

LETTERS

MERITS AND RISKS OF MORE UNDERGROUND TESTS

The news report "End of an Era: Superpowers Sign START, Limiting Nuclear ICBMs" (August, page 49) contains the incorrect statement that the House Armed Services Committee Panel on Nuclear Weapons Safety endorsed continued underground nuclear tests.

That panel, which I headed (John S. Foster of TRW and Charles H. Townes of the University of California, Berkeley, are the other members), was asked to provide Congress with a technical analysis of the safety of US nuclear weapons as a basis for debating future policy decisions. Last year we did the first (and only) comprehensive review of the safety of the US nuclear stockpile since World War II and the subsequent buildup to more than 20 000 warheads. The House Armed Services Committee initiated this study because of concerns about the safety of several weapons systems in the US arsenal—concerns that led the Secretary of Defense to take immediate steps to reduce the risk of accidental detonations that could disperse plutonium into the environment in potentially dangerous amounts or even generate a nuclear yield. Those steps included removing the short-range air-to-ground attack missiles from the alert bombers of the Strategic Air Command and modifying some of the artillery-fired atomic projectiles deployed with the US forces.

It was a major conclusion of our study that "unintended nuclear detonations present a greater risk than previously estimated for some of the warheads in the stockpile." An important contribution to the understanding of these greater risks has come from advances in supercomputers that make it possible to carry out more realistic, three-dimensional calculations to trace the hydrodynamic and neutronic development of nuclear detonations. We now appre-

ciate—and underground tests have confirmed—how inadequate, and in some cases misleading, were the earlier, two-dimensional calculations. The panel concluded that it is important to "identify the potential sources of the largest safety risks and push ahead with searches for new technologies that do away with them and further enhance weapons safety." We also argued that "it is no longer acceptable to develop weapons systems without a factual data base with which to support design choices that are critical to the system's safety."

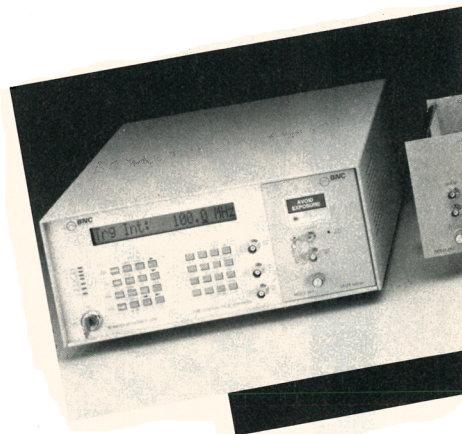
The final recommendations of our study—some of which are being implemented, while others are still under review—include both technical goals and organizational changes to strengthen the safety assurance process. We also concluded:

To accomplish the goals we have set out in this study the US nuclear weapons program will have to give higher priority and devote more of its resources to efforts to enhance safety—taking a long-range view in search of big advances in technology beyond just evolutionary, incremental improvements. Such a call for reorienting the emphasis of the current program should not be viewed as requiring an enlargement of the total program, particularly as we look forward to maintaining a smaller nuclear force in the new strategic environment. It does, however, require that adequate and steady resources be made available for the RDT&E [research, development, testing and evaluation] needed to underpin such a program.

Our recommendations directly raise the issue of continued underground testing. It is a political issue to properly weigh the political benefits of a comprehensive test ban

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against the fact that, today, the uncertainties in the safety of nuclear weapons are simply too large. In fact, as the report emphasizes, scientists do not now have the data base they need to assess the risks adequately. As individuals, my colleagues and I addressed the question of continued underground bomb tests in our testimony of 18 December 1990 before the House committee. Not surprisingly, our common technical conclusions did not translate into identical political views.

My own views are expressed in the following statement, which I had prepared in anticipation of being questioned on this subject during the hearings (and which I read into the record almost verbatim):

It is not easy to answer a question about what implications our report and its recommendations have on continued underground explosions versus a CTBT [comprehensive test ban treaty] because difficult political, as well as technical, judgments must be made. On the technical side, which I am more comfortable to judge, I would emphasize that we can and should make important progress toward enhanced safety of the nuclear stockpile in a number of ways that do not require underground nuclear test explosions. They include:

- ▷ redirecting the weapons RDT&E program toward enhanced safety as its principal goal;
- ▷ performing laboratory experiments to develop a data base that is required for sound analyses of the risks of initiating a nuclear yield or of dispersing plutonium under a variety of abnormal circumstances for existing weapons;
- ▷ retiring older weapons from the stockpile that fail to meet modern safety design criteria;
- ▷ adapting common warheads of compatible size that already exist and incorporate the desired safety features to several different weapons systems that are designated to remain in the US arsenal; and
- ▷ adopting operational procedures—such as limiting aerial overflights—to minimize handling and transporting risks.

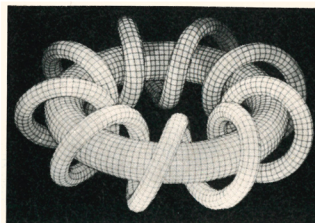
However, to go further and design new warheads with safety-optimized designs, or just simply safer configurations, it will be necessary to perform underground nuclear tests. For a program focused on safety alone, the number of tests would be limited

and their yields considerably lower than the maximum of 150 kT permitted under the TTBT [Threshold Test Ban Treaty].

