Letters

SDI Survey

R. Gange, in his recent letter (16 Jan., p. 268), writes that the negative response to the Strategic Defense Initiative found in the Cornell survey of National Academy of Sciences members resulted because the scientists "were polled on a system dissimilar to the one needed to satisfy the goals of SDI." According to Gange, the survey "stated" that the purpose of SDI is to defend the U.S. civilian population, whereas the true purpose, he informs us, is "to preserve a U.S. capability to retaliate in the event of a Soviet nuclear first strike." Gange misrepresents both the survey and the SDI program.

The ten questions in the survey dealt with a wide range of issues, such as the testing of an SDI system (87% said it probably could not adequately be tested), and the prospects that an SDI system could meet the Administration's performance criteria of survivability and cost-effectiveness (80% said the prospects were "poor" or "extremely poor," while 4% said the opposite). The issue of population defense was strictly confined to Question 6, which asked how many attacking Soviet warheads an SDI system would have to destroy to provide such defense (74% of the respondents said that more than 99% of the warheads would have to be destroyed). The survey contained no comment regarding whether or not the purpose of SDI is population defense.

However, the most authoritative Administration officials have been quite explicit about it. President Reagan said that SDI "is not and should never be misconstrued as just another method of protecting missile silos" (*1*). According to a declassified version of National Security Decision Directive No. 172, authorized by the President in May 1985, "The purpose of the defensive options we seek is clear—to find a means to destroy attacking ballistic missiles before they can reach any of their potential targets. . . . Thus, the goal of our research is not, and cannot be, simply to protect our retaliatory forces from attack" (*2*). Defense Secretary Weinberger said that SDI "will not be intended to defend our strategic weapons systems" (*3*); "it is not our missiles we seek to protect but our people, and we must never lose sight of that goal" (*4*). This is how the Administration represents the program to Congress and the public, despite Gange's contrary opinion of the goal of SDI.

The sharply negative reaction to SDI among members of the National Academy of Sciences was not created by the survey, but merely quantified by it. Judging from the results, it appears that a very large majority of Academy members in the physical and mathematical sciences regard SDI as technically unsound. The final report on the survey results is available from me on request.

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2. *Special Report No. 129* (Department of State, Washington, DC, June 1985).
3. C. W. Weinberger, *Annual Report to Congress*, 5 February 1986.
4. ———, Pentagon press conference, 1 July 1986.

Nuclear Winter Debate

My participation in current research and acquaintance with both the "TTAPS" and the National Center for Atmospheric Research groups prompts me to offer some perspective on the debate about climatic effects of nuclear war. Although it coined the provocative phrase "nuclear winter," the article by Turco, Toon, Ackerman, Pollack, and Sagan (*1*) merely concluded that land surface cooling of highly uncertain although possibly dramatic magnitude is a plausible consequence of a nuclear exchange—an assertion that none of the more accurate, three-dimensional computations performed since that time have refuted (*2*). Unfortunately, the TTAPS "baseline" result of 35°C cooling from a hemispheric mean annual average of 15°C—which TTAPS pointed out was exaggerated due to the model's neglect of ocean heat storage—was subsequently treated in much of the press as definitive truth (and also extended to the Southern Hemisphere on the assumption that the smoke would spread globally, but without considering the consequent reduction in smoke density). Hence the popular perception that "nuclear winter" equals global deep freeze. Meanwhile the three-dimensional simulations painted a far less apocalyptic picture even though they confirmed that massive smoke injections into the middle to upper troposphere could lead to dramatic surface cooling and some interhemispheric transport.

