Letters

Global Warming Report

Leslie Roberts' article "Global warming: Blaming the sun" (24 Nov., p. 992) is misleading on several counts. It should first be noted that one of the authors of the Marshall Institute report (*1*), William Nierenberg, also prepared the major National Research Council report (*2*) on the topic (the most massive of the "carefully researched and reviewed expert reports" Roberts refers to). The three scientists referred to as supporters of the report are reported to be scientists "whose major work is largely outside the grenhouse field." It is hard to know what is meant by this. Virtually no one I know of has devoted his or her career to the "greenhouse field." However, each of the scientists mentioned (Reginald Newell, Jerome Namias, and myself) has published more papers on climate dynamics in the refereed professional literature than have any of the other figures mentioned in the article. In the letter by Namias and myself that is referred to by Roberts, we simply endorsed the major conclusions of the Marshall Institute report: namely, that first, no evidence for the existence of the "greenhouse effect" can be found in the temperature records of the last 100 years; and second, current forecasts of global warming for the 21st century are so inaccurate and fraught with uncertainty as to be useless to policy-makers. We still endorse these conclusions. As for the importance of research, no one suggests that 5 years will bring absolute certainty on the issue of the warming, but it seems unreasonable to insist that we can't reduce the degree of uncertainty substantially in roughly this period.

I personally do not know why the discussion of solar effects was included in the report; it certainly was far from central to the main arguments. It would be difficult to argue with the contention attributed to Schneider, Mahlman, and others, that "the only question [concerning the warming] is how much, and by when." However, what is omitted from such contentions is the plausible possibility that the answer to the question "how much" may turn out to be very little. It is over this possibility that much current debate centers. To be sure, even 5 years of debate cannot settle such an issue, but research might.

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REFERENCES

1. W. A. Nierenberg, R. Jastrow, F. Seitz, *Scientific Perspectives on the Greenhouse Problem* (Marshall Institute, Washington, DC, 1989).
2. W. A. Nierenberg, Ed., *Changing Climate—Report of the Carbon Dioxide Assessment Panel* (National Academy Press, Washington, DC, 1983).

I object to both the tone and to much of the material presented in Roberts' article. Immediately, I dispute the statement in the subtitle. Our report does not wish away greenhouse warming. We make two recommendations. One is that a very large increase be made in resources to study these effects. We would not have made this recommendation if we did not believe that the possibilities were extremely serious.

Our second recommendation, that major policy actions not be undertaken until the implications are better understood, seems to be the source of the various criticisms. More to the point seems to be the interest in the possibility that this report has influenced White House thinking in a major way. This gives rise to a second misstatement of fact—one that I see as personal criticism. The article says, "Nierenberg, for his part, has been working hard to get the message into the White House." I have done no such thing. I was not even aware that anyone in the White House had a copy of the report when I received a call to come to Washington from La Jolla, on very short notice, to brief some staff. At great personal inconvenience, I did so, but from then until now, I have had no further contact with anyone in the White House. It is more likely that letters to the President and the White House by such distinguished scientists as Jerry Namias and Richard Lindzen have had at least an equal, if not greater, impact. Despite the article's flat statement to the contrary, Lindzen, Newell, and Namias have made important contributions to the subject, unlike some of the critics cited in the article.

In response to John Perry's remark about the climate models, we agree that "there are hellacious uncertainties . . .," which is one of the major reasons for our recommendation on policy; but I disagree when Perry says that all the uncertainties we present are on the downside. If I were to criticize our report today, it would be for having presented a 0.5°C rise in temperature as a fact when a variety of evidence now makes it seem questionable. Having attended the most recent meeting of the Climate Diagnostics Workshop, I am certain that most working climatologists believe that there has been no significant increase in temperature in the last 100 years. There were 150 attendees, and only two papers were directly on global warming. None of these people were quoted in Roberts' article, nor were other well-known and respected scientists who have come forward in favor of the Marshall Institute report.

To respond to the remark "snapped" by an unnamed "senior Academy official" about the influence of possible solar variations, it is correct that it was discussed—but only as an example of the many poorly understood possible contributions to the problem, among which remain water in the form of vapor and clouds (which is the most difficult), the other greenhouse gases, colloidal particles, and turbidity.

Despite Steve Schneider's comment about solar variations, much good work is being done that gives a positive indication of the influence of solar variations, even back over the last century. A paper on the subject covering the atmospheric temperature over the oceans presented by Newell at the Climate Diagnostics meeting showed such an effect. Another paper by C. D. Keeling, analyzing his famous data set, also shows the influence of solar variation and is being prepared for publication.

Roberts' repetitious references to the National Academy of Sciences are perplexing. I was chairman of the Academy committee that submitted the 1983 report on global warming. It is the most complete that has been published and is still being widely referenced. It was put forward during the discussions at the same White House meeting where the Marshall Institute report was summarized. Fred Seitz, Dick Lindzen, Jerry Namias, and I are all members of the Academy; while we do not speak for the Academy, it was only natural to include the Academy's findings in the White House briefing.

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Roberts' article about the Marshall Institute study of the greenhouse problem does not do justice, in my opinion, to the standards of objective reporting usually seen in *Science*.

Roberts names three prominent meteorologists—Richard Lindzen, Jerome Namias, and Reginald Newell—who have endorsed the Marshall Institute report's findings on the inadequacies of current global warming predictions. The article mentions their support, but dismisses them with the comment that their major work is outside the field. This is a major misstatement. Lindzen, Namias, and Newell have been far more active in the fields of research pertinent to the greenhouse effect than any critic of the Marshall Institute study quoted by Roberts.

