

Letters

Hansen and the Greenhouse Effect

Richard A. Kerr's article about James Hansen (Research News, 2 June, p. 1041) is, in my opinion, extremely misleading. Not only does it cast Hansen in a very bad light, it also gives the impression that the greenhouse problem could well be just another environmental false alarm. As a colleague who knows Hansen well, I would like to address these issues.

First, it should be pointed out that the meeting referred to in Kerr's article was organized by a group of people sympathetic to the Department of Energy's position that the greenhouse gas buildup cannot yet be taken seriously. In this regard I feel that the view of this group was not representative of the scientific community's stance. In a sense, Hansen was effectively entering a lion's den.

Second, most would agree that Hansen's depth of insight into the greenhouse problem is matched by few others in the field. He and his colleagues at the Goddard Institute of Space Studies have focused their major research efforts on this problem for the past decade. The papers they have published have had an enormous impact. In my estimation, none of the participants at the meeting can match Hansen's credentials and expertise. In fact, Hansen's group might be referred to as the Avis of climate modeling, while Michael Schlesinger, who organized the meeting, comes from a group that could be called the Rent-A-Wreck of climate modeling. I believe that Hansen is motivated only by his interests in the welfare of the planet and, while I do not agree with all the details of his congressional testimony, I support its major thrust.

With regard to the greenhouse problem, I feel that Kerr does not convey the fact that concern does not rest on whether a significant greenhouse warming has yet occurred. Rather, it rests on a host of model simulations and back-of-the-envelope calculations, all of which suggest that a substantial warming will occur. Further, the records of the last 150,000 years found in ice cores and in marine sediments scream to us that the earth's climate system is highly sensitive to nudges. The ozone hole demonstrates that processes generally considered unimportant in computer simulations can indeed prove to have serious consequences in the real world. The fact that we cannot prove that the warming during the last century was caused by man-induced greenhouse gases is not the major issue. Rather the issue is that, by adding infrared-absorbing gases to the atmosphere, we are effectively playing Russian

roulette with our climate. It is essential that we plan a proper course of action should the consequences prove detrimental to agriculture and wildlife.

Hansen may prove to be incorrect in his prediction of the potential seriousness of the greenhouse gas buildup, but it should be understood that concerns such as his are born of a deep regard for the future of our planet and not by fame or funding.

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Broecker states that the Workshop on Greenhouse-Gas-Induced Climate Change: A Critical Appraisal of Simulations and Observations "was organized and controlled by a group of people sympathetic to the Department of Energy's position that the greenhouse gas buildup cannot yet be taken seriously." Had Broecker accepted my invitation to participate in the workshop and made his contribution there, rather than in the pages of *Science*, he would have known this not to be the case. On the contrary, the 61 participants of the workshop from Australia, Canada, the Federal Republic of Germany, the Soviet Union, the United Kingdom, and the United States have an abiding concern for the climate future of the earth. This concern motivates them to understand this issue to the best of their ability lest society otherwise turn away from it in the near term, because of unrealized expectations, and thereby aggravate its solution in the long term. This concern is evident in the workshop press release which follows.

It is certain that increasing the concentrations of carbon dioxide, methane, chlorofluorocarbons and other trace gases will enhance the greenhouse effect. The concentration of these gases has increased substantially during the last 100 years as a result of human activities. Over the same period the average global surface air temperature has risen by about 0.5 degree Celsius, although this increase has not been constant in time or uniform over the globe. It is tempting to attribute this warming to the increase in greenhouse gases. Because of the natural variation of temperature, however, such an attribution cannot now be made with any degree of confidence. For the same reason, a temporary cooling should not be taken as evidence that greenhouse gas-induced warming in the next century is unlikely.

To increase our understanding of the long-term natural variations of climate requires detailed global information extending back over several centuries. Estimates of natural variability can be obtained from observations in the historic past and from simulations of climate with mathematical climate models on supercomputers.

