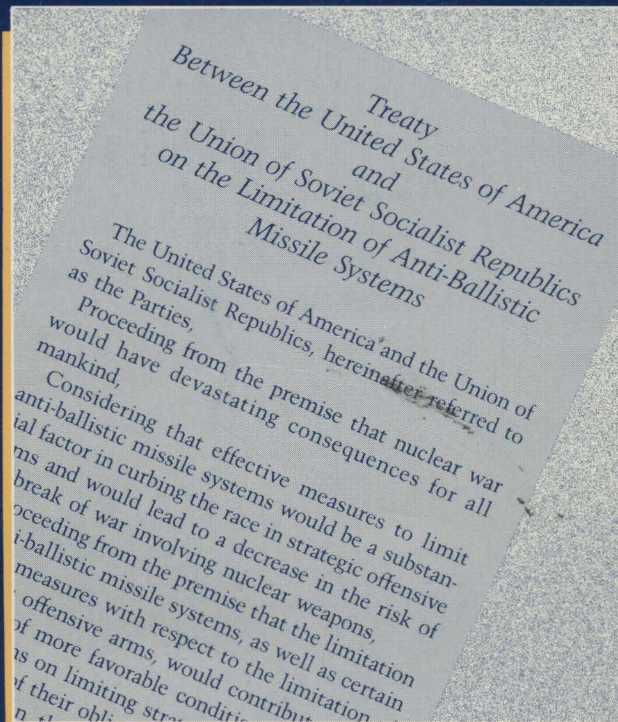
FOUNDATION FOR THE FUTURE



THE ABM TREATY AND NATIONAL SECURITY

The Arms Control Association

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Preface

The Antiballistic Missile Treaty is the most fundamental arms agreement yet reached between the United States and the Soviet Union—a critical component of U.S. security policy. By prohibiting all significant ABM defenses, the treaty successfully prevented what might have been a ferociously expensive and dangerously destabilizing race between offense and defense. Without the ABM Treaty's limits on missile defenses, the excessive missile buildup of the 1970s and 1980s would surely have been far worse.

The ABM Treaty also provides the essential base for reductions in offensive arms, by limiting the defenses those forces must overcome. Today, with a Strategic Arms Reduction Talks (START) agreement nearing completion, that promise of offensive arms reduction is finally being fulfilled. Clear and effective limits on missile defenses will be even more vital as the United States and the Soviet Union move on to deeper START II reductions in their offensive forces. The ABM Treaty will provide the necessary building blocks for seizing the current opportunity for improved security at lower levels of confrontation. In that sense, the ABM Treaty is truly the "foundation for the future," as the title of this book suggests.

The ABM debates of the 1980s have cooled somewhat. The Soviet Union has pledged to dismantle the Krasnoyarsk radar, and overwhelming majorities of both houses of Congress have offered the ABM Treaty strong support. With the dramatic warming of superpower relations, the idea of tearing up the treaty to pursue the Star Wars chimera appears increasingly far-fetched. But President Bush and Secretary of Defense Cheney still pay homage to a more limited form of President Reagan's Star Wars dream, declaring their intention to deploy a prohibited nationwide missile defense as soon as it is ready. The scandalous "reinterpretation" of the ABM Treaty has not yet been abandoned—an issue the Senate may be forced to address when it considers the ratification of START. The long ABM controversy President Reagan sparked in 1983 is not yet over.

From the inception of the Star Wars debate, the Arms Control Association has played a key role in building support for the ABM Treaty. Members of the Association's Board of Directors were repeatedly called upon by Congress to testify to the ABM Treaty's importance, and effectively refuted the case for the Reagan administration's efforts to reinterpret the treaty, and the arguments of those who would abandon the agreement entirely. The Association's staff provided a stream of information and research assistance to Congress in its effort to protect the ABM Treaty from attack, and served as a center of ABM expertise for the national press. The Association's magazine, *Arms Control Today*, provided constant coverage of the ABM issue, including a point-by-point rebuttal of the Reagan administration's charges of widespread Soviet cheating on the treaty. In addition, the Association took a major part in the creation of the National Campaign to Save the ABM Treaty.

To my mind, this book provides the most comprehensive and compelling defense of the ABM Treaty ever published. From "brilliant pebbles" to the "defense transition," from Krasnoyarsk to "other physical principles," all the arcana of the ABM debate are here, and explained in plain English. It is an effective antidote to the Star Wars contagion. Part I outlines the logic, history, and terms of the ABM Treaty, and describes the technology of both the U.S. Strategic Defense Initiative and Soviet missile defense programs. The threats facing the treaty, from reinterpretation to questionable compliance, are discussed in Part II. Part III then lays out a road map for the future, making the case for pursuing an ABM research program that remains within the traditional interpretation of the ABM Treaty, while pursuing new agreements to clarify and strengthen the ABM Treaty's restraints.

