

Climate Change: The Science Isn't Settled

By James Schlesinger
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Despite the certainty many seem to feel about the causes, effects and extent of climate change, we are in fact making only slow progress in our understanding of the underlying science. My old professor at Harvard, the great economist Joseph Schumpeter, used to insist that a principal tool of economic science was history -- which served to temper the enthusiasms of the here and now. This must be even more so in climatological science. In recent years the inclination has been to attribute the warming we have lately experienced to a single dominant cause -- the increase in greenhouse gases. Yet climate has always been changing -- and sometimes the swings have been rapid.

At the time the U.S. Department of Energy was created in 1977, there was widespread concern about the *cooling trend* that had been observed for the previous quarter-century. After 1940 the temperature, at least in the Northern Hemisphere, had dropped about one-half degree Fahrenheit -- and more in the higher latitudes. In 1974 the National Science Board, the governing body of the National Science Foundation, stated: "During the last 20 to 30 years, world temperature has fallen, irregularly at first but more sharply over the last decade." Two years earlier, the board had observed: "Judging from the record of the past interglacial ages, the present time of high temperatures should be drawing to an end . . . leading into the next glacial age." And in 1975 the National Academy of Sciences stated: "The climates of the earth have always been changing, and they will doubtless continue to do so in the future. How large these future changes will be, and where and how rapidly they will occur, we do not know."

These statements -- just a quarter-century old -- should provide us with a dose of humility as we look into the more distant future. A touch of that humility might help temper the current raging controversies over global warming. What has concerned me in recent years is that belief in the greenhouse effect, persuasive as it is, has been transmuted into the dominant forcing mechanism affecting climate change -- more or less to the exclusion of other forcing mechanisms. The CO₂/climate-change relationship has hardened into orthodoxy -- always a worrisome sign -- an orthodoxy that searches out heretics and seeks to punish them.

We are in command of certain essential facts. First, since the start of the 20th century, the mean temperature at the earth's surface has risen about 1 degree Fahrenheit. Second, the level of CO₂ in the atmosphere has been increasing for more than 150 years. Third, CO₂ is a greenhouse gas -- and increases in it, other things being equal, are likely to lead to further warming. Beyond these few facts, science remains unable either to attribute past climate changes to changes in CO₂ or to forecast with any degree of precision how climate will change in the future.

Of the rise in temperature during the 20th century, the bulk occurred from 1900 to 1940. It was followed by the aforementioned cooling trend from 1940 to around 1975. Yet the concentration of greenhouse gases was measurably higher in that later period than in the

former. That drop in temperature came after what was described in the National Geographic as "six decades of abnormal warmth."

In recent years much attention has been paid in the press to longer growing seasons and shrinking glaciers. Yet in the earlier period up to 1975, the annual growing season in England had shrunk by some nine or 10 days, summer frosts in the upper Midwest occasionally damaged crops, the glaciers in Switzerland had begun to advance again, and sea ice had returned to Iceland's coasts after more than 40 years of its near absence.

When we look back over the past millennium, the questions that arise are even more perplexing. The so-called Climatic Optimum of the early Middle Ages, when the earth temperatures were 1 to 2 degrees warmer than today and the Vikings established their flourishing colonies in Greenland, was succeeded by the Little Ice Age, lasting down to the early 19th century. Neither can be explained by concentrations of greenhouse gases. Moreover, through much of the earth's history, increases in CO₂ have followed global warming, rather than the other way around.

We cannot tell how much of the recent warming trend can be attributed to the greenhouse effect and how much to other factors. In climate change, we have only a limited grasp of the overall forces at work. Uncertainties have continued to abound -- and must be reduced. Any approach to policy formation under conditions of such uncertainty should be taken only on an exploratory and sequential basis. A premature commitment to a fixed policy can only proceed with fear and trembling.

In the Third Assessment by the International Panel on Climate Change, recent climate change is attributed primarily to human causes, with the usual caveats regarding uncertainties. The record of the past 150 years is scanned, and three forcing mechanisms are highlighted: anthropogenic (human-caused) greenhouse gases, volcanoes and the 11-year sunspot cycle. Other phenomena are represented poorly, if at all, and generally are ignored in these models. Because only the past 150 years are captured, the vast swings of the previous thousand years are not analyzed. The upshot is that any natural variations, other than volcanic eruptions, are overshadowed by anthropogenic greenhouse gases.

Most significant: The possibility of long-term cycles in solar activity is neglected because there is a scarcity of direct measurement. Nonetheless, solar irradiance and its variation seem highly likely to be a principal cause of long-term climatic change. Their role in longer-term weather cycles needs to be better understood.

There is an idea among the public that "the science is settled." Aside from the limited facts I cited earlier, that remains far from the truth. Today we have far better instruments, better measurements and better time series than we have ever had. Still, we are in danger of prematurely embracing certitudes and losing open-mindedness. We need to be more modest.

The writer, who has served as secretary of energy, made these comments at a symposium on the 25th anniversary of the Energy Department's CO₂/climate change program.