The report's critics lay great stress on the matter of solar variability and climate change. Solar variability is important, but it is not essential to the principal finding of the report—that clouds and oceans introduce enormous uncertainties into the global warming predictions. This view is widely held in the climatology community (*1*).

The vituperative nature of some of the criticisms quoted by Roberts (for example, "noisy junk science") suggests that more than technical issues are involved in the hostile reaction to the Marshall Institute study.

The nature of the concealed issues emerges in the sharp disagreement over the time required to obtain better greenhouse forecasts. Roberts quotes critics of the Marshall Institute report as saying it may take decades, to narrow the range of uncertainty in the forecasts. It's possible, however, that the models could yield the accuracy needed by policy-makers in 3 to 5 years—provided the government accelerates the pace of climate research with a major infusion of funds. Critics of the Marshall Institute report say we cannot afford to wait. They would like to see the government move now toward limits on CO_2 emissions. That appears to be the policy issue underlying the technical argument.

In our view, the technical facts indicate that early limits on CO_2 emission are unnecessary and may be undesirable. A 3- to 5-year investment in better forecasts would still give the United States sufficient time to counter the greenhouse threat, if that turns out to be necessary. But if the decision on CO_2 limits is made now, and turns out to be wrong because it was based on inaccurate information, the cost to the United States could be staggering—an estimated $0.8 to $3.6 trillion (*2*). With a price tag like that, a few years of waiting for the fruits of an accelerated research program would seem to be in order. Prudence dictates spending a few hundred million dollars to obtain guidance on the wisdom of decisions that could cost the United States trillions of dollars.

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REFERENCES

1. For example, C. D. Cess *et al.*, *Science* **245**, 513 (1989).
2. P. Passell, *New York Times*, 19 November 1989, p. 2.

According to Roberts, the Marshall Institute report asserts that "the warming trend of the past century was probably caused by increased solar activity. . . ." Nowhere in the report can statements be found that would justify Roberts' remark. The report's approach to the climate impact of solar variability is suitably cautious. It comments correctly that lulls in solar activity have tended to occur every 200 years or so during the last 1000 years, quotes findings by Wigley and Kelly that these solar lulls tend to be correlated with cold spells in climate, and concludes, "if the correlation between low solar activity and low temperature continues," a natural cold spell can be expected in the 21st century.

The operative word in this conclusion is "if." The Marshall Institute statement is not a "prediction," as Roberts calls it, but a reasonable comment about the meaning of past trends in solar and climate data.

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A component of the Marshall Institute report is the prediction of lower solar activity for the next century, leading to a postulated mini–Ice Age that would offset any greenhouse warming. The prediction is based on an extrapolation of the carbon-14 record in tree rings, which in turn has been associated with solar activity (*1*). The carbon-14 in tree rings reflects solar-modulated changes in the carbon-14 production rate (Q) in the atmosphere. A record of Q change (*2*) can be derived from the tree-ring record through carbon reservoir modeling. The 9600-year Q record has a complex spectral distribution, with three periodicities averaging 420, 218, and 143 years, explaining up to 50% of the variance (*3*). The mathematical expressions of two variants of these average periodicities are listed in (*3*). Extending the time-dependent equations into the future suggests low Q values, and hence elevated solar activity, for the 21st century.

The above analysis is at variance with the interpretation of the Q record [taken from (*2*)] in the Marshall Institute report. This is mainly due to a 50-year shift in Q applied by the authors of the report. Whereas the carbon-14 century type variations in tree rings indeed should be shifted by a couple of decades to counteract the influence of the lag in carbon reservoir response to Q change, such a shift should not be applied to the Q record.

The carbon-14 record has limited predictive value for solar activity variations (only a portion of the variance can be explained in the above manner). Taking due consideration of these limitations, I hesitantly suggest that increased (relative to the long-term

average) solar activity may be in the cards for the next century.

My reluctant solar activity prediction does not imply the endorsement of a solar enhancement of the anthropogenic warming of the next century. The relationship between solar activity and climate is tenuous at best [for example, see (*4*)], and the atmospheric amplification mechanism(s) needed to convert the small measurable changes in solar constant into climate change is(are) as elusive as ever.

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REFERENCES

1. M. Stuiver and P. D. Quay, *Science* **207**, 11 (1980).
2. M. Stuiver and T. F. Braziunas, in *Secular Solar and Geomagnetic Variations in the Last 10,000 Years*, F. R. Stephenson and A. W. Wolfendale, Eds. (Kluwer, Dordrecht, 1988), pp. 245–266.
3. M. Stuiver and T. F. Braziunas, *Nature* **338**, 405 (1989).
4. M. Stuiver, *ibid.* **286**, 868 (1980).

Response: Richard Lindzen, Jerome Namias, and Reginald Newell are distinguished scientists, and they have made major contributions to the understanding of the atmosphere. Numerous of their colleagues say, however, that their primary work has not been in the field of greenhouse studies.

Nierenberg may not have approached the White House, but his colleagues at the Marshall Institute apparently did. According to Juanita Duggan, who organized the briefing at which Nierenberg spoke, the Marshall Institute called the White House, not vice versa, and offered to brief them on the report. Duggan says that "the Marshall Institute made themselves tremendously available."

Nierenberg cites unnamed participants in the recent Climate Diagnostics Workshop in support of his position and chides me for not interviewing them. He says that only 2 of 150 papers at the workshop focused on global warming. But the focus of the workshop, according to its organizers, is seasonal or year-to-year climate variation, not long-term trends. Many of the papers at the recent workshop dealt with the 1986–1988 El Niño.

My article did not question whether solar variability could have contributed to the 0.5°C rise of the past decade. Schneider, for one, is quoted as saying that solar variation could in fact be responsible for it. His point, and the point of others I interviewed, is that whether greenhouse warming can now be detected is simply not the issue.

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