with support of Kyoto. To many voters therefore he comes across as a zealot; to ecoactivists, however, he comes across as a hypocrite for not pushing the issue harder during the campaign. The fate of the Protocol may well depend on whether Gore wins or loses the election in 2000. Conversely, an informed debate about the scientific and economic problems of the Kyoto Protocol could scuttle the Gore presidential bid.

Recommendation: In the absence of scientific support or any evidence that a warmer climate would on balance be harmful, and in view of the ineffectiveness and exorbitant cost of the Kyoto Protocol, it is recommended that the United States exercise Article 2 of the FCCC and withdraw from the Climate Treaty. Such an action would have a sobering effect on politicians globally and allow them to focus on real world problems: avoidance of general warfare and alleviation of poverty in the developing countries.

Notes

1. The text of the 1992 Global Climate Treaty, formally known as the Framework Convention on Climate Change (FCCC), and of the 1997 Kyoto Protocol (listing Annex-I countries and status of ratification) is available at www.unfccc.de.
2. IPCC WG-I, J. T. Houghton et al., eds., *Climate Change 1995: The Science of Climate Change* (Cambridge, U.K.: Cambridge University Press, 1996). See SPM, p. 5.
3. I have raised the issue in a forum article in the Transactions of the American Geophysical Union ("Unknowns about Climate Variability Render Treaty Targets Premature," *Eos* 78 [1997]: 584; *Eos* 79 [1998]: 188). The variability of the past climate is documented in references listed there.
4. R. Estrada, chairman, Kyoto conference, lecture at Stanford University, Center for Environmental Science and Policy, February 11, 1999.
5. Most of the issues entering into the scientific debate are discussed in S. Fred Singer, *Hot Talk, Cold Science: Global Warming's Unfinished Debate* (*HTCS*) (Oakland, Calif.: Independent Institute, 1997). A second edition of *HTCS* (1999) updates the scientific discussion and includes a summary of the economic impact of a hypothetical global warming.

Additional scientific points

1. There is a striking contrast between theory and measurements. The models expect the most dramatic temperature rise at high latitudes, but scientists searching for such evidence in the polar regions are coming up empty-handed (J. D. Kahl et al., "Absence of Evidence for Greenhouse Warming over the Arctic Ocean in the Past 40 Years," *Nature* 361 [1993]: 335–37). Temperature records taken at the South Pole between 1957 and 1987 also show no warming (J. Sansom, "Antarctic Surface Temperature Time Series," *Journal of Climate* 2 [1989]: 1164).

2. A recent paper by D. Dahl-Jensen et al. ("Past Temperatures Directly from the Greenland Ice Sheet," *Science* 282 [1999]: 268–79) displays a temperature record from a Greenland ice-core borehole that clearly shows an absence of warming in the last fifty years.

3. Another important paper is by H. Conway et al. ("Past and Future Grounding-Line Retreat of the West Antartic Ice Sheet," *Science* 286 [1999]: 280–83); it demonstrates the continuing melting of the West Antarctic ice sheet, which is responsible for much of the sea-level rise that has been ongoing since the end of the last Ice Age, about 15,000 years ago. *HTCS* (figure 11 and the accompanying discussion on pp. 18–19) suggests that a putative global warming will slow down rather than speed up the ongoing sea-level rise as more evaporation and precipitation lead to more rapid ice accumulation on the Antarctic continent.

6. James E. Hansen et al., "Climate Forcings in the Industrial Era" *Proceedings of the National Academy of Sciences* 95 (1998): 12753–58. The paper throws doubt on the ability of models to make predictions: "The forcings that drive long-term climate change are not known with an accuracy sufficient to define future climate change." Some supporting facts are the following:

   1. Climate models have not yet incorporated the presumed large but poorly understood *indirect* cooling effects of sulfate aerosols (by increasing cloudiness) or the quite different optical effects of carbon soot from industrial and biomass burning and of mineral dust arising from disturbances of the land.