Climate models are our best tool for estimating future changes in climate. These models project a global warming of a few degrees by the middle of the next century due to the continuing and projected increases of greenhouse gases. Such a

change is several times larger than the warming of the past century. Changes in precipitation and other climate quantities are also projected. However, climate models give differing pictures of the regional features of climate change, including the frequency of droughts and storms.

Progress to improve our ability to project future climate will best be achieved by the further development, analysis, and verification of climate models, by the acquisition, assembly and analysis of climate data, by observational studies of climatic processes, and by providing the human and computer resources required for these tasks.

We, the participants in the international Workshop on Greenhouse-Gas-Induced Climatic Changes, conclude that the need to reduce the current uncertainties about the magnitude, timing and regional detail of future climatic changes is an urgent international priority.

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The article "Hansen vs. the world on the greenhouse threat" leaves the impression that James Hansen (or the position he has taken) is out of the mainstream of the climatological community and that his efforts are less than scientifically based. The major issue of contention is whether or not Hansen is stepping outside the bounds of reasonableness with his statement that "with a high degree of confidence we could associate the warming with the greenhouse effect," and with his communication of this to Congress.

Cause and effect is an incredibly difficult association to make in science. For greenhouse theory, there is no existing testable sufficient condition that would verify that the observed warming and greenhouse change are related. Rather, there are various testable necessary or circumstantial conditions that can be considered. The "fingerprinting" technique reportedly favored at the Amherst conference is just one of many tests that can be performed, and it has its problems like all of them. The fingerprinting technique uses the spatial pattern of climate change to detect greenhouse change, which is a noisier signal than the global average. In addition, studies to date with the fingerprinting method have considered only the predicted equilibrium response to greenhouse change in the absence of ocean currents for the purpose of comparison with observations (1). The actual transient response pattern could be quite different from the predicted equilibrium response (2).

The bottom line, however, is that all the circumstantial evidence in the world does not make a sufficient condition (be it for refutation or for confirmation). To say anything useful about the association between the theory and observations, all the circumstantial evidence must be considered, not

just the results of any single statistical test. When one speaks of confidence in association of the warming and greenhouse change, then one is extrapolating on the basis of disparate information from various sources and tests. The confidence quoted cannot be associated with a particular statistical test and objective number. Rather, one is making value judgments over how much confidence to associate with the circumstantial evidence that is available. When Hansen looks at the evidence and assigns a high degree of confidence to it, he is being no less, or no more, scientific than, say, fellow modeler Michael Schlesinger when he assigns a low degree of confidence on the basis of the same evidence.

The challenge presented by Hansen's manner of communicating his position (congressional testimony) is over how scientists resolve disputes over interpretation, and communicate scientific information about contentious public issues. Should Hansen have gone before Congress? Should he have used the word "confidence," or something else? What is it about the science and the policy associated with this issue that makes a high confidence statement more or less defensible than a low confidence statement? How do the standards for certainty change (if at all) when a scientific issue has policy implications? Is there a "scientific" way of communicating information outside a field? Scientists need to consider how to speak out and how to respond to those who do and those who don't. Perhaps the logical follow-up from the Amherst meeting on greenhouse science is to hold another meeting where climatologists directly address the communication issues around which they have hitherto been skirting.

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REFERENCES

1. T. P. Barnett and M. E. Schlesinger, *J. Geophys. Res.* **92**, 14772 (1987).
2. S. H. Schneider and S. L. Thompson, *ibid.* **86**, 3135 (1981).

Response: Broecker contends that the group assembled at the Amherst workshop on the greenhouse was not representative of the scientific community. To the extent that computer modelers play a role, the statement is unsupportable. There are five greenhouse modeling groups generally recognized as world-class. All were represented at the workshop. In addition, few if any researchers in the climate community have publicly agreed with Hansen's "high degree of confidence" statement.

