letters

SDI: Political realities

I want to congratulate the editors for publishing two separate perspectives on the Strategic Defense Initiative. Gerold Yonas's article (June, page 24), although curiously titled "Strategic Defense Initiative: The politics and science of weapons in space," was an objective presentation of the motivation behind the SDI proposal, including a useful history of past antiballistic-missile research, with a programmatic description of the recent progress in and prospects for defensive technologies. I believe it is important for PHYSICS TODAY readers to understand that there is a strong motivation among many politicians, other than the President, to seek alternatives to the Mutual Assured Destruction doctrine. The recent Congressional debate on SDI in the House revealed a spectrum of such views among SDI supporters. A majority of the House rejected attempts to reduce SDI funding any further from the House Armed Services Committee mark of $2.5 billion and also defeated attempts to constrain the program in a way that some Members thought was necessary to insure tight compliance with the ABM Treaty. Yonas's article reaffirms the widely held view of solid SDI supporters, that even though a missile defense system would not be completely impenetrable, it would reduce the threat of any enemy first strike by "drastically increasing the uncertainty of success and the ultimate cost" to the aggressor of such an operation. I would also suggest that such a defense would serve as an excellent shield against the isolated nuclear missile launch, whether triggered by accident or national recklessness.

On the other hand, I am extremely curious about the chief political concern of Wolfgang K. H. Panofsky, who believes that SDI has been oversold (June, page 34), a charge that is rendered somewhat questionable by the objectivity of Yonas's article. In this regard, we in the Congress look to Panofsky for the wisdom of his technological evaluations rather than his civics lesson; the avowed purpose of his article is "to point out that political perceptions as to what SDI is all about are running widely ahead of the technical realities of strategic missile defense." I wonder why he is so interested in a limited research program when there is such a diversity of technology to examine in terms of defensive possibilities. Also, the strong undercurrent of technological pessimism of certain SDI critics is at odds with their buoyant optimism about the next physics machine, the Superconducting Super Collider. I dispute his contention that "no one has identified an even plausible scenario through which we can make a safe transition from the current offense-dominated nuclear balance to the proposed defense-dominated stability." Alvin Weinberg and others have suggested such plausible approaches, and only a Neanderthal response by the Soviets would rule them out. Also, to insist on a "defense-dominated" alternative is to ignore the possibility of a "middle ground" on SDI. As a student of arms-control issues, I am stunned by his contention that "while a partial defense does not protect population and industry from a massive strike, it might be perceived by the opponent as blunting a second strike...." This appears to me to be a very improbable Soviet view.

I do support Panofsky's caution on SDI demonstrations, but I believe that we should not constrain SDI technology development on the basis of an almost paranoiac concern about departures from the ABM Treaty. I would suggest to Panofsky that the House of Representatives and the Senate have already given the political answer to the question: "On what scale and within what framework should the United States conduct strategic defense research?" The answer appears to be somewhere between $2.5 and $3 billion for fiscal 1986, and the strong sentiment appears to be for a program that is not strictly limited by additional constraints—nor is it "full-speed ahead" in the sense of disregarding the ABM Treaty. Members of our Science and Technology Committee recently assessed the foreign reaction to SDI, and I believe, in that context, Panofsky is rather cava-

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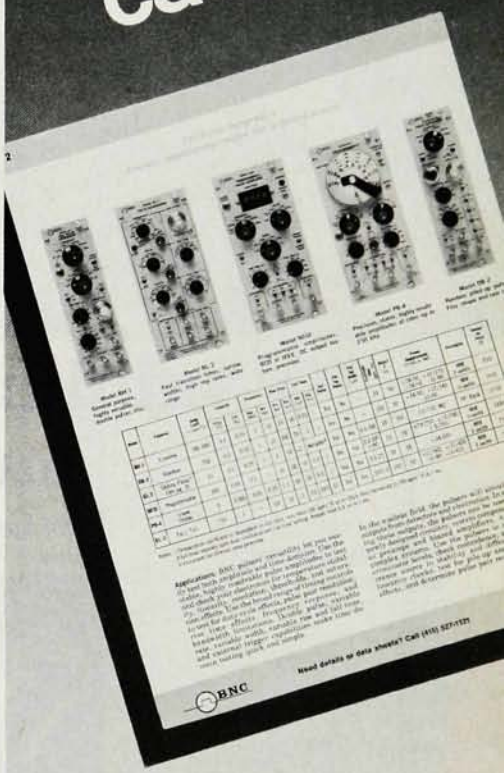