   2. None of the climate models incorporate the effects of a variable sun. It has always been assumed that solar variability is simply too small, but this view is now changing. Even if the radiative forcing from changes in solar irradiance is less than that from GHG, the larger variability of the

sun in the ultraviolet may play a much greater role. Evidence is now forthcoming that UV-caused variations of the ozone layer or changes in solar corpuscular emissions ("solar wind") could (indirectly) influence atmospheric circulation or cloudiness—which in turn can cause significant climate changes. (*HTCS*, p. 15)

3. Climate models generally do not incorporate the large surface albedo changes that have come about through land-clearing for agriculture and, more recently, through reforestation in some parts of the world. Nor do the models take account of the likely climate effects of rapidly growing air traffic. (*HTCS*, p. 54)

4. Even though the models are not yet validated as far as temperature trends are concerned, some human influences on climate may already be noticeable. Observations indicate that the diurnal temperature range has been decreasing in the Northern Hemisphere (NH) and perhaps in the Southern Hemisphere (SH) as well. These could be caused by possible increases in aerosols or cloudiness. There is evidence also for winter warming, but not yet for the expected warming at high latitudes predicted by the climate models. On the other hand, observed stratospheric cooling appears in line with what one might expect from the increase in CO_2, as well as from the ongoing depletion of ozone.

5. An earlier story by Richard Kerr exposed other shortcomings of climate models: "Climate Modeling's Fudge Factor Comes under Fire," *Science* 263 (1994): 1528. He refers in particular to the need for "flux adjustments," an arbitrary correction of the energy flux between atmosphere and ocean to prevent a drift of the atmospheric temperature. One researcher stated bluntly: "The oceanographic models that are coupled to the atmospheric ones are so primitive that I have no confidence in any integration carried out for a year or two" (reported in S. Shackley et al., *Adjusting to Policy Expectations on Climate Change Modeling: An Interdisciplinary Study of Flux Adjustments in Coupled Ocean-Atmosphere General Circulation Models*. Report No. 48 [Cambridge, Mass.: MIT Joint Program on the Science and Policy of Global Change, 1999]).

7. J. R. Christy et al., "MSU Tropospheric Temperatures: Dataset Construction and Radiosonde Comparisons," *Journal of Atmospheric and Oceanic Technology* (in press) 2000. See also figure 9 and discussion in *HTCS* (p. 19).

8. National Research Council, *Reconciling Observations of Global Temperature*

Change (Washington, D.C.: National Academy Press, January 13, 2000). The report confirms the validity of the satellite data that show no appreciable warming of the bulk of the atmosphere and of the surface data that show a strong warming of the surface in the past twenty years. The report does not resolve the disparity.

9. The book *HCST* also discusses cloud feedback and water vapor feedback uncertainties and quotes (on p. 52) from three IPCC reports that demonstrate how modelers are increasingly becoming aware of model shortcomings.
10. R. Mendelsohn and J. E. Neumann (in *The Impact of Climate Change on the United States Economy* [Cambridge, U.K.: Cambridge University Press, 1999]) led a team of twenty-three economic experts who analyzed the impact of the putative warming accompanying a doubling of CO_2. Contrary to the IPCC conclusion, they found overall benefits rather than damages, with the important reversals for agricultural crops and timber resources (see pp. 18–19 of *HTCS*). Of particular relevance to economic impacts is the book by Thomas Gale Moore, *Climate of Fear: Why We Shouldn't Worry about Global Warming* (Washington, D.C.: Cato Institute, 1998).
11. IPPC WG-I, 1990: J. T. Houghton et al., eds., *Climate Change: The IPCC Scientific Assessment* (Cambridge, U.K.: Cambridge University Press, 1990). See esp. SPM, p. xii.
12. Richard Kerr has interviewed a number of IPCC scientists and published their opinions in "Greenhouse Forecasting Still Cloudy," *Science* 276 (1997): 1042. See also p. 16 of *HTCS*.
13. It is frequently claimed that chapter 8, which gave rise to the major IPCC conclusion, is based on 130 peer-reviewed articles. Actually, the conclusion is based mainly on two research papers by Santer et al., neither one of which had been published at the time the chapter was under review. One paper (B. D. Santer et al., "Towards the Detection and Attribution of an Anthropogenic Effect on Climate," *Climate Dynamics* 12 [1995]: 79–100) appeared only in December 1995, *after* the IPCC report was approved; the other paper (B. D. Santer et al., "A Search for Human Influences on the Thermal Structure of the Atmosphere," *Nature* 382 [1996]: 39–46) appeared in July 1996, after the IPCC report was printed (in May 1996). Now that the scientific community at large has scrutinized both of these papers, it is possible to discern their shortcomings:

Fig. 8.10(b) on p.433 of the 1996 IPCC report shows a time plot of a pattern correlation coefficient as a measure of the similarity between model-predicted and observed geographic patterns of (near-surface) temperature change. As stated in the figure caption, "there is a positive linear trend [in the coefficient] over the last fifty years [1943 to 1993], indicating that . . . the observed temperature-change patterns are becoming increasingly similar to the predicted signal pattern." But as pointed out (S. F. Singer, *Eos* 80 [1999]: 372), this "positive linear trend" shown in the IPCC report depends entirely on the choice of time period (*HTCS*, p. 9). The trend can also be zero or even negative, as clearly shown in the original research paper of Santer et al. in *Climate Dynamics*, 1995, but these (nonpositive) trend lines were edited out when the figure was reproduced in the IPCC report. It therefore gives the reader the misleading impression that there is indeed only a positive trend, and therefore, increasing agreement between calculated and observed temperature patterns—hence, "a discernible human influence on climate."

14. Indeed, model calculations that incorporate the effects of sulfate aerosols show a reduced warming in the Northern Hemisphere, with warming attaining maximum values in the mid-troposphere of the Southern Hemisphere. (See 1996 IPCC report, fig. 8.7b, p. 428.) Does this pattern exist in the observations? The IPCC report (in the caption for figure 8.7, p. 428) claims "a common pattern of hemispherically asymmetric warming in the low- to mid-troposphere, with reduced warming in the Northern Hemisphere [since aerosols are produced in the NH]." Yet, when finally published, it was discovered (P. J. Michaels and P.C Knappenberger, *Nature* 384 [1996]: 522–23) that the data cover only the period of 1963 to 1988, when indeed there was a warming trend in the Southern Hemisphere following the Agung volcanic eruption that cooled the atmosphere in 1963. The complete available radiosonde record of 1958 to 1995, however, shows *no warming trend* in the Southern Hemisphere. In fact, both surface data and satellite data show a strong warming trend in *northern* mid-latitudes, contrary to model predictions (*HTCS*, p. 15).

15. T. P. Barnett, B. D. Santer, P. D. Jones, R. S. Bradley, and K. R. Briffa, "Estimates of Low-Frequency Natural Variability in Near-Surface Air Temperature," *Holocene* 6 (1996): 255–65.

16. K. Hasselmann, "Are We Seeing Global Warming?" (*Science* 276 [1997]: 914–15). A recent article ("No Guilty Verdict Yet for Climate Change,"

Frankfurter Allgemeine Zeitung, December 15, 1999) comments on Hasselmann's transformation from global warming advocate to a less certain position about human influence on changing climate.

17. T. P. Barnett, K. Hasselmann, M. Chelliah, T. Delworth, G. Hegerl, P. Jones, E. Rasmusson, E. Roeckner, C. Ropelewski, B. Santer, and S. Tett, "Detection and Attribution of Recent Climate Change: A Status Report" *Bulletin of the American Meteorological Society* 80 (1999): 2631–59.

18. Wigley et al., "Anthropogenic Influence on the Autocorrelation Structure of Hemispheric-Mean Temperatures," *Science* 282 (1998): 1676–79. The authors found that the autocorrelation coefficients (for lags between one and twenty years) for *observed* hemispheric temperature data (from 1880 to 1995) differ markedly from those for *unforced* (control-run) simulations (i.e., without any greenhouse-gas increase). They then assert that this difference betrays a significant anthropogenic influence, and also yields a climate sensitivity in the IPCC range (i.e., 1.5–4.5°C for a doubling of greenhouse gases). I hypothesize that the Wigley et al. result is influenced by the unusual sustained temperature rise, from 1860 to 1940, generally identified with the recovery from the preceding Little Ice Age. To test this hypothesis, I divided the temperature record into two parts: (1) pre 1940 (when the human contribution to atmospheric GHG was minor) and (2) post 1940. When I then repeated their analysis, I found that the pre-1940 autocorrelation coefficients differed markedly from the unforced (i.e., non-GHG-enhanced) model simulations, while the post-1940 coefficients did not. If one were to interpret my results in the same fashion as Wigley et al., it would mean that there was an anthropogenic influence *before 1940 but not since then*. Such an interpretation is, of course, unwarranted.