Broecker says that concern does not rest on detection of the greenhouse warming. The reactions of Congress and the public suggest otherwise. True, the physics of the greenhouse and a wealth of circumstantial evidence require an eventual warming. But years of Capitol Hill testimony to that effect failed to sway Congress or the public. It was Hansen's claim of certain detection of the greenhouse, not hosts of calculations, that touched off last summer's media firestorm.

As Risbey ably points out, some might view Hansen's conclusion as scientific; his manner of presentation, however, might well be the subject of thoughtful discussion.

—RICHARD A. KERR

NASA's Objectives

Philip H. Abelson (Editorial, 26 May, p. 901) offers enthusiasm for the objectives of NASA in developing new satellites and other hardware for examining the earth. I have no doubt that NASA and its supporters in and outside government plan to develop that equipment. But I have serious doubts about the objectives. NASA has had extraordinary capability for many years for advancing the topics that Associate Administrator Leonard A. Fisk espoused recently before a Senate committee, but it has done so in the most modest degree.

Landsat imagery has been available since 1972. AVHRR (Advanced Very-High Resolution Radiometer) imagery, radar imagery, and imagery from other sensors have been available in the public realm for years. NASA's support for the use of these data has been miniscule. For example, extraordinary efforts have been made to persuade NASA and the Department of Energy, separately or jointly, to enable a global survey using existing satellite imagery of the area of forests and rates of deforestation to reduce some of the uncertainties about climatic change that Fisk apparently emphasized and Abelson cites. These efforts, extending over more than a dozen years, have produced little support for trifling objectives usually focused on a further development of methods or equipment, but not on data about the earth. NASA's own staff has repeatedly voiced a lack of interest in support of the very objectives now advanced.

Abelson has the emphasis correctly stated: it is the development of new hardware, not the development of new information. NASA's clients are not the scientific community interested in how the earth works and the citizens who are likely to be affected by that information, but the aerospace industry and NASA's own engineers. Only

weeks ago the scientific community had to mount an extraordinary effort to persuade the Administration and Congress that the Landsat program, which gathers data from around the world under collaborative arrangements with other nations, should not be allowed to die through lack of funds. NASA's help in saving Landsat was approximately in proportion to its contributions to the use of that remarkable system.

Abelson's optimism will be justified only if Congress and the Administration join in refocusing NASA on the objectives that Fisk articulated. A step in the direction of reestablishing credibility might be to redirect some of the funds currently used in the shuttle program to the use of existing data and the development of techniques for handling more such data efficiently.

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Elephant Management

I would like to compliment *Science* on its coverage of the ivory crisis ((News & Comment, 9 June, p. 1135). Any delay in protecting the African elephant from the depredations of bounty hunters will contribute to the extinction of this valuable species, and that's why I am pushing for immediate congressional funding for effective management of these animals. I urge the members of the scientific community to join in this effort to protect one of the most important and breathtaking members of the animal kingdom.

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Erratum: In Robert Pool's Research News article of 21 April (p. 284), "Skepticism grows over cold fusion," the following remark was incorrectly attributed to electrochemist Allen J. Bard (p. 285, col. 1). "The lesson that more heat is produced than is accounted for by burning all the setup is starting to get through to me. The effects are starting to add up to a fairly strong case." That statement was made by another panelist at the cold fusion session of the April 1989 American Chemical Society meeting in Dallas, Texas.

Erratum: In Marjorie Sun's article "South Carolina blocks test of rabies vaccine" (News & Comment, 30 June, p. 1535), the person identified as Jarrett is Michael Jarrett, State Commissioner of the South Carolina Department of Health and Environmental Control. The person identified as Brown is John Brown, toxicologist and chairman of the ad hoc biotechnology committee of the South Carolina state health department.

Erratum: In Mark Crawford's News & Comment article "Agricultural groups push research plan" (14 Apr., p. 140), the U.S. Department of Agriculture's Joint Council on Food and Agriculture Sciences was incorrectly referred to as the "Joint Council on Food and Agriculture Safety."