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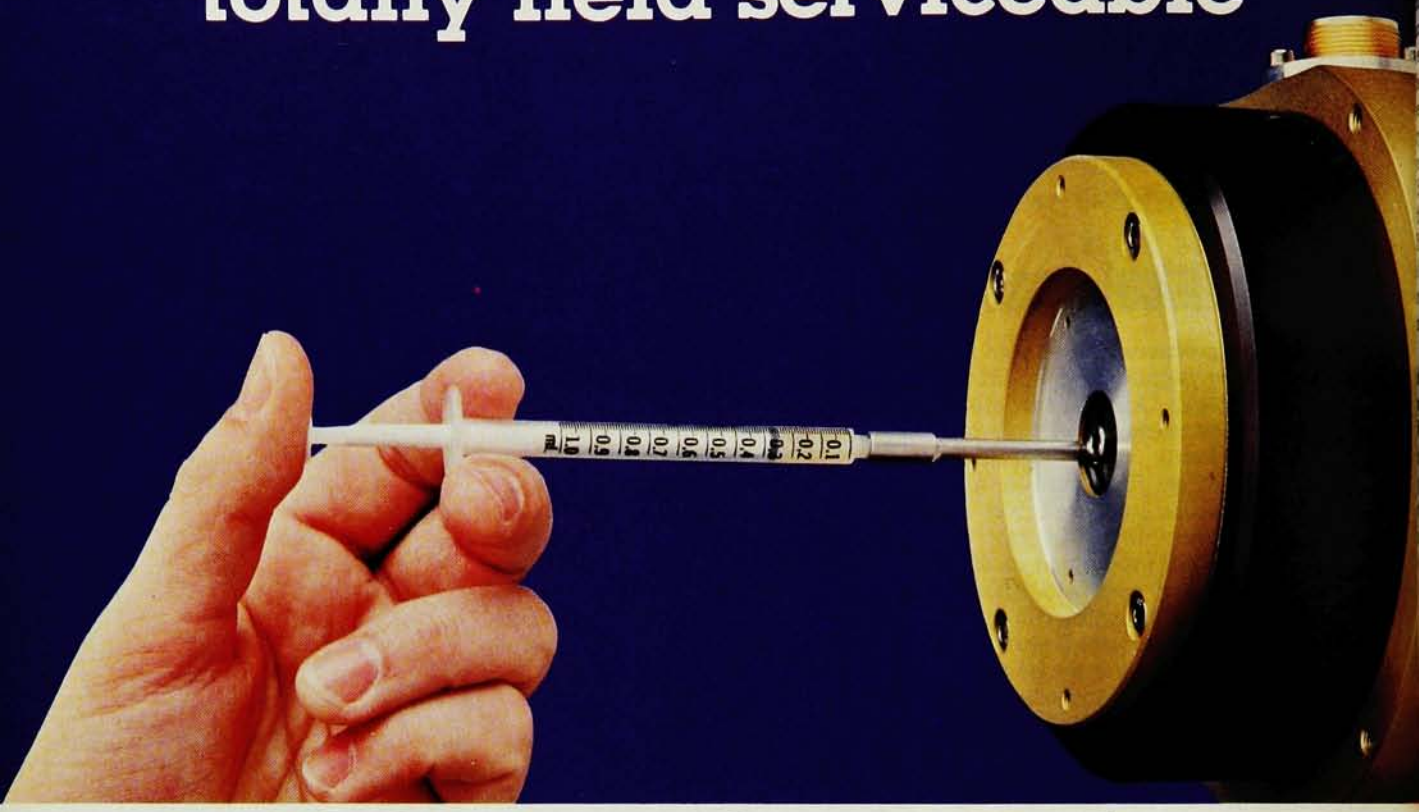

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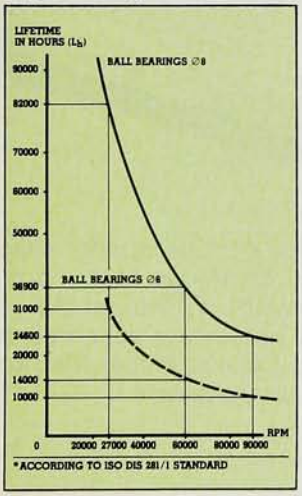

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lier in his description of Europe's reaction. His conclusions are relatively accurate in describing the response of certain European governments, but they are misleading with respect to the very strong interest of European industry within NATO. Interestingly enough, he seems disturbed that the US has found "some receptive ears" for "this frankly commercial SDI appeal." The latter reaction seems much more of a biased judgement than the result of a constructive analysis of how NATO might best be involved in the program.