On behalf of the Association, I would like to express particular thanks to Senior Research Analyst Matthew Bunn, the book's author, on whose tireless efforts the project's success depended. His encyclopedic knowledge of the subject and his keen appreciation for the interaction of its political, military, and technical dimensions enabled him to present the fundamental policy issues of the ABM debate in a remarkably clear and objective fashion. The Association is indeed fortunate that Mr. Bunn will bring his interdisciplinary talents to a broader range of issues as the new editor of *Arms Control Today*. Spurgeon M. Keeny, Jr., the Association's president and executive director, provided detailed direction and guidance throughout the project. James P. Rubin provided essential advice and assistance in the project's early stages while serving as the Association's assistant director for research. Ivo Daalder, Sidney Graybeal, Wolfgang Panofsky, John Pike, John Rhinelander, and Sandy Thomas each reviewed chapters in their particular areas of expertise. A succession of talented interns provided valuable research assistance, including Lorie Alexander, Gregg Kavett, Elizabeth Krantz, Andy Weiss, and Jon Welner. Cathie Lorenz and Gregory Webb performed the grueling task of converting the manuscript from typescript to its final form. The Association is grateful to all of them.

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I am confident that this book will provide both a comprehensive introduction for the student and a valuable reference for the expert reader.

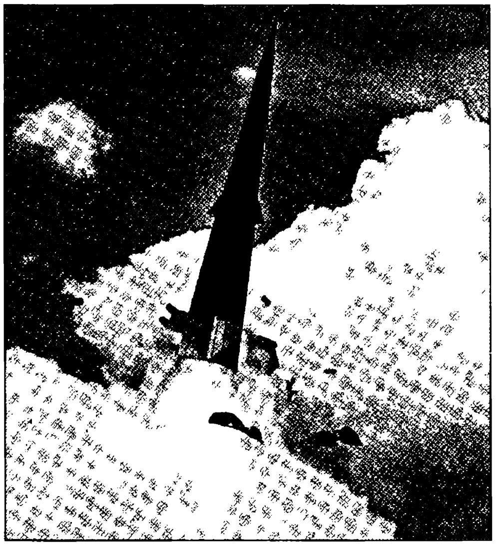
—Gerard C. Smith
Chairman of the Board

FOUNDATION FOR THE FUTURE

THE ABM TREATY AND NATIONAL SECURITY

PART ONE

POLICY AND TECHNOLOGY OF MISSILE DEFENSE



The U.S. Army's nuclear-armed Sprint ABM missile, developed in the 1960s.

I. The ABM Treaty: Cornerstone of Security and Arms Control

The Antiballistic Missile (ABM) Treaty of 1972 is the centerpiece of strategic arms control and a bulwark of U.S. national-security. By banning nationwide defenses against strategic ballistic missiles, the ABM Treaty prevented an expensive and dangerous race between defense and offense, providing the essential foundation for negotiated limits on offensive strategic arms.

While neither the United States nor the Soviet Union ever completely abandoned the search for effective defenses against nuclear weapons, the ABM Treaty's strict limitations on missile defenses codified the recognition by both sides that no defense technology then available or foreseeable could provide genuine protection from the fearsome destructive power of nuclear weapons. Instead, widespread deployments of missile defenses would only force the other side to increase and improve its offensive forces to overcome them, touching off a renewed arms competition. And the combination of partial missile defenses and accurate, quick-strike offensive forces might increase each side's incentives to strike first in an intense crisis, heightening the risk of nuclear war. The Senate's 88-2 vote approving the ABM Treaty reflected the broad U.S. consensus on the risks posed by nationwide missile defenses.

That consensus was shattered on March 23, 1983, when President Ronald Reagan issued a dramatic call for a nationwide missile defense—precisely what the ABM Treaty had prohibited a decade before. The program to develop such a defense is now known as the Strategic Defense Initiative (SDI). President Reagan set the SDI program on a course toward near-term deployment, which would require abrogating the ABM Treaty, and President George Bush has so far kept the program on that same path.

THE PROMISE OF PROTECTION AND THE REALITY OF DETERRENCE

Over the years, President Reagan repeatedly presented SDI to the American people as a leakproof shield. His 1983 address described it as a system to render nuclear weapons "impotent and obsolete," and later speeches referred to it as "a shield that missiles could not penetrate—a shield that could protect us from nuclear missiles just as a roof protects a family from rain," and a "screen" that would "make it impossible for missiles to get through." Reagan predicted that such a defense would make possible "the total elimination of nuclear weapons."

This vision had enormous appeal, since everyone would like to be protected from the terrifying threat of nuclear war. But as the leaders of both the United States and the Soviet Union recognized when they negotiated the ABM Treaty, such a defense simply cannot be achieved with any known or envisioned technology. The immense destructive power of nuclear weapons, the many and varied means of delivering them, and the enormous resources available to either superpower to overcome an opponent's defense together create fundamental and enduring obstacles to protecting the population of either the United States or the Soviet Union from the ravages of nuclear war.

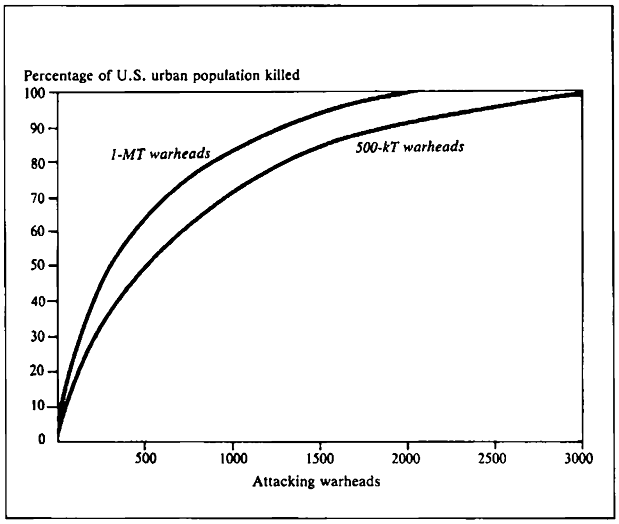
The most fundamental of these factors is the destructive power of nuclear weapons. Pound for pound, modern nuclear weapons are as much as a million times more destructive than conventional explosives, creating a revolutionary new situation in warfare. In World War II's Battle of Britain, a defense of London that shot down only eight percent of the attacking bombers on its best days provided highly effective protection, for it took a punishing toll on German bombers that had to return again and again. But in the face of nuclear weapons such a defense would be useless, for nuclear-armed bombers and missiles need only reach their target once. A single nuclear bomb can utterly destroy a city, as was grimly demonstrated at Hiroshima and Nagasaki.

