3 **[3]**; however, the effect of clouds is poorly understood**.** Some observers suggest that water and clouds dominate the greenhouse effect in the atmosphere by a factor of about 10-20 over other components **[4]**. Water absorbs infrared radiation over a much broader range of wavelengths than does carbon dioxide, and water and clouds, unlike carbon dioxide, also adsorb radiation due to collisions between molecules or particles that also act briefly like complex, adsorbing molecules **[5]**. The fact that climate models using current understanding of radiative transfer physics fail to predict observed temperature trends in the lower atmosphere (troposphere) **[6]** indicates that the models lack some important parameters or observational controls. Our quantitative knowledge of the actual concentrations and distribution of water in the atmosphere, feedbacks between various heating and cooling effects, and the weather phenomena that affect these parameters, can only be described as very poor [7]. All discussions of water as a greenhouse gas should be tempered by recognition of this ignorance.

Carbon dioxide, of course, forms an essential ingredient for the plant and marine life on Earth on which all other life depends. Indeed, the planet life essential to human existence initially evolved in the geologic past at levels of carbon dioxide many times higher than exist today and still grows significantly more vigorously at higher carbon dioxide levels, particularly with increasing temperature [8]. Existing plant life obviously has adapted to a long-term trend of decreasing atmospheric carbon dioxide that has prevailed over the last 175 million years [9]. In that context, studies of the sizes of fossil Ginkgo leaf stomata (gas exchange pores) indicate that high, but erratic carbon dioxide levels persisted in the Western United States, and certainly across the Earth, from 250 to 65 million years ago [10].

Direct, continuous measurements of carbon dioxide in the atmosphere at the top of Mauna Loa, Hawaii, over the last 53 years appear to show a steady increase from 260 to 385ppm, [11] amounts many times lower than those for most of Earth history. Unfortunately, validity of Mauna Loa measurements is not without its questions [12]. These data have been adjusted by assuming a constant value for atmospheric carbon dioxide emissions from the burning of fossil fuels [13]. The raw data from Mauna Loa show that carbon dioxide emissions are not constant and actually showed a decrease after 1992 [14]. Mauna Loa measurements, however, may be the best we can do until satellite measurements are available. Indeed, atmospheric carbon dioxide concentrations only declined to about 260ppm approximately 9000-years ago, or some 19,000 years after slow warming began following the peak of the last major Ice Age [15]. During the Mauna Loa measurement period, at least 50% of the carbon dioxide produced by fossil fuel burning cannot be accounted for even if one makes the unlikely assumption that the measured rise since 1958 is entirely the result of fossil fuel burning. Advocates of human-caused global warming see this "Missing Sink" for carbon dioxide as lurking somewhere, yet to be discovered [16]. The missing carbon dioxide is probably in the oceans but definitely not in the atmosphere.

Carbon isotope ratios appear to be the only means to measure how much atmospheric CO2 has resulted from the burning of fossil fuels. Only about four percent of modern carbon dioxide in the atmosphere and upper-ocean today can be shown to have its origins in the burning of fossil fuels, based on ratios of stable carbon isotopes [17]. Although one would think that an isotopic analysis and mass balance calculation would be an obvious project to undertake, the just referenced publications appear to be the only such analysis published [18]. Such an analysis is possible because geological processes (metamorphism) associated with fossil fuel formation from plant debris, concentrate the lighter isotope of carbon (^{12}C) in coal and oil. In contrast, Earth-surface biological processes tend to produce higher proportions of the heavier carbon isotope (^{13}C). Analysis of carbon isotopes indicates that isotopically heavier non-fossil fuel sources of carbon dioxide continue to dominate new contributions of this gas to the atmosphere. Natural emissions of methane (CH_4), the third most important greenhouse gas, reinforce this isotopic picture further as experiments indicate that methane passing through a column of rock becomes isotopically lighter **[19]**.

No significant evidence exists that changes in atmospheric carbon dioxide drive global temperature variations **[20]**. The last 50 years of steady increase in carbon dioxide of one molecule per 100,000 molecules of air every five years has had no demonstrable effect on the multi-decade cooling and warming cycles since 1979 when collection of temperature data by satellite began to augment other measurement sources. Cooling between 1935 and 1975 and after 2000 **[21]** occurred even as a steady rise persisted in atmospheric carbon dioxide. The slow long-term warming since the coldest portion of the Little Ice Age (500-1900) shows no signs of acceleration during 150 years of industrialization and use of fossil fuels. This warming has averaged about 0.9 degree Fahrenheit (0.5 degree Centigrade) per 100 years for the last 350 years **[22]**.

The mathematically derived maximum sensitivity of surface temperature to doubling atmospheric carbon dioxide, to about 760ppm, is 3.5-5.5 ºF (2-3 ºC). This calculation is tightly constrained by over three decades of records of both carbon dioxide concentrations on Mauna Loa and global temperatures measured by satellite **[23]**. At the rate of carbon dioxide increase since 1960, doubling from today would occur in about 150 years, assuming that there were no prolonged intervals of global cooling. Doubling the atmospheric content of carbon dioxide just from new fossil fuel emissions, however, would require burning an unrealistic quantity of fossil fuels as most new emissions ultimately will end up dissolved in or precipitated from the oceans.

Should the observed rate of natural warming since the Little Ice Age continue during the next 150 years, the global temperature would increase about 1.4 ºF (0.7 ºC) or about one-third of that if atmospheric carbon dioxide were doubled. Barring temporarily increased emissions from major volcanic eruptions **[24]**, this suggests that the long-term ***rate*** of increase in carbon dioxide, at least in part, actually may be a measure of the ***rate*** of natural warming, reflecting release of gas from global sinks, particularly the deep oceans **[25]**. Recent studies and investigations of deep sea cores, for example, indicate a significant release of carbon dioxide from the Southern Ocean during the waning millennia of the last Ice Age **[26]**.