I would hope that Panofsky could demonstrate a bit more faith in the politicians and the American system. We in the Congress deal with "perception versus reality" every day. It is our job to get the best information from the technical community so that the SDI does not represent "a situation of enormous danger" or permit "overblown expectations of protection from nuclear weapons . . ." to persist among the public. It appears to me that Panofsky just doesn't trust the political system that has served us so well for the four decades of the strategic nuclear era since 1945. Certainly, supported by technological optimism and constructive diplomacy, SDI ought to be given a chance; let the politicians worry about whether the "politics are outrunning the technology" or decision-making. As Michael Heylin, editor of *Chemical and Engineering News*, has noted (in the issue of 10 June) regarding SDI, "to date, reaction to critical issues raised by qualified scientists has contained about as much denigration as reason." In the June 1985 issue of PHYSICS TODAY, a lack of objectivity was very visible in the anti-SDI article.

MARILYN LLOYD

7/85 *US House of Representatives*

•

At times our society seems to concentrate so heavily on the drawbacks and hazards of new and emerging technologies that they eventually appear, wrongly, likely to do more harm than good. Three prominent examples of this technological pessimism are nuclear power, agribusiness and genetic engineering; in each case, emotional arguments, based apparently on fear, reduce perilously the public's willingness to accept these great advances. Technological pessimists, if they were around at the beginning of this century, might have sought to block the development and widespread use of the automobile because it threatened eventually to cause numerous deaths each year. Yet today society obviously gains far more than it loses from autos.

Another target of technological pessimism is the Strategic Defense Initiative. Within weeks of President Reagan's "Star Wars" speech of March 1983, prominent scientists began to publish denunciations of the idea, arguing that the President's objectives were technically unfeasible. The flow of anti-SDI articles grew into a virtual torrent by the middle of 1984, and for a while it seemed that nearly everyone with a PhD was against the initiative.

Slowly, however, as the government's own preliminary studies were completed and as cleared experts were able to relate some of their key results in the public literature, a more balanced picture emerged. This picture showed that the prospects for defensive technologies to eventually reverse the current dominance of offensive technologies in nuclear strategy were good enough to warrant a serious investment of the American taxpayers' money. The public also learned that the Soviets have been working much more intensely than the US on the same problem for many years, and that to a significant extent SDI was needed just to assure that the Soviets are not tempted some day to break out of he ABM Treaty of 1972. By now the public literature on SDI has shifted perceptibly in favor of the program.

Wolfgang K. H. Panofsky's SDI piece in the June issue of PHYSICS TODAY shows that the torch of technological pessimism still burns, though not as brightly as it once did, when it comes to SDI. Perhaps the most striking expression of technological pessimism in Panofsky's paper is his opinion that no new technology has emerged since March of 1969 to justify President Reagan's more optimistic evaluation of strategic defense. In failing to recognize the basis for this more hopeful view, Panofsky apparently ignores: the landing of men on the Moon and the development of space technology since that time; the last 16 years of the computer revolution and the concurrent gains in laser and optics technologies and missile guidance; and the successful demonstration last year of the destruction of a simulated nuclear warhead in ballistic flight by a non-nuclear interceptor. These apparent oversights indicate an inclination to seek the gloomy side of technical matters.

Much of the remainder of Panofsky's article deals with SDI policy issues, not technical ones, and it must be noted that in this sphere Panofsky must be regarded as an interested amateur, not as a learned expert. So when Panofsky tends to see the negative side of such questions as whether the US SDI effort will stimulate a renewed strategic arms race, extend warfare into the heavens or weaken the Atlantic alliance, the reader has a legitimate reason to question the basis for the author's pessimism. As a technologist who has devel-