The TTAPS group is guilty at least of lack of energy in combating distorted reporting of their model's results, as well as a tendency—apparent in some of the remarks quoted by Eliot Marshall (News & Comment, 16 Jan., p. 271)—to imply that their original findings are as good as inscribed on stone tablets. In fact, the best guess ventured in (*1*) was, considering the moderating effects of ocean heat storage, the 35°C land surface temperature drop predicted by the model ought to be reduced by about 30% in continental interiors and 70% along coastlines, that is, by roughly a factor of 2. The latest generation of three-dimensional models (*3*) do indeed show land surface temperature drops in the general range of 10° to 20°C for Northern Hemisphere middle latitudes when smoke is injected into the atmosphere in the northern summer, but substantially smaller cooling is indicated for the tropics and the Southern Hemisphere, or when smoke appears in other seasons.

All this may be interesting from some abstract intellectual perspective, but from a more pragmatic standpoint it matters little whether the climatic damage of nuclear war would by itself serve to destroy civilization. There should be little doubt that other, better-known consequences of a nuclear exchange would be sufficient. I believe the most valuable result of the "nuclear winter" debate will be to force people to face that disturbing fact.

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REFERENCES AND NOTES

1. R. P. Turco, O. B. Toon, T. Ackerman, J. B. Pollack, C. Sagan, *Science* **222**, 1283 (1983).
2. For example, see C. Covey, S. H. Schneider, S. L. Thompson, *Nature (London)* **308**, 21 (1984); S. L. Thompson, *ibid.* **317**, 35 (1985); R. C. Malone, L. H. Auer, G. A. Glatzmaier, M. C. Wood, O. B. Toon, *Science* **230**, 317 (1985).
3. R. C. Malone, L. H. Auer, G. A. Glatzmaier, M. C. Wood, O. B. Toon, *J. Geophys. Res.* **91**, 1039 (1986); S. L. Thompson, V. Ramaswamy, C. Covey, in preparation.

It escapes me why we spend even a single dollar, much less $5.5 million, annually, to find out whether a nuclear holocaust will deep-freeze the earth, or whether it will not result in that and only pulverize Washington, Moscow, Leningrad, Boston—and cause the starvation of "hundreds of millions or even billions" of people elsewhere.

At issue is not a question of science. At issue is a military-political debate on whether or not a nuclear exchange can be risked. The answer is obvious. So why don't we instead invest $5.5 million more annually for something useful, like fostering cross-cultural understanding to reduce the suspicion that fuels the arms race?

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I read with interest the article in the 16 January issue of *Science* saying that experimental evidence shows that the effects of the nuclear winter that would result from a nuclear exchange would not be nearly as catastrophic as the doomsayers have been saying.

It is interesting to note that there was a strong push to "ban the bomb" in the early 1960s when the United States was continuing to develop its weaponry. Shortly thereafter, the advocates remained silent for nearly two decades while the Soviet Union developed its nuclear capabilities. When the United States began a push to catch up in this area, these people started the "Chicken Little" number, telling us that "the sky is falling in" with the nuclear winter threat. However, when the President proposed the "Star Wars" defense that could greatly reduce the potential problem if feasible and in place, these gloomsayers suddenly went silent on nuclear winter and evoked as many arguments as possible against even investigating the feasibility of such a defense. There is an inconsistency here.

I would like to ask these people which side of the debate they are on. If they are so concerned about a nuclear winter and so convinced that it would result from a nuclear exchange, why are they not the President's strongest supporters on the Star Wars defense issue?

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Marshall's article on nuclear winter overlooks several critical points. There is now, and surely will continue to be, uncertainty about the exact atmospheric effects of a large-scale nuclear war. There is nonetheless little question that even atmospheric perturbations much smaller than those of the more pessimistic scenarios would result in severe consequences for human beings throughout most of the Northern Hemisphere. Estimates of the amount of reduction in temperatures and sunlight during the growing season generated in recent studies indicate the probability of substantial damage to both agriculture and natural communities should the conflict occur at a biologically sensitive time.

While continent-wide deep freezes in summer now appear unlikely, transient quick freezes or even near-freezing temperatures accompanied by low light levels could wreak havoc on plant life, particularly if these episodes occurred repeatedly as patchy smoke clouds passed overhead. Even the "milder" nuclear winter scenarios now postulated represent growing season conditions far outside human experience in the modern era. Even within that experience, persistently overcast skies and cool summer weather have been sufficient to cause widespread crop failures and food shortages.