19. National Research Council, *Reconciling Observations of Global Temperature Change* (Washington, D.C.: National Academy Press, January 2000).

20. Wigley and Santer were lead authors of the notorious chapter 8 of the "Second Assessment Report" of the Intergovernmental Panel on Climate Change (IPCC). This chapter was changed surreptitiously *after* it was approved in December 1995; the changes and deletions were discovered only when the printed version appeared in May 1996. (For details, see www.sepp.org/ipcccont/ipcccont.html.) Among other critics, Professor Frederick Seitz (*Wall Street Journal*, June 12, 1996) states: "In my more than 60 years as a member of the American scientific community, including service as president of both the National Academy of Sciences and

the American Physical Society, I have never witnessed a more disturbing corruption of the peer-review process than the events that led to this IPCC report."

See also F. Seitz, "Global Warming Report: Basic Rules Disregarded," *Wall Street Journal*, August 13, 1996; S. F. Singer, "Climate Debate," *Nature* 382 (1996): 392; P. Weiss, "Industry Group Assails Climate Chapter," *Science* 272 (1996): 1734.

21. Quoting from the Leipzig Declaration on the climate debate: "We believe that the dire predictions of a future warming have not been validated by the historic climate record, which appears to be dominated by natural fluctuations, showing both warming and cooling. These predictions are based on nothing more than theoretical models and cannot be relied on to construct far-reaching policies. As the debate unfolds, it has become increasingly clear that—contrary to the conventional wisdom—there does not exist today a general scientific consensus about the importance of greenhouse warming from rising levels of carbon dioxide. In fact, most climate specialists now agree that actual observations from both weather satellites and balloon-borne radiosondes show no current warming whatsoever—in direct contradiction to computer model results."

    For the full text of the four statements, see the Internet at http://www.sepp.org. See also *HTCS*, pp. 40–42. For results of the 1991 survey of IPCC scientists, see S. F. Singer "Warming Theories Need Warning Label," *Bulletin of Atomic Scientists*, June 1992, pp. 34–39, and "No Scientific Consensus on Greenhouse Warming," *Wall Street Journal*, September 23, 1991.

22. For a more detailed discussion, see M. S. Kirova, *Estimating the Costs of Kyoto: Uncertainties and Assumptions Driving the Model Results*, CSAB Policy Study No. 154 (St. Louis, Mo.: Washington University, 1999). The most optimistic cost estimates for Kyoto compliance stem from the White House Council of Economic Advisers (CEA). Their July 1998 report, *The Kyoto Protocol and the President's Policies to Address Climate Change*, pegs the cost at only 0.1 percent of GNP—or $14 for the right to emit a ton of carbon. (Details are given at www.whitehouse.gov/WH/New/html/kyoto.pdf.) The most pessimistic estimate, from the Energy Information Administration (EIA) study, pegs the cost at 4.2 percent of GNP, with a permit cost of $342 per ton of carbon emitted. The difference comes mainly from the assumed amount of international emission trading. Under

the nearly cost-free CEA scenario, U.S. emissions are hardly reduced, while the EIA scenario with no emission trading envisages an effective cut in fossil-fuel use of some 30 percent. (Details of the EIA study *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity* can be found at www.eia.doe.gov/oiaf/kyoto/pdf/sroiaf9803.pdf.)

23. It is generally agreed that the Kyoto Protocol, even if punctiliously enforced, would not be effective in mitigation. Paul Portney, head of the respected policy institute Resources for the Future, expressed his view at a conference of the U.S. Energy Information Administration on March 22, 1999. He stated for the record that all environmentalists, politicians, and think-tank types were in private agreement that the Kyoto Protocol was a dead letter and it was time to move on.