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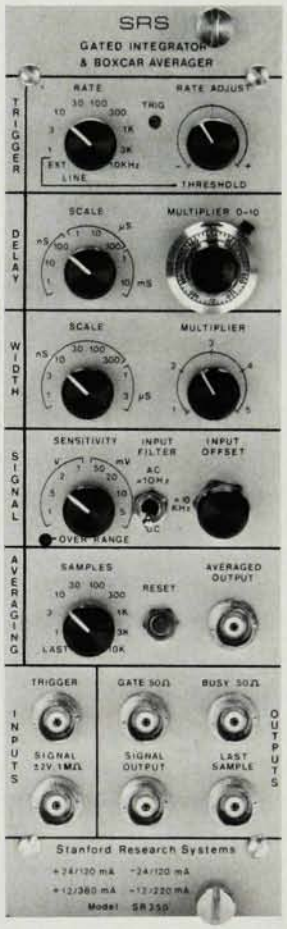

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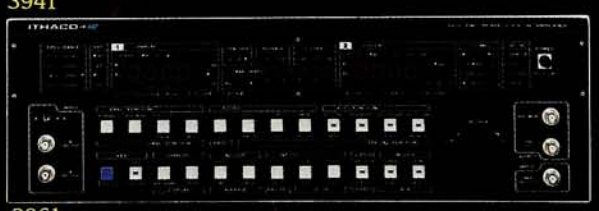

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oped a strong interest in policy issues related to strategic weapons, I suspect that Panofsky has simply transferred his technological pessimism into the realm of policy. My readings of the literature on SDI and strategic-weapons policy lead me to envision a fair likelihood that an optimistic view of the outcomes of these questions is appropriate.

The SDI program is no panacea, but taken together with arms-control negotiations and other weapons developments, it may help us to move away from mutual assured destruction, toward a less dangerous strategic balance with the Soviets. It is legitimate, and it complies with the applicable provisions of the US–Soviet ABM Treaty. It is new because the technology for strategic defense has advanced profoundly in the past dozen years, so the old technical objections do not apply.

The SDI program offers the prospect of improving global security with weapons that do not threaten people, only other weapons. The program will also assure that the Soviets do not obtain a technical lead over the US in this area and threaten to put us at a disadvantage by constructing a defense that outperforms anything we could deploy. The US should pursue SDI with vigor and resolve; the world needs it.

MARVIN KING
Riverside Research Institute
7/85 *New York, New York*

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The articles by Gerold Yonas and Wolfgang K. H. Panofsky on Star Wars (June, pages 24, 34) reminded me sharply of the immense Calutron project during World War II, built to separate uranium isotopes. It was obvious that nothing would work at all, or if it would, poorly. In retrospect it was impossible to separate isotopes as high-current ion beams. L. B. Loeb (UC) must have ridiculed the entire project. Imagine the multiplication of ion-beam currents by a factor of million; the beam-current blow-up by electrostatics; the difficulty of separating isotopes separated by $^{3}/_{238}$ mass; and the ion source—impossible.

But Ernest O. Lawrence was backed by men like Kenneth R. MacKenzie and R. L. Thornton, Frank Oppenheimer and A. T. Finkelstein, so he did it anyway. The *how* was my postwar project; but the material produced stopped the war with a thud. The *why* was as obvious then as it is today, and today's scientists seem even more capable.

If the Calutron had been debated, it never would have been built, nor would most of the postwar projects leading to space, computers and automation. President Franklin Roosevelt's lead attracted men, like Lawrence and Oppenheimer, with a clear and, surely, humanitarian purpose. Reagan needs only to find equal men, perhaps Steven Weinberg and A. V. Phelps (theory; reality), to guide research on paths that are not clear, but with goals that justify the effort.

CARROLL B. MILLS
7/85 *Kenwood, California*

•

Before reading your Star Wars articles I mentally predicted the content. The article "in favor" (actually, no one is in favor of war) discussed the technicalities, engaged in no personal attacks and stated that the whole matter was still being debated. The article "opposed" dismissed all technical arguments, indulged in extravagant language ("insane," "so-called rational," "wildly," "over blown"), referred ominously to "the future of civilization as we know it," attacked "uncritical media analyses" (which appears to mean publishing both sides of the question) and used *ad hominem* language ("Reagan reacted in an instinctive- . . . mode"). What surprised and disappointed me was to find the highly respected name of Wolfgang Panofsky attached to this article so deficient in reasoned scientific discussion.