A one-megaton bomb, for example, would demolish even concrete buildings out to a range of three miles, killing almost everyone within that zone, and if the weather and other conditions were right could create mass fires over more than a hundred square miles. Today, the United States and the Soviet Union each have well over 20,000 nuclear weapons, more than half of which can reach the other country, and the capability to produce many more. Virtually all of these weapons are many times the size of the bomb that destroyed Hiroshima. Facing such overwhelming offensive power, a defense of people and cities must be essentially perfect to offer genuine protection, for even a small fraction of either superpower's strategic arsenal could wreak devastating damage.

But virtually no one involved in military technology believes that such perfection or near-perfection will ever be achievable. Nuclear weapons are incredibly destructive, comparatively cheap, and numerous.

> ***"There is no realistic hope that we shall ever again be able to protect American cities. There is no leakproof defense."***
> *—James Schlesinger, 1984*
> *Former Secretary of Defense*

Cities are vulnerable, precious, and few. Those are the fearful truths of the nuclear age, creating a fundamental and enduring advantage for the offense. Nothing in the foreseeable future will change them. Mutual assured destruction—the ability of either the United States or the Soviet Union to destroy the other in response to an attack—is not a chosen policy, but a grim and unavoidable reality. The United States and the Soviet Union are, in the words of atomic bomb developer Robert Oppenheimer, "two scorpions in a bottle," each capable of destroying the other, each deterred from doing so by the fear of retaliation. It is that unchanging reality that is the fundamental basis for the ABM Treaty.

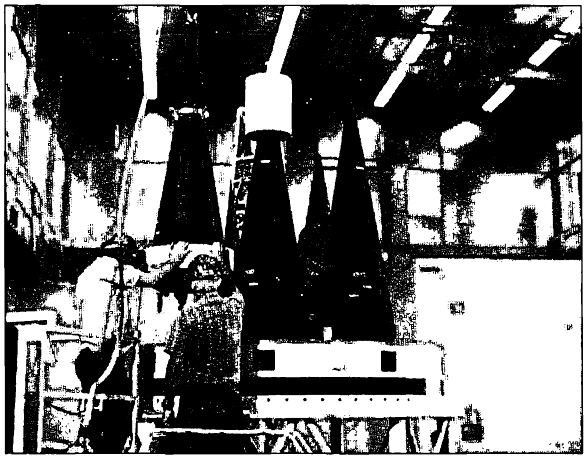


Fearsome Power: *A single nuclear bomb can destroy an entire city, as was demonstrated at Hiroshima (left). Today, each superpower has over 11,000 strategic nuclear weapons, each armed with an explosive power many times that of the Hiroshima bomb. The detonation of even a few hundred warheads, a tiny fraction of either superpower's strategic arsenal, could mean rapid death for most of the urban population of either the United States or the Soviet Union (right). As a result, a defense against nuclear weapons would have to be nearly perfect to offer any substantial protection.*

Indeed, both President George Bush and Secretary of Defense Richard Cheney have publicly recognized that President Reagan's vision of a defensive shield is more than SDI can achieve. The concept, as Cheney put it, was "oversold." As a result, official studies of SDI now emphasize not replacing nuclear deterrence through total defenses, but merely "enhancing" it, perhaps through defenses designed to protect U.S. nuclear forces. But it should be clearly recognized that this is a fundamentally different goal, not one which offers any hope of eliminating the nuclear danger or any more "moral" alternative to reliance on the threat of nuclear retaliation for deterrence. And as will be described below, most foreseeable missile defenses would be far more likely to undermine deterrence than to enhance it.

MISSILE DEFENSES AND THE ARMS RACE

Despite the enormous barriers to a genuine population defense, many SDI advocates argue that partial defenses would be better than none at all. But as the two superpowers realized when the ABM Treaty was negotiated, deployment of widespread missile defenses would only intensify the arms competition, by forcing each side to increase its offensive forces to overcome the others' defenses.



Offense-Defense Race: *Construction of a widespread missile defense by either superpower would force the other side to build up its offensive force to maintain its deterrent capabilities, touching off a renewed arms competition. Initial Soviet ABM efforts in the 1960s played a significant role in the U.S. decision to deploy multiple-warhead missiles, or MIRVs (above), accelerating the strategic arms race.*

Soviet leaders would surely perceive American moves toward deployment of a nationwide missile defense as an effort to disarm the Soviet Union, reducing the effectiveness of missiles Soviet leaders have spent the equivalent of hundreds of billions of dollars to build. The Soviet Union would be certain to respond, seeking to maintain its hard-won offensive capability by developing countermeasures and increasing its offensive forces to ensure that the U.S. defense could be penetrated. Soviet ABM development efforts would presumably be stepped up as well, and the Soviet Union would probably begin deploying a nationwide missile defense of its own. If it wished to maintain its strategic capabilities in the face of these new Soviet threats, the United States would then be forced to redouble its defensive and offensive efforts. Rather than a useful increment of defensive protection, the result would be a dangerous, spiraling arms race.