    The 1987 Montreal Protocol (MP) (for the protection of the ozone layer), which resulted in banning the production of CFCs, is often held to be a paradigm for the Kyoto Protocol. The analogy is not very strong—except insofar as they are both based on rather shaky science and do not place stringent requirements on developing nations—a fatal flaw for any global environmental issue. (In fact, enforcement of the MP is so poor that smuggling of foreign CFC production into the United States is second in importance only to the smuggling of drugs.) Perhaps more important, halocarbons constitute only a minor percentage of the national economy; raising their cost saddles consumers with great expense but makes little impact on the GDP. Substitutes are mostly available, albeit at much higher cost. Not surprisingly, certain chemical companies holding patents for the manufacture of such substitutes are fully supportive of the MP.

24. "US Attacked for Failure to Fight Climate Change," *Financial Times*, February 19, 1997.

25. Despite all these problems, a number of organizations are lining up to become traders of emission permits. They hope to emulate the U.S. trading program in emission rights for sulfur dioxide and receive broker fees for such a service. Most recently, the World Bank has signed up financial supporters for starting a pilot program that may reach the scale of $150 million. Its Prototype Carbon Fund will finance projects in developing nations that would not be economic without subsidies and then assign the emission credits so gained to the financing group.

26. The Morelia Declaration was designed to influence the 1992 Rio de Janeiro U.N. Conference on Environment and Development (UNCED).

Published in the *New York Times* (October 10, 1991), it predicts "at least three nuclear catastrophes on the scale of Chernobyl" by the year 2000, millions of environmental refugees from sea-level rise, and the loss of a quarter of all living species within the next 50 years. Its flavor can best be appreciated from its concluding sentence: "If the latter half of the 20th century has been marked by human liberation movements, the final decade of the second millennium will be characterized by liberation movements among species, so that one day we can attain genuine equality among all living things."

The Morelia statement finds an echo in Al Gore, *Earth in the Balance: Ecology and the Human Spirit* (Boston, Mass.: Houghton Mifflin, 1992). Gore's 1992 compendium of environmental alarms was reissued in April 2000, with an extensive new foreword. Far from softening his controversial views on the environment, Gore warns that, unless the warming trend is halted, sea levels could rise high enough to cause "a catastrophic mutation in our physical and human geography." In a postscript, Gore jauntily reaffirms perhaps the most controversial point in his book: that "completely eliminating" the internal combustion engine during his lifetime is not only possible but "needs to be done." Failure to curb global warming will bring cataclysmic consequences, he warns.

In "Gore in the Balance," Jonathan Rauch (*National Journal*, September 18, 1999) writes:

> Gore is hysterical. The environmental crisis is not merely a problem, it is an enemy. The adversary, moreover, is "nothing less than the current logic of world civilization," whose assault on the planet is morally equivalent to Hitler, the Holocaust, slavery, and Communism. "Consumptionism" and totalitarianism are both "examples of alienation and technology run amok," and both require the same sort of all-or-nothing struggle. "Either we move toward the light or we move toward the darkness." From now on, therefore, "we must make the rescue of the environment the central organizing principle for civilization." Every policy, institution, law, and alliance must be directed to that end. Marginal adjustments and moderate improvements "are all forms of appeasement."
>
> The extremism is troubling, even shocking, but it would be excusable as overheated rhetoric if not for Gore's attitude toward his own hysteria. The truth, he says in a characteristic

> locution, is "almost unbearably obvious." Why, then, are so many people unconvinced? Those who deny the obvious are cowardly or corrupt, "seeking to camouflage timidity or protect their vested interest in the status quo." Or they are addicts—of consumptionism—in a state of pathological denial. Fundamentalism, in its broadest sense, is the inability to take seriously the possibility that you might be wrong. Gore's book is a casebook example. It elevates hysteria to a virtue and regards doubt as a disease.

Not much has changed since Gore ran for vice president in 1992. As George Will reports (*Washington Post*, November 18, 1999): Al Gore recently said, "There's not a statement in that book that I don't endorse." Will's essay concludes: "Never in recorded history have birth rates been as low, or per capita food production as high, as at the moment. Gore must pray for relief from the accumulating evidence that Earth is not really hanging in precarious balance."

Ironically, Gore's "global warming mentor" at Harvard, cited respectfully in the book, did not at all share Gore's alarmist views. For a sampling of Professor Roger Revelle's statements and writings, see *Environment News* (published by the Heartland Institute, Chicago) 3, no. 1 (January 2000): 9, or www.sepp.org/weekwas/1999/Oct2.html.

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