ROBERT H. GOOD
California State University
8/85 *Hayward, California*

WOLFGANG K. H. PANOFSKY REPLIES: My article was not intended to deal primarily with detailed technical issues. I was informed by the editor of PHYSICS TODAY that Gerold Yonas would describe the technical nature of the programs; although I did not see Yonas's article before publication, I correctly assumed that he would give a lucid and fair presentation of the ballistic-missile defense technologies now in view. I also appended a rather extensive bibliography to benefit those interested in greater technical detail than what could be covered in two articles in PHYSICS TODAY. It was never the editor's intent to have the two articles consist of one "in favor" and the other "opposed" to SDI. As I state, I support a ballistic-missile research program selectively, and Yonas in his article is careful in not misrepresenting research in progress to be a matter of accomplished fact. Thus my comments on exaggerated political perceptions are not targeted at the companion article in PHYSICS TODAY. I remain, however, highly critical of the oratory and promotion surrounding SDI.

I am recommending continued research on strategic defense to explore the promise of various technical approaches, to protect against "technological surprise" and to hedge against a potential Soviet breakout from the

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ABM Treaty. The reason I suggest a lower level of effort than that proposed by the Reagan Administration is my opposition to some of the costly demonstration projects and the inclusion of some very expensive programs, which have advanced sufficiently, so that one can already say with confidence that they are not promising approaches to the ballistic-missile defense problem. My article does strongly object to "putting the cart before the horse"—that is, making policy assumptions or extending false hopes that defensive technologies might relieve the offensive balance of terror, until and unless the results of such research indicate that there is a sound technical basis for such a change.

Robert H. Good, Marvin King, Marilyn Lloyd and Carroll B. Mills described my PHYSICS TODAY article on SDI as an expression of technical pessimism. This does not describe my position. These respondents compare the promise of SDI with the promise of earlier technological achievements that were greeted with initial skepticism. Indeed, earlier achievements—to use the examples cited by the correspondents, nuclear power, agribusiness, genetic engineering, the Calutron and man on the moon—were extraordinarily difficult undertakings whose feasibility many doubted. The Superconducting Super Collider, to which Lloyd refers, is a difficult undertaking that I confidently believe can be successful. Yet, all these undertakings pit man's ingenuity against Nature, not against other human opponents. The moon did not fight back.

Even if research results indicate technological promise, SDI should not automatically lead to development and deployment. We are not dealing with a static situation. Rather, the introduction of substantial antimissile defenses would initiate a defense–offense and measure–countermeasure competition with an alert and determined opponent. In contrast to the other technological achievements cited, a complete antimissile defense system can never be tested or improved as a result of realistic operational experience. Careful thought must be given whether or not such a further escalation of the arms competition between the US and the USSR would increase or decrease national and international security. My article identifies the relevant factors that such an analysis should consider to answer this question. Here I am indeed registering pessimism by expressing doubt that such analysis would show that our security would gain by yet another level of technological competition. I object to the emphases on demonstration and stimulation of economic interests by the SDI program that would make it so difficult to make a reasonable future decision on deployment in the face of the pressures generated.

Lloyd professes to be "stunned" by my contention that: "While a partial defense does not protect population and industry from a massive strike, it might be perceived by the opponent as blunting a second strike." This thought is not at all new. In fact many national leaders, including Secretary of Defense Casper Weinberger, have stated their conviction that an expanded Soviet ABM system could signal a first-strike intent. We must realize that in present circumstances a very real fear, justified or not, of the aggressive intentions of the opponent exists both on the US and the Soviet sides. My article contains an earlier quote: "The heaviest defense system we considered, one designed to protect our major cities, still could not prevent a catastrophic level of US fatalities from a deliberate all-out Soviet attack. And it might look to an opponent like the prelude to an offensive strategy threatening the Soviet deterrent." That statement was made by President Nixon in 1969.

I am troubled by Lloyd's remark that my article demonstrates "Panofsky just does not trust the political system that has served us so well. . . ." Just because I have faith in that system, I am persuaded that decisions by government need not and should not be accepted uncritically. Lloyd writes: "We in the Congress look to Panofsky for the wisdom of his technological evaluations rather than his civics lessons." King writes: "Much of the remainder of Panofsky's paper deals with SDI policy issues, not technical ones, and it must be noted that in this sphere Panofsky must be regarded as an interested amateur, not as a learned expert." But who or what is a "learned expert" on SDI?

I have had the privilege, for over two decades, of working in the boundary areas between policy and science, starting as a US negotiator in the early Nuclear Test Ban negotiations; as a member of the President's Science Advisory Committee, including its Strategic Military Panel; and as a member of the General Advisory Committee on Arms Control to the President and other senior government officials. I have published both in *Foreign Affairs* and *Physical Review*. Many difficult decisions faced by government and industry require consideration of scientific–technical and administrative–political factors. For these decisions to be made wisely within our system it is essential that communication gaps between the scientific, military and political constituencies be bridged.