Major non-fossil fuel sources of modern carbon dioxide **[27]** include volcanic eruptions **[28]**, input from rivers **[29]**, biological processes and decay, and, probably most importantly, release from the oceans due to slow warming over the past three and a half centuries. Major volcanic eruptions occur every few years with each eruption releasing about two times the mass of current annual emissions from fossil fuel use **[30]**. As would be expected due to their huge capacity to hold carbon dioxide and the rapid exchange between the ocean and atmosphere, the oceans regulate the amount of that gas in the atmosphere as climate variations occur over the scale of decades to centuries **[31]**. They do so by containing about 50 times the dissolved carbon dioxide present in the atmosphere **[32]**, including derived chemical species, with solubility increasing with decreasing temperature **[33]**. Over at least the last 130 years, the varying ***rate*** of increase of carbon dioxide in the atmosphere closely follows temperature increases and decreases **[34]**. Overall, however, the fraction of new carbon dioxide emissions absorbed by the oceans appears to have remained roughly constant for the last 250 years, if not much longer.

Where, then, is all the carbon dioxide from fossil fuels that is not in the atmosphere [35]? Geoscientists have long known that most atmospheric carbon dioxide cycles through the upper ocean every 5-10 years [36]. Some new carbon dioxide, with estimates of 20-35 percent of new emissions from all sources [37], cycles down into cold deep waters where its solubility is greatest and where recycling times slow to hundreds or thousands of years [38]. Some carbon dioxide goes into organic and inorganic deposition of calcium carbonate that ends up in the sediments on the ocean floor. Life processes have sequestered significant carbon in new biomass, particularly in phytoplankton [39] and non-edible hydrocarbons [40] in the oceans. Accelerated rock weathering also occurs [41] with the calcium released precipitated as carbonate in soils and ocean sediments.

Although atmospheric carbon dioxide has risen slowly in response to slow warming following the Little Ice age, ice cores suggest that atmospheric methane (CH4) has been rising for about 5,000 years only to accelerate in the last 200 years [42]. Like major climate changes, the variation in atmospheric methane over thousands of years appears to correlate with systematic variations in the precession of the Earth's orbit around the Sun [43]. The nearer term acceleration in the quantity of methane has been attributed to human activity [44], but, as with increased carbon dioxide concentrations, it also correlates with the post-Little Ice Age warming of the last 350 years. Warming may be increasing the rate of release of stored methane as well as the rate of biological methane production through an increase in plant productivity due to higher temperatures and carbon dioxide fertilization as well as more rapid decomposition rates [45].

Studies of the history of atmospheric gas concentrations show that natural, non-volcanic increases in carbon dioxide and methane normally ***follow***, that is, lag global temperature increases by several hundred to a thousand years [46]. Similarly, and even more clearly, natural decreases in carbon dioxide and methane ***follow***, that is, lag global temperature decreases. This suggests that current increases in atmospheric carbon dioxide and methane reflect, at least in large part, a response to the average century-by-century global temperature increases since about 1660 as those increases gradually permeate the deep oceans. This cause and effect reflects the fact that increased temperature will accelerate the release of both carbon dioxide and methane [47] from warming oceans and biological processes.

Climate scientists ignore the lag between global temperature increases and oceanic and biological carbon dioxide release at their peril. For example, oxygen isotope analysis of cores from the Southern Ocean discloses that a temperature oscillation at about 40 million years was quite extreme [48]. A major increase in atmospheric carbon dioxide appears to have been associated with this temperature rise. The analysts, however, do not know which came first, a rise in temperature or a rise in carbon dioxide. They dismiss as unlikely any potential role for any other cause of global atmospheric and oceanic heating even though strong correlations exist between ice ages and orbital cycles of the Earth. Similarly, others assume that modern increases in atmospheric carbon dioxide cannot be the result of anything but fossil fuel uses [49] even though well-recognized natural increases have occurred in the geologic past. The potential positive or negative greenhouse effects of the delayed response of atmospheric concentrations of carbon dioxide to temperature changes might affect the ultimate scale of those temperature changes; but the complexities of water and cloud feedback related to atmospheric carbon dioxide may make such a determination difficult at best **[50]**.

Major, long-term carbon dioxide emissions resulting from huge outpourings of lava, as occurred over ~600,000 years from the Central Atlantic Magmatic Province (201 million years ago) **[51]**, also may be instructive as to the relative roles of atmospheric components in climate change. This particular series of eruptions appears to have raised atmospheric carbon dioxide from about ~2000 to ~4400ppm with no identified associated global temperature anomaly. In turn, this suggests that volcanic carbon dioxide, even at elevated levels that may have persisted for hundreds of thousands of years, is not an effective greenhouse gas given other potential complexities such as co-produced aerosols and clouds that are known to cause net cooling of the atmosphere.

The scientific rationale behind the Administration's and Congress' proposed massive intrusion into American life in the name of climate change requires more than a "consensus" of like-minded climate analysts and bureaucrats about "carbon dioxide." It requires a recognition that climate has changed in both the recent and geological past with little or no correlation with changes in atmospheric carbon dioxide concentrations. Bad science and unconstitutional usurpation of the natural rights of the people and the constitutionally reserved powers of the States did not sit well with the electorate in 2010 and should not in subsequent elections.

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