The importance and desirability of these tests will have to be weighed against the political judgment as to how central—now or perhaps five years from now—a complete ban on underground testing, i.e., a CTBT, would be to strengthening or even preserving the nonproliferation regime. I agree with Secretary of State James Baker when he said in Washington, DC, on 19 September [1990] that we cannot approach nuclear proliferation in a business-as-usual manner, and further when he went on to say, both in his name and in that of [former] Soviet Foreign Minister Shevardnadze, that “we both see proliferation as perhaps the greatest security challenge of the 1990s . . . and we agree that stopping and countering proliferation must be a central part of our agenda.” A number of actions by the United States and the Soviet Union, the two nuclear superpowers, can play a role in strengthening the nonproliferation regime—in particular, the ending of the cold war and the development of constructive political relations, and the signing of arms reduction treaties like the INF [Intermediate-Range Nuclear Forces], CFE [Conventional Forces in Europe] and START [Strategic Arms Reduction Treaty]. It is very difficult for me at present to judge just how important a CTBT at this time would be, in addition to these steps. However, looking ahead, I presume that a CTBT would help strengthen a nonproliferation regime; it might also be a constructive step simply to reduce the number of permitted underground nuclear tests as well as their maximum yields, in a program justified and directed solely to enhanced safety at least for a fixed period of time.

At some point we will have to make a political decision on the importance and timing of a CTBT. Recall that the NPT [Nuclear Proliferation Treaty] review conference is scheduled for 1995. While the US would like the NPT to be continued indefinitely, or for an extended period, we may well face proposals in the absence of a CTBT for only a very limited, or even a terminal, extension.

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The US and, indeed, the nations of the world should support and work to implement Secretary Baker's priority call to stop and counter proliferation. If, or when, it is judged that agreeing to a CTBT is important to "stopping and countering proliferation," in Secretary Baker's words, I think we should agree to such a ban. Meanwhile, our testing program should be designed to advance the possibilities and understanding of enhanced safety and thereby help us prepare for the possibility of a CTBT.

As scientists my fellow panelists and I did our best to present an informed, objective set of technical findings and recommendations on this important subject. As responsible citizens we also expressed our individual conclusions about its political policy implications. I regret that in *PHYSICS TODAY*'s reporting on this important technical safety issue, the political dimension was presented inaccurately.

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Stanford University
Stanford, California

8/91

Can Sociology Ease Physicists' Malaise?

I have had the opportunity to attend one of Leon Lederman's talks on the state of funding and morale in the scientific community, and would like to make a short comment on it.

It seems to me that even though it is easiest to attribute the low morale among scientists in the US to a lack of adequate funding, it is just as plausible to postulate that the funding situation is a consequence of the low morale. After all, it is only natural that those who give the money—the public, through the funding agencies—are reluctant to fund a sector of society whose "health" (Lederman's word) is poor. Scientists are not isolated from the rest of society, and most "ordinary" people are aware, if only distantly and through the media, of the troubles affecting the scientific community; this awareness will certainly translate into a deterioration of support. The rise of some antitechnocracy movements undoubtedly also fuels this sentiment. I believe that rather than cure one of the symptoms of the malaise (by increasing the supply of money), it would be better first to attempt to identify the roots of the problem. This is of course a very difficult proposition, since it probably involves unquantifiable sociological

factors—anathema to "real" scientists. However, it might be worth exploring issues that may be contributing to the present spiritual state of scientists, such as their training, the competitive atmosphere (hasn't science become another rat race, as fierce and ruthless as what we see in the business world?) and the ethical aspects of science (for example, those relating to military applications). As a young postdoc just starting out on my career, I admittedly do not have all of the answers, but how can these aspects of our profession not have a major effect on the health of our outlook?

As a practical step, I would like to suggest that scientists should try to work more closely with those who study the sociology of science. Why are the sociologists and historians of science so disconnected from the practitioners of science? A little cross-fertilization might help both sides to get over the mutual feelings of derision, and possibly also to solve some of these questions.

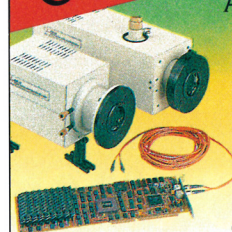
JAN A. TAUBER
4/91 University of California, Berkeley

LEDERMAN REPLIES: Physicists are conditioned by their training to seek unconventional solutions to intractable problems. This is natural. If a conventional solution would do, the problem would already have been solved. The resistance of science policy analysts to the possibility that inadequate funding is the cause of the deteriorating morale of scientists is perhaps understandable, especially when those analysts are Washington based. "You just can't throw money at the problem," they say. (I say, "Try us!")

But if Jan Tauber would talk to his colleagues, he'd quickly learn that *they* overwhelmingly believe that the problem is funding. Perhaps a wise sociologist knows better, but the problem is not that subtle. The issues that Tauber raises—competition, ethics, antiscience fundamentalists (and he could have added regulatory pressure, bureaucracy, lousy high schools and so on)—have always been with us. They wax and wane, and we cope as best as we can. Contact with historians and sociologists is clearly a profitable cultural activity, but it's hard to believe it can help the present circumstances. What really hurts is "My grant was not renewed" or "I can't fund my new idea" or "I can't take on any more graduate students." Is Tauber's historian-sociologist going to respond, "That's not your problem; you only think that's your problem—the root cause of your poor morale is

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