Such a competition would be fantastically expensive, draining both economic and technological resources from other endeavors—a factor which would place a major constraint on the likely pace of such an offense-defense competition. Indeed, avoiding the cost of such a race was a major motivating factor in the U.S. decision to negotiate the ABM Treaty, and presumably figured prominently in Soviet decision-making as well. Former Secretary of Defense Harold Brown has estimated that attempting to maintain an effective population defense in the face of an ever-changing Soviet offensive threat could cost $100-$200 billion every year—in addition to the costs of improving U.S. offensive forces to counter Soviet missile defenses. (See Chapter IV, "The Strategic Defense Initiative.")

The arms competition between the United States and the Soviet Union certainly involves more than this simple action-reaction dynamic. A host of domestic, bureaucratic, and foreign-policy factors also play a role. But the basic point cannot be ignored: Neither superpower will sit idly by while the other seeks to threaten its offensive deterrent by deploying a nationwide missile defense.

Indeed, the notion that defense spurs offense is not merely an abstract theory, but the hard-learned lesson of history. Soviet deployment of a rudimentary ABM system in the 1960s played a significant part in the U.S. decision to deploy multiple-warhead missiles (so-called multiple independently targetable reentry vehicles, or MIRVs), dramatically increasing the number of missile warheads threatening the Soviet Union. The Soviet ABM system also created powerful domestic political pressure for a U.S. ABM system, eventually leading to deployment of the Safeguard system. Within a few years, the Soviets were also testing and then deploying MIRVs, greatly increasing the strategic threat to the United States.

The same logic holds true today: The Reagan administration repeatedly cited improving Soviet defenses to justify both SDI and new U.S. offensive missiles. In a 1985 report to President Reagan, then-Secretary of Defense Caspar Weinberger argued that "even a probable [Soviet] territorial defense would require us to increase the number of our offensive forces and their ability to penetrate Soviet defenses to assure that our operational plans could be executed." We can hardly expect the Soviets to be less concerned with maintaining their strategic power. Indeed, Marshal Sergei Akhromeyev issued very similar warnings while chief of the Soviet General Staff, saying that a U.S. defense would "force" the Soviet Union "to build up its own strategic offensive forces, supplementing them with means of defense," leading to "an uncontrolled arms race for decades."

Supporters of SDI have argued that while all these arguments might have been true of the ABM systems of the past, the new defensive technologies under development in the SDI program will be so much cheaper than improved offenses that offensive forces will simply be unable to compete. The offense-defense race will be short-circuited, leading eventually to a safer world dominated by advanced defenses. But while the technology of defense has improved substantially over the last two decades, the technology of offense has improved as well. Fundamentally, neither the destructive power of nuclear weapons nor the vulnerability of urban society have changed since 1972. The terrible fact is that in the nuclear age, it remains far easier and cheaper to destroy a city than to protect it. (See "How Much Has Changed Since 1972?" p.44.)

PREDICTABILITY

Predictability is essential for both sensible military planning and arms control negotiations. The ABM Treaty fostered a predictable strategic balance by moderating fears of widespread missile defenses, allowing each side to plan its strategic forces with the knowledge that the other side could not put even a limited nationwide missile defense in place for at least several years.

Without the ABM Treaty, the inevitable uncertainties in predicting the course of a technological competition between ballistic missiles and missile defenses would have enormously complicated military planning. Unable to accurately predict what mix of offensive and defensive technologies the other side might develop in 10 years' time, each side would have been forced to increase its forces to meet plausible "worst case" future threats, intensifying the likely offense-defense race. The uncertainty in gauging capabilities of future missile defenses would have been particularly great, as their overall effectiveness would depend on the interaction of a complex network of sensors, computers, and weapons which could never be fully tested short of nuclear war.

Such races between measure and countermeasure inevitably increase the pace of technological change, further complicating military planning and increasing the cost of preparedness. U.S. bomber forces, for example, have seen revolutionary changes over the last decade, from cruise missiles to stealth technology, all driven by the need to overcome projected improvements in Soviet air defenses. By contrast, the ABM Treaty's limits on missile defenses have allowed the basic technology of ballistic missiles to remain little changed for nearly two decades.

DEFENSES AND ARMS CONTROL

Because improvements in offensive forces are the surest way to overcome an opponent's defenses, offense and defense are inextricably linked. As a result, limits on missile defenses are the necessary base for negotiated limits on offensive strategic missiles. Without the ABM Treaty's strict limits on missile defenses, neither SALT I nor SALT II (Strategic Arms Limitation Talks) would have been possible.

> ***"We can be as certain as the rising of the sun that if we or the Russians begin to approach success in such weaponry, you would then be asked for additional hundreds of billions of dollars to develop and deploy a wide range of offensive missiles which can penetrate or evade such space defenses. Anyone who denies this is living in a world of illusion, lacking realism and candor. . . . It would be foolish in the extreme to suppose that we could obtain any significant or lasting advantage over the Soviets in space weaponry."***
>
> *—Dean Rusk, 1984*
> *Former Secretary of State*

The ABM Treaty is even more critical today, as the focus of negotiation shifts from limitations to reductions in strategic arms. It is clear that there will be no strategic arms reduction (START) agreement unless the ABM Treaty is maintained, and limits on defenses will be even more essential as the United States and the Soviet Union negotiate subsequent agreements for deeper reductions. As six former secretaries of defense argued in 1987, it is only the ABM Treaty that "makes possible the negotiation of substantial reductions in

Toward a Defense Transition?

