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GLOBAL WARMING: A DISSENTING OPINION

A debate is currently raging within the scientific and political communities over global warming. The debates revolve around, among other issues, whether global warming will take place, what will be the impact on civilization, what can and should be done about it, and so forth. The present majority opinion within the scientific community is that global warming will occur. A recent article by Richard S. Lindzen of MIT's Center for Meteorology and Physical Meteorology offers a minority opinion on global warming. This Technical Attachment will briefly summarize the article entitled: "Some Coolness Concerning Global Warming", which appears in the March 1990 issue of the *Bulletin of the American Meteorological Society*, pages 288 through 299.

Lindzen does not dispute the record which shows an increase in carbon-dioxide in the atmosphere which is theorized to play a major role in the warming of the atmosphere (the so-called greenhouse effect). Predictions of global warming due to increasing carbon-dioxide, based on numerical model runs, generally indicate between 1.5 to 5 degrees (Celsius) increase in the globally averaged temperature. Lindzen argues that such predictions suggest that increases in carbon-dioxide that have occurred over the last 150 years should already have produced warmings of about .5 to 2 degrees.

Lindzen then discusses the problems associated with trying to measure the globally averaged temperature, including poor data coverage over most of the globe (the oceans), problems with the way temperatures at sea are measured, differences in data quality around the world, the effect of urbanization on the data, and the natural variability of the climate. These problems suggest the uncertainty in the measurements are as large as the climatic effects being sought. Regardless of these problems, Lindzen argues that the data does not show the warming that should have already occurred. This is particularly true over the continental U.S. where the data are believed to be most dense and of the highest quality, and where the data has been adjusted to account for urbanization. New methods of global temperature monitoring via satellite agree best with the U.S. data. He further states the model-based predictions suggest the greatest increase in temperature should occur over the polar regions, and particularly in winter. Data from the Arctic shows just the opposite; a cooling trend. Lindzen states, "We certainly cannot assert that no warming occurred; however, it cannot be said the data show it."

Potential problems with the global warming hypothesis and the numerical modeling of the phenomena are discussed by Lindzen. The primary argument with current models is over the treatment of clouds and water vapor in the atmosphere, particularly at high altitudes (above the level where carbon-dioxide has the most impact). Most current models assume warming will increase the amount of moisture at high levels and thus create a "positive feedback" mechanism, further warming the atmosphere as radiation emitted by the earth is absorbed by high-level clouds and water vapor and then re-emitted back to the surface. In fact, without this positive feedback, Lindzen argues, globally averaged temperatures rise by only about 1/3 of the "positive feedback" predictions. On the contrary, Lindzen states

carbon-dioxide induced warming will produce enhanced tropical convection that will produce stronger compensating subsidence, and thus dryer mid- and upper-level air. He further believes the enhanced convection will result in more efficient transport of heat from low-levels to mid- and upper-levels, where it will be above the level where most of the carbon-dioxide absorption takes place. Both of these effects will allow for more efficient radiational cooling of the atmosphere, and thus result in "negative feedback". Thus, he believes corrected models may predict warming of only tenths of a degree, well within the magnitude of changes that have already occurred in the historical record without disastrous consequences.

The bottom line from this article is that Lindzen (and others) believe greenhouse warming may be much smaller than currently publicized estimates. For a much more thorough review of Lindzen's arguments, readers should consult his (very readable) article in the *Bulletin*.