Long Hot Future: Warmer Earth Appears Inevitable

The planet earth will be a warmer place in the 21st century, and there is no realistic strategy that can prevent the change. Scientists and societies should instead concentrate their efforts on learning how to adapt to a warmer world—and to the new climate's likely effects on agriculture, water resources and sea level.

That, in broad paraphrase, is the central conclusion of two independent studies, both released this week, of the so-called "greenhouse effect"—the effect, that is, of rising levels of atmospheric carbon dioxide on global climate. Carbon dioxide, which is released into the atmosphere primarily through burning coal, oil and gas, is the most abundant of the greenhouse gases — gases that absorb the earth's radiated energy and create a thermal blanket around the globe. Both studies—one requested by Congress and the other by the administration—address the question of whether or not changes in energy policy might prevent or delay changes in climate. Both conclude that some warming is probably inevitable and that even very forceful policies—such as heavy taxing of fossil fuel use by industry — are unlikely to significantly delay the heat.

The greenhouse theory has been known and debated since the 19th century, but only in recent years have scientists developed the mathematical modeling techniques that make it possible to predict future climate. Both studies make use of such models. This week's report to Congress, prepared by the National Research Council (NRC), predicts that the level of atmospheric carbon dioxide will double (to approximately 600 parts per million) by the year 2065. Such an increase, the report concludes "with considerable confidence," will be accompanied by an increase in the earth's surface temperature and the temperature of the lower atmosphere—probably in the range of 1.5 to 4.5 degrees centigrade. A change in the lower end of that range is more probable, the report states; but in order to underscore the significance of even a small global temperature change, the report adds that the earth's temperature has changed only 2 degrees centigrade over the last 1,000 years and only 6 to 7 degrees in the past million years. The changes predicted for the next century, the authors say, "carry our planet into largely unknown territory."

What is unknown is how a 2 degree temperature change would affect weather conditions, which in turn affect water supply, agriculture, regional welfare and world politics. Although the authors speculate wildly — Arctic melting might make possible the old dream of a "Northwest Passage"—they emphasize that their inferences about regional changes are offered "with much less confidence." They suggest that the temperature rise will be relatively greater at the poles; that a 3 to 4 degree temperature increase would cause the sea level to rise about 70 centimeters; that summers will be drier in the middle latitudes (where the United States is situated). Precipitation, water supply and agriculture may be affected differently in different regions of the world, the report says.

While the report of the NRC (part of the National Academy of Sciences) concludes that the worldwide problem is "intractable," it is a "reason for caution, not panic." The predictive model, the report emphasizes again and again, contains many "enormous uncertainties": It requires estimation of the future economy, patterns of fuel use, the carbon dioxide sent into the atmosphere by fossil fuels, the amount of the carbon dioxide that actually stays in the atmosphere, and the effect of the gas (and all other greenhouse gases) on climate—all processes that are not well understood. It is not likely that the worst scenario will occur, the report states, so any immediate action to cut back on use of fossil fuels is unjustified. While society should be prepared to switch from fossil fuels to other energy sources if necessary, the report states, it is more prudent to study ways of adapting to environmental change.

That, too, is the conclusion of the second report, prepared by Stephen Seidel and Dale Keyes for the Environmental Protection Agency (EPA), which was designed specifically to determine if a change in energy policy regarding fossil fuels could help control carbon dioxide emission enough to prevent the predicted warming. The study used three models—estimating future energy use, levels of atmospheric carbon dioxide, and the ultimate effects of gases on temperature—to evaluate the effects of public policy innovations on the climate 60 and 120 years from now. Using the estimate that a 2 degree change will occur by the year 2040 and a 5 degree change will occur by 2100, they found that only a total ban on coal use by the end of the century would significantly delay the temperature rise — pushing it back 15 years. Even a worldwide tax of 300 percent on the cost of fossil fuels, the authors report, would delay the 2 degree rise by only five years. The timing and magnitude of the coming temperature change is more likely to be affected by such unknowns as the role of other greenhouse gases and the sensitivity of the atmosphere to these gases, than by changes in economic growth and energy demand, the report notes. The EPA report concludes that an international ban on coal use is politically unfeasible, and that research on national adaptive strategies is the best course.

—W. Herbert

Bugs in the termite gas estimates?

By some accounts concentrations of atmospheric methane, a long-lived trace gas and a contributor to global warming, have doubled in the last 150 years and are still rising at a rate of nearly 2 percent per year. One proposed source of as much as half of this yearly contribution is termites. Billions of them worldwide gnaw through wood and plant fiber, their guts providing a plush abode for the microbes that break the cellulose down into organic compounds the insects can use.

It has been known for several decades that termites produce methane. But a year ago when researchers from the National Center for Atmospheric Research (NCAR) in Boulder, Colo., published their startling assertion that termite gas comprises a major portion of the annual flux of atmospheric methane (SN: 11/6/82, p. 295), other scientists hustled to their laboratories or to the field to reproduce or challenge the results. The latest of these retorts was presented last week in Santa Fe, N.M., at the Sixth International Symposium on Environmental Biogeochemistry. Ralf Conrad of the Max Planck Institute for Chemistry in Mainz, West Germany, described work performed with colleague Wolfgang Seiler. They measured methane and carbon dioxide emissions from termite mounds in a savanna in Transvaal, South Africa, and found that while "termites are definitely a significant source of methane," they contribute far less of the gas to the atmosphere than proposed by NCAR researchers Patrick Zimmerman, James Greenberg and colleagues.

The original report proposed that the insects release about 150 teragrams, or 150 million tons, of methane to the atmosphere each year. (The atmosphere is said to hold about 4,000 teragrams of methane; 14 million people weigh about one teragram.) Seiler and Conrad estimate that the termites contribute about 10 million tons. Reinhold Rasmussen and M.A.K. Khalil of the Oregon Graduate Center in Beaverton, who first demonstrated the increase in atmospheric methane (SN: 12/11/82, p. 375), propose that termites supply 15 to 30 million tons of the gas per year. These latter amounts still constitute sizable quantities of the gas, but leave room for large