I am therefore troubled by the disap-

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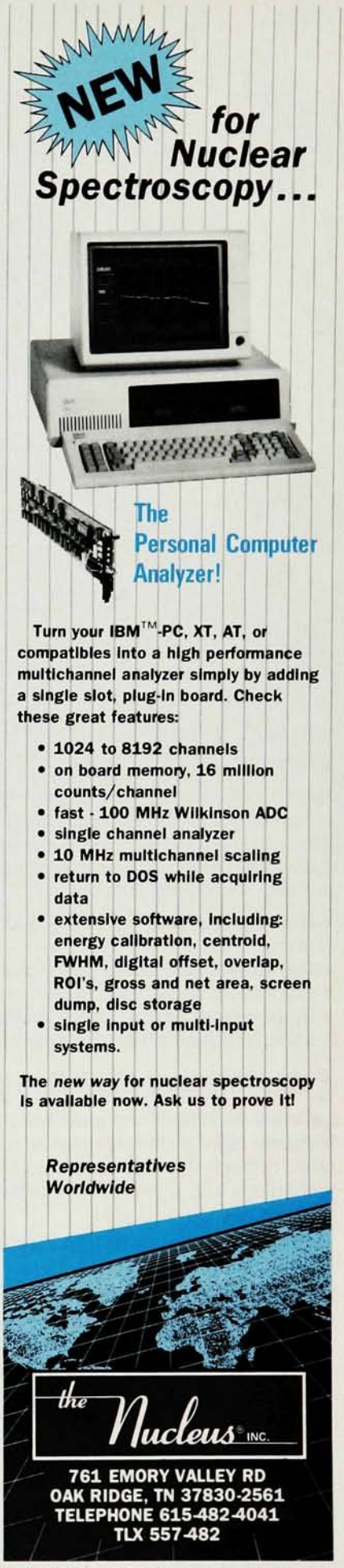

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letters

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proval expressed by some of the correspondents, that my article deals not only with technical issues but also with policy implications of technical undertakings. A scientist faces a dilemma: If he restricts his comments strictly to scientific–technical statements in disregard of broader implications to society, he can be (and frequently is) accused of insensitivity, immorality, or worse. If he expresses views extending beyond purely technical facts, he can be accused (and I am so-charged by some of the correspondents) of abusing his reputation, gathered in purely technical endeavors.

Almost all decisions involving technical factors combine established scientific–technical facts with judgments as to where science and technology will lead in the future; it is in this judgmental area that technicians can and do differ. The political decision maker frequently finds it difficult to sort out complex, and at times even contradictory, assertions made by members of the technical community.

I believe the public interest is served best if those members of the technical communities who have a real interest in policy issues communicate their views on both technology and policy. Accordingly, I do hope that in accordance with my faith in our political system, these articles in PHYSICS TODAY have contributed to a more realistic understanding of the risks vs. benefits of research on ballistic-missile defense and the SDI program as currently pursued.

WOLFGANG K. H. PANOFSKY
8/85 *Stanford University*

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I think that the articles and letter in the June 1985 issue gave a very good summary of the hopes, and some of the problems, associated with the Strategic Defense Initiative. I would like to comment on one of the critical problems that was noted only very briefly in Gerold Yonas's article (page 24). He stated the well-known fact that, "The ability of any defense to respond effectively to a ballistic-missile attack is largely dependent on the feasibility and reliability of boost-phase and post-boost interception."

All the SDI schemes I have seen require that a large majority of an enemy's intercontinential ballistic missiles will be destroyed during their boost phase. There are, however, a number of simple methods by which a superpower could be assured that all or almost all of its warheads would get safely through the boost phase. Commonly mentioned examples are that the destruction of a tiny fraction of a defense's low-altitude boost-phase satellite battle stations would open brief windows through which the boost phase of an attack could be launched, or that boosters can be launched under a shield of nuclear explosions.

One other technique involves the single-booster problem, or super-MIRVing: What if the Soviets loaded up their new shuttle or their new extremely large rocket with 1000 warheads rather than the 10 or so carried by most current ICBMs? A whole nuclear attack could be launched with a single booster, and we would not know it until the boost phase was over and the warheads were being deployed. Unless we are going to make it a policy to try to shoot down all of each other's shuttles and all single rockets launched by potential adversaries, it will be possible to get one ICBM through a defensive system's boost-phase intercept before the defense knows what the rocket is carrying.