The Reagan administration's long-range vision for SDI called for a gradual "transition" from today's reliance on deterrence by the threat of nuclear retaliation to a final goal of complete reliance on defenses. In the Geneva arms talks, American negotiators have proposed a "cooperative transition," in which each side would agree to deploy missile defenses while reducing offensive forces. But if the Soviet Union refused to agree—as it has to date—the Reagan administration envisioned a "competitive transition," with the United States building ever-more-capable missile defenses in the hope of defeating an ever-changing Soviet offensive threat.

It is widely acknowledged, however, that complete reliance on defenses simply cannot be achieved in such a competitive environment. As Richard DeLauer, then President Reagan's under-secretary of defense for research and engineering, acknowledged in 1983: "With unconstrained proliferation of Soviet missiles, no defensive system will work." No matter how great the economic and technological resources applied to a U.S. missile defense, Soviet efforts could ensure that enough Soviet missiles would still be able to penetrate U.S. defenses to devastate U.S. urban society—meaning that the United States would be forced to maintain offensive forces capable of penetrating Soviet defenses to pose a comparable retaliatory threat to the Soviet Union.

In the end, deterrence would continue to rest on the threat of offensive retaliation—and hence, no genuine "transition" from offensive to defensive deterrence would occur. Rather, the only "transition" would be from a world of secure retaliatory forces to a world of unending and dangerous offense-defense competition. Whether we like it or not, the Soviet Union has a "veto" over a transition to reliance on defenses.

A "cooperative transition" also faces a variety of fundamental obstacles and dangers. First, the Soviet Union has adamantly and consistently rejected the idea of permitting missile defenses while reducing offensive forces—just as the United States had in the past. Soviet leaders have made it absolutely clear that in response to widespread U.S. missile defenses, the Soviet Union would be forced to increase, not decrease, its offensive arsenal. Thus, as former Secretary of Defense James Schlesinger has said, the two parts of the cooperative transition concept—deployment of defenses and reduction of offenses—are "internally inconsistent," rendering the concept "fundamentally flawed."

In the hope of gaining Soviet acceptance of such a cooperative transition, President Reagan proposed "sharing" SDI technology with the Soviet Union. But like his vision of a leakproof defensive shield, this oft-repeated "sharing" idea ran directly contrary to technical realities. Offering the Soviet Union the vast array of high-technology secrets involved in an SDI system would not only hand the Soviet Union the keys to overcoming the defense, but would allow across-the-board improvements in other Soviet military capabilities as well. Eventually, President Reagan's advisers convinced him to change the offer from sharing technology to an unspecified sharing of the "benefits" of defenses—a plan which Lieutenant General James Abrahamson, then director of the SDI Organization, told Congress would be "conditioned on safeguarding our own national defense technology." Not surprisingly, the Soviet Union has openly ridiculed such "sharing" concepts.

Moreover, the stated goals of such a "transition" agreement could more easily be reached without putting missile defenses into the mix. Conceptually, the result of an agreement that combined offensive reductions with deployment of defenses would be an even deeper cut in the capability of the remaining offensive forces. Such larger reductions in offensive capability, if agreeable to both sides, could be far more cheaply, easily, and reliably achieved by deeper cuts in the offensive forces themselves than by agreement that each side would build complex high-technology missile defenses. Adding nationwide missile defenses to the picture would dramatically complicate any negotiation, for there would be enormous uncertainty as to how effective each side's offensive and defensive forces would be in acting against each other in time of war, making a negotiated balance much more difficult to achieve. As the nonpartisan congressional Office of Technology Assessment pointed out in 1985, "The negotiability of any such agreement is very much in question. Nobody has suggested how the problems of measuring, comparing, and monitoring disparate strategic forces—problems which have plagued past arms control negotiations—could be satisfactorily resolved in the far more difficult situation where both offensive and defensive forces must be included."

Moreover, while SDI supporters have argued that missile defenses deployed in such a transition would enhance stability, a growing array of independent studies have warned of the opposite result: Increasing missile defenses in the context of vulnerably based offensive forces could create dangerous first-strike incentives, as the defenses became more and more capable of reducing the potency of the retaliation following a first strike.

In addition, far from providing "insurance" against cheating on offensive reductions, as President Bush has suggested, permitting nationwide missile defenses in such an accord could open a dangerous possibility for a sudden "breakout" from the agreement. With the radars and other long-lead-time items for a nationwide defense in place, along with substantial production lines for ABM components, either side could rapidly produce and deploy more missile interceptors than permitted, possibly threatening the viability of the reduced offensive deterrent of the other side before it could easily respond. Moreover, both sides would worry that the other might secretly develop new countermeasures to its defense, or new defensive technologies, suddenly changing the agreed balance of strategic power.