Moreover, other elements in the "nuclear winter" phenomenon that would affect at least the northern mid-latitudes are not discussed in the article. These include toxic smogs, ionizing radiation levels sufficient to have severe effects on people and nonhuman organisms, enhanced ultraviolet-B radiation, and pollution and siltation of rivers and onshore marine waters. Any one of these elements, and many others that could be listed, would result in serious environmental problems. In combination, even with no diminution of light or temperature, they would constitute an unprecedented environmental catastrophe.

In short, while it is essential to continue exploring the exact nature and extent of changes in light levels and temperature that might occur following wars of different dimensions, it would be folly to ignore the much more basic question of what the multiple impacts of nuclear warfare, in combination, would do to us and our life-support systems.

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From the accelerated publication of the TTAPS article in 1983 until the appearance of Marshall's article "Nuclear winter debate heats up," I fear that *Science* has been more a part of the problem of retrograde popular perceptions of "nuclear winter" than of its solution. Marshall has done much to rectify this. But in implying that my criticism of TTAPS derives from recent remarks by George Rathjens and others, Marshall errs. I published a critique of TTAPS in the spring 1984 issue of *Foreign Affairs* that followed Carl Sagan's publication of "Nuclear war and climatic catastrophe" (*Foreign Affairs*, Winter 1983/1984).

It addressed many of the points Marshall exposits in his article, including the unpublished status of the underlying analysis (the TTAPS bluebook), the inappropriateness of one-dimensional models in formulating policy conclusions, and the arbitrary character of the model's parameterization.

Marshall has made liberal use of documents I provided (for example, his article begins with a passage from Gabriel García Márquez from the October 1986 issue of *Sanity*, the journal of the Campaign for Nuclear Disarmament). He also reiterates much of the substance of "In from the cold: Nuclear winter melts down" (*The National Interest*, Fall 1986), which he refers to but does not name. I do not begrudge him this.

But I must question the liberty he has taken with the context of a quotation from it. Why has he taken only the italicized portion of the following sentence: "In 1982 a question arose *within the inner circle of the world's disarmament activists*: could the moral force of . . . Jonathan Schell's . . . 'The Fate of the Earth' be transformed into a scientific imperative?" and framed it with the words "hatched," "plot," "bamboozle," and "terrify"? These words are his, not mine. I wrote that the acceptance of TTAPS by the media and policy analysts "requires no conspiracy theory. In fact, in some respects, the successful marketing of the 'nuclear winter' concept has been remarkable for its openness."

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Response: Seitz avoids finding a conspiracy, but just barely. He writes: "Psychological strategists of the peace movement were not content with the fearsome carnage of a nuclear holocaust. They had identified 'psychic numbing' and 'denial' as impediments to mass demands for disarmament, and needed something new to dramatize the horrors of nuclear war." According to Seitz, leaders of the environmental and peace movements "convened an ad hoc consortium of foundations seeking to promote disarmament as well as scientific organizations with a bent for political activism. Cornell astrophysicist and media personality Carl Sagan began organizing a scientific advisory board. . . . While the foundations assembled funding and laid the groundwork for a major public relations and television production campaign, Sagan seized upon the work of Crützen and Birks [an analysis of smoke's effects on the climate]. . . . Theirs was a subjunctive disaster, but in the hands of others it would be transformed into an exhortation." Seitz ends by lamenting the "dominion over a variety of organizations and journals" activists have gained since the antiwar movement of the 1960s.

—ELIOT MARSHALL

Erratum: In the News & Comment article "Court rejects Rifkin in biotech cases" by Mark Crawford (9 Jan., p. 159), the Food and Drug Administration (FDA) was incorrectly portrayed as having abandoned biotechnology guidelines issued by the Biotechnology Science Coordinating Committee. The agency continues to endorse the guidelines, but notes they "do not have specific regulatory significance for FDA."