In my opinion, there are lots of visionary, exciting ways to spend several billion dollars per year that would be far more beneficial to our country and to the development of new basic science and technology than SDI.

RICHARD L. KAUFMANN
University of New Hampshire
7/85 *Durham, New Hampshire*

●

The article by Gerold Yonas on the Strategic Defense Initiative may have described the nature of the problem and our research programs quite well, but it clearly reveals the fatal flaw in the philosophy of the whole plan. Yonas describes the four phases of SDI. In phase three, the transition, both sides would deploy their defenses and would make significant reductions in offensive missile forces. Because it is very likely that our SDI program will move ahead substantially faster than that of the Soviets, the real issue is whether or not *they* will reduce their offensive weapons.

What precedent can Yonas cite of offensive weapons being discarded because defensive systems were developed? Was the bow and arrow discarded when the shield was invented? Was the tank eliminated when the anti-tank gun was deployed? Were poison gases kept under wraps when a gas mask to counter chlorine was distributed? No. More powerful bows were invented, more heavily armed and armored tanks were built, and phosgene and mustard gas were developed. To expect the Soviet lion to extract his teeth and lie down beside the lambs is being a bit optimistic, especially in view of the arms race as it has progressed during the past 40 years.

Far more likely will be new offensive developments of smaller, faster launch systems, protective coatings, maneuverable payloads and submarine-

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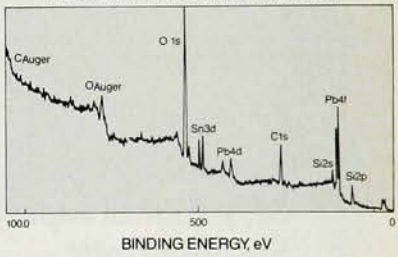

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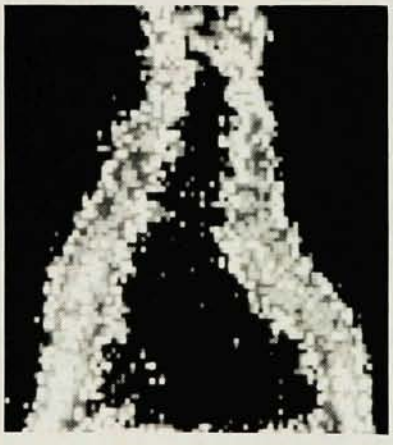

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letters

launched systems, all of which can easily be developed during the 15–20-year interval before full deployment of SDI. Twenty years is roughly the time needed to develop two generations of missiles, based on the history of liquid-fueled, solid-fueled, MIRV and MX missiles. Neither side can possibly know what its defense system will have to face in the year 2005. Hence, any system designed today will be obsolete by the time it is fully operational; and because of the massive damage to be inflicted by a partial penetration, a partially deployed system will be totally ineffective.

GEORGE WALLERSTEIN
University of Washington
Seattle, Washington

7/85

Educating teachers

Your lengthy report on the revitalized NSF education program in the January issue (page 55) brought pleasure at first, but upon reflection, sadness. I recalled the post-Sputnik period, the programs for upgrading instruction in elementary-school science and mathematics and my experience at the time, teaching science and mathematics to prospective and in-service elementary teachers. Then, all elementary teaching candidates (grades 1–8) took two years of laboratory science and one year of mathematics—even at such institutions as Paterson and Cortland State Teachers Colleges. Today, candidates for elementary-teaching certification receiving training at some private colleges need take no more than 9 to 11 credit hours in science and mathematics combined! Only three of these credits must be in a laboratory science. The mathematics can be quite basic—arithmetic! Furthermore, one researcher detects[1] a high level of anxiety relative to the teaching of science in prospective elementary-school teachers.

I fear that the Federal funds will be poured into an educational "black hole," as a result. The science and mathematics background of present-day elementary-school teachers is far too weak. Remediation and strengthening in science and mathematics content and methodology is not possible. I speak from observing my own students and, as a result of an NSF grant, students and programs in mathematics remediation at other colleges and universities.

The only hope is in the programs of some of the former state teachers colleges, where an elementary-education major can take a concentration in mathematics and science.

Have school administrators and