As long as the United States and the Soviet Union continue to rely heavily on ballistic missiles for their deterrent strength, the dangers posed by permitting nationwide defenses would become even more acute—not less—if the two sides could agree to very deep reductions in offensive forces. Potential first-strike incentives would grow as the possibility of genuinely reducing damage through a first blow became more real. And sudden illegal improvements in one side's defense would pose a far greater threat against a deterrent force of only a few hundred warheads than they would against today's enormous arsenals. Indeed, if the United States and the Soviet Union eventually pursue such deep reductions, it will probably be necessary to complement them with a "zero-ABM" agreement, eliminating the single 100-interceptor ABM site now permitted.

In President Reagan's vision, such a "defense transition" would end with the total elimination of U.S. and Soviet ballistic missiles. In that case, the United States would have to rely on only one leg of its strategic triad, air-breathing weapons such as bombers and cruise missiles—a concept the Joint Chiefs of Staff have publicly criticized. Mutual agreement on such a qualitative change in nuclear policy would require an extraordinary level of trust and cooperation between the superpowers, amounting to a transformation in their strategic relations even greater than what has occurred since Mikhail Gorbachev came to power.

If such a radical agreement could be reached, the best approach would be to reduce offensive missiles to zero without deploying defenses until the missile disarmament was complete—as President Reagan himself proposed at Reykjavik. Such a disarmament-focused approach would avoid the missile-defense complications described above. If any defense at all were then needed, it would be only a limited system to hedge against the possibility of a small, secretly retained missile force. Such a limited missile defense would not require the exotic space-based technology being developed in SDI. If such an outcome—which would more accurately be termed a "disarmament transition" than a "defense transition"—is the goal, the focus of current discussions must be on whether ballistic missiles can be safely eliminated and on how best to achieve revolutionary disarmament agreements, not on near-term deployment of missile defenses.

Even under such an agreement, the United States and the Soviet Union would remain vulnerable to attack by bombers, cruise missiles, and other means of delivery—unless the two superpowers and all the other nuclear-capable states could agree on a total nuclear disarmament accord, a distant prospect at best.

For the foreseeable future, none of these visionary ideas are likely to come to pass. As long as nations continue to fear and mistrust each other, and to rely on military forces for security, it is extremely unlikely that any combination of disarmament and defense will remove the nuclear threat. For the present, the best that can be hoped for is a stable deterrent, ensured in part by the ABM Treaty's restrictions on missile defenses, coupled with negotiated agreements to help reduce the nuclear danger.

strategic offensive forces." (See Chapter X, "Nationwide Missile Defenses or the ABM Treaty?")

Here, too, SDI supporters argue that the assumptions of the ABM Treaty were fundamentally wrong. By making offensive missiles less effective, they claim, defenses will encourage the Soviet Union to consider agreeing to reduce such missiles in arms control agreements.

But both the history and the logic of the nuclear age indicate that defenses would have precisely the opposite effect, forcing an offensive buildup. Why should the Soviet Union ease the job of U.S. defenses—which they view as a dangerous threat to their deterrent—by reducing the offensive forces those defenses face? The U.S. response to Soviet air defenses has been just the opposite: rather than agreeing to dismantle its bomber fleet, the United States has responded with a constant stream of technical and tactical countermeasures, from low-level flight to the B-2 bomber. And in large part because of Soviet air defenses, the United States rejected all limits on bombers in SALT I, and has demanded special treatment for bombers in both SALT II and START. Indeed, even the strategy panel President Reagan set up to inaugurate the SDI program, known as the Hoffman Panel, warned that the Soviet Union's "current program emphases suggest that they would be more likely to respond with a continuing buildup in their long-range offensive forces [than with agreement to reductions]." (See "Toward a Defense Transition?" p.8.)

The ABM Treaty, therefore, is the fundamental starting point for U.S.-Soviet strategic arms control. Its limitations not only enhance U.S. security in and of themselves, but they are the prerequisite for other agreements that would go still further in reducing the nuclear danger.

MISSILE DEFENSES AND THE RISK OF NUCLEAR WAR

An offense-defense arms competition would be fraught with risk. The combination of rapid-strike offensive missiles and widespread missile defenses could increase the danger of a nuclear first-strike attack, for the possibility that defenses could limit any retaliation from an offensive blow could increase the incentive to strike in an intense crisis.

Because any defense would be more effective against a relatively small, disorganized retaliatory strike than against a massive, well-coordinated first blow, missile defenses could increase the advantages of being the first to strike in a future nuclear war. In a future confrontation that appeared to be sliding toward war, leaders on each side might face increasing pressure to strike first, for the enormous deterrent effect of nuclear weapons would be balanced against the perception that striking first might substantially reduce the devastation their country would otherwise suffer in the event of war. Such first-strike incentives—known as "crisis instability"—would greatly increase the danger of crises exploding into all-out war.

Defenses which were themselves vulnerable to preemptive attack would exacerbate this situation, posing tempting targets for a first strike. Space-based defenses, such as those proposed for SDI, would be especially vulnerable. Moreover, space-based defenses could contribute to an offensive attack by striking defense satellites on the other side with essentially no warning. As former Secretary of Defense Harold Brown has said, "everything that works well as a defense also works somewhat better as a defense suppressor."

Missile defenses, in short, could paradoxically increase the danger of an offensive nuclear attack, fostering the illusion that a nuclear war could be fought, survived, and won. As former President Richard Nixon once put it, they could "provide a shield so that you could use the sword." Indeed, leaders in both superpowers have already expressed the fear that the other side's defenses are part of an offensive strategy. Then-Secretary of Defense Weinberger warned in 1986 that Soviet work on defenses "means the Soviets are seeking a first-strike capability." Similarly, Soviet leader Mikhail Gorbachev, in a televised speech in the Soviet Union, warned that the "supposed defensive nature" of SDI is "a fairy tale for the gullible. The idea is to attempt to paralyze the Soviet Union's strategic arms and guarantee the opportunity of an unpunished nuclear strike against our country."

A genuine and substantial ability to reduce damage by striking first and defending against the resulting retaliation could only be achieved in the unlikely event that defenses reached a very high level of effectiveness, and offensive forces were vulnerable to attack. If the capabilities of defenses remained limited, and each side possessed large and survivable offensive forces, there would continue to be little real advantage in launching a preemptive attack. But the perception of a damage-limiting capability could run ahead of the reality, particularly in the strained decision-making of an intense confrontation, and it is impossible to know what combination of offense and defense would be needed to tilt the balance of decision toward war.

Supporters of SDI argue that partial defenses would have the opposite effect, enhancing deterrence by protecting a fraction of U.S. strategic forces from Soviet attack, and thereby throwing "uncertainty" into any possible Soviet first-strike calculations. But a large fraction of U.S. strategic forces are already reliably protected from attack by means other than active defense, including thousands of warheads on invulnerable submarine-launched missiles and alert bombers. While U.S. fixed, land-based intercontinental ballistic missiles (ICBMs) are theoretically vulnerable to attack, they represent less than one-fifth of the U.S. strategic force, and alternatives such as mobile missiles are likely to provide a less costly and more effective approach to improving their survivability than missile defenses. Indeed, abrogating the ABM Treaty to deploy a missile defense would permit the Soviet Union to build a missile defense of its own; while the U.S. defense could protect some ICBMs, a Soviet defense would reduce the effectiveness of both ICBMs and submarine-launched ballistic missiles (SLBMs), possibly doing more to cast doubt on the U.S. deterrent than the U.S. missile defense could do to protect it. (See Chapter X, "Nationwide Missile Defenses or the ABM Treaty?")

THE ABM TREATY AND THE CURRENT ISSUES

It was these concerns that led to the negotiation of the ABM Treaty in 1972. The ABM Treaty bans nationwide defenses against ballistic missiles: combined with its 1974 Protocol, it permits only a single ABM site, armed with 100 ABM launchers.

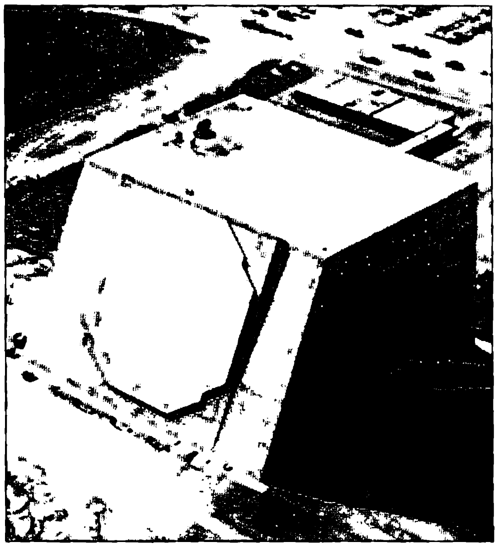
This agreement to nearly ban defenses against strategic ballistic missiles was not reached because of any perverse notion that it is good to remain vulnerable to nuclear attack. Rather, the ABM Treaty was signed in 1972 and maintained since then because of hard-headed calculations by both the United States and the Soviet Union that neither could gain real protection in an unfettered offense-defense race, and that genuine security could more readily be attained through mutual agreement to limit defenses than through an open-ended competition. The ABM Treaty is a treaty of unlimited duration, based on premises that both sides expected to endure. And it has endured, providing substantial security benefits to both parties for nearly two decades. Unfortunately, however, the Reagan administration rejected the basic premises on which the ABM Treaty was based, and set the SDI program on a path to deployment of a nationwide defense, a course that would require abandoning the ABM Treaty in the 1990s. President Reagan also attempted to reinterpret the accord in 1985, arguing that its ban on development and testing of space-based ABM systems and components simply does not apply to the new technologies being developed in SDI. That "broad interpretation" was quickly rejected by the Soviet Union and most U.S. experts, and posed a major obstacle to achievement of a strategic arms reduction agreement for years thereafter.

To date, the Bush administration has chosen to keep SDI on the same course, despite the sweeping changes under way in the Soviet Union and Eastern Europe and the accompanying reductions in the Soviet military threat—including an ever-strengthening Soviet commitment to the ABM pact, exemplified by the recent Soviet decision to dismantle the illegal Krasnoyarsk radar. While the Bush administration has reduced the planned funding for SDI as compared to Reagan-era projections—and the Congress has reduced it still further—both the administration's rhetoric and the SDI program's budgetary focus remain centered on near-term deployment of nationwide missile defenses. Bush has committed himself to "deployment of SDI as soon as feasible," pledging to choose the exact design of a nationwide missile defense in his first term. Secretary of Defense Richard Cheney has testified before Congress that he "would advocate the abrogation of the treaty" as soon as an SDI system was ready for deployment, saying later that he would be "derelict in my responsibility as secretary of defense not to advocate that position."

> ***"Effective arms control does not require defense. . . . As a practical matter, it would be very difficult to induce the Soviets to reduce their offensive forces if they faced the prospect of a strategic defense for which they might need those offensive forces to penetrate."***
>
> *—Brent Scowcroft, 1985*
> *President Bush's National Security Adviser*

Moreover, while strong majorities of both houses of Congress have supported the traditional interpretation of the ABM Treaty, blocking SDI testing that would be prohibited under that view of the accord, the Bush administration has refused to accept the traditional interpretation in the ongoing strategic arms negotiations. Although the Soviet Union announced in September 1989 that it would be willing to sign a START agreement without agreement on how to interpret the ABM Treaty, Soviet negotiators continue to insist that U.S. violation or withdrawal from the ABM Treaty as traditionally interpreted would mean the end of Soviet offensive reductions under START.

In short, the fate of the ABM Treaty remains a critical unresolved issue in U.S. security policy. This book is intended to address the wide range of issues raised in recent debates over SDI and the ABM Treaty, suggesting a path to preserve this essential agreement for the twenty-first century.



The Perimeter Acquisition Radar: The long-range tracking radar of the Safeguard ABM system.

II. The History of Nuclear Defense And the ABM Treaty

Since the dawn of the nuclear age, both the United States and the Soviet Union have searched without success for an effective defense against nuclear attack. Through the 1940s and much of the 1950s, bombers posed the primary strategic nuclear threat. Both superpowers responded with large-scale air-defense systems, including thousands of radar-guided missiles and hundreds of fighter aircraft.

By late 1950s and the early 1960s, however, the advent of long-range Soviet ballistic missiles forced a reevaluation of the U.S. air-defense program. The system could not intercept ICBMs and was extremely vulnerable to direct ICBM attack, making it ineffective even as an antibomber defense. Consequently, U.S. strategic defense spending gradually shifted away from air defenses to the new problem of antiballistic missiles (ABMs). The Soviet Union, however, facing a large U.S. bomber force as well as air threats from Europe and China, has continued to maintain and upgrade its massive air-defense system.

EARLY ABM SYSTEMS

Some preliminary research on the ABM problem had been underway since the immediate aftermath of World War II, in projects such as Thumper and Wizard. But in 1958, the Army won a bureaucratic struggle with the Air Force over control of the ABM mission, receiving the go-ahead to develop the Nike-Zeus ABM missile, a long-range, nuclear-tipped interceptor. The Advanced Research Projects Agency (later with Defense added to its name, to become DARPA) was put in charge of follow-on ABM developments, while the Air Force was to pursue radars and battle management.

Over the next several years, as work on Nike-Zeus advanced, the Army regularly proposed rapid deployment of the system but was rebuffed by a coalition of critics in the White House, the Office of the Secretary of Defense, and the Air Force. These opponents pointed out that the system's mechanically steered radars would be overwhelmed by a large attack and were themselves vulnerable to blinding or destruction, and that the system could be overcome by potential Soviet countermeasures such as warhead-mimicking decoys or radar-reflecting chaff. Moreover, the cost of a widespread Nike-Zeus system would be extremely high, and such a deployment might provoke the Soviet Union to increase its offensive forces to overcome it. This basic troika of arguments—technical weaknesses, cost, and strategic implications—have remained the backbone of the anti-ABM case through all subsequent debates, reflecting the enduring obstacles to mounting an effective defense against a sophisticated adversary armed with the devastating destructive power of modern thermonuclear weapons.

In July 1962, Nike-Zeus scored the first in a series of test successes, intercepting an ICBM for the first time.

But it was clear that Nike-Zeus was simply too primitive to handle the likely future Soviet missile threat. In 1963, the Zeus program was replaced by Nike-X, which incorporated a new, electronically steered "phased-array" radar, capable of simultaneously tracking many targets, and a short-range interceptor called Sprint, designed to intercept Soviet missiles inside the atmosphere. In addition, the long-range Zeus interceptor was eventually upgraded, to become the Spartan. Deployment would be delayed while the more advanced system was developed.

SENTINEL, SAFEGUARD, AND SALT

Although these changes addressed some of the most obvious technical flaws of Nike-Zeus, critics within and without the Defense Department continued to raise both technical and strategic doubts.

Indeed, the outlines of the missile-antimissile race predicted by ABM opponents were already beginning to emerge. In the early 1960s, intelligence on Soviet ABM activities led to increased U.S. spending on decoys and other antidefense "penetration aids," and was a significant factor in the U.S. decision to develop and ultimately deploy MIRVs—multiple independently targetable reentry vehicles—allowing each missile to deliver several warheads to separate targets. The first Soviet ABM deployment around Moscow also created powerful domestic pressure for deployment of a U.S. ABM system. In this environment, then-Secretary of Defense Robert McNamara and others concluded that the only way to avoid a long-term arms race in both offensive and defensive strategic arms was to negotiate an arms agreement, placing particularly strict limits on ABMs.

By the mid-1960s, the possibility of such agreed restraints on strategic arms was gaining increasing currency. Relations between the United States and the Soviet Union had warmed somewhat following the Cuban missile crisis, leading to the successful negotiation of the Limited Test Ban Treaty. The United States had deployed large offensive nuclear forces, and the Soviet Union was rapidly catching up, creating a deterrent balance in which neither side could launch a nuclear attack on the other without facing certain and devastating retaliation. Arms control proponents argued that maintaining that balance through negotiated limits on the arms competition was more likely to lead to lasting security than an unlimited race in ABMs and strategic offensive forces. At the same time, the advent of satellite reconnaissance increased confidence in the possibility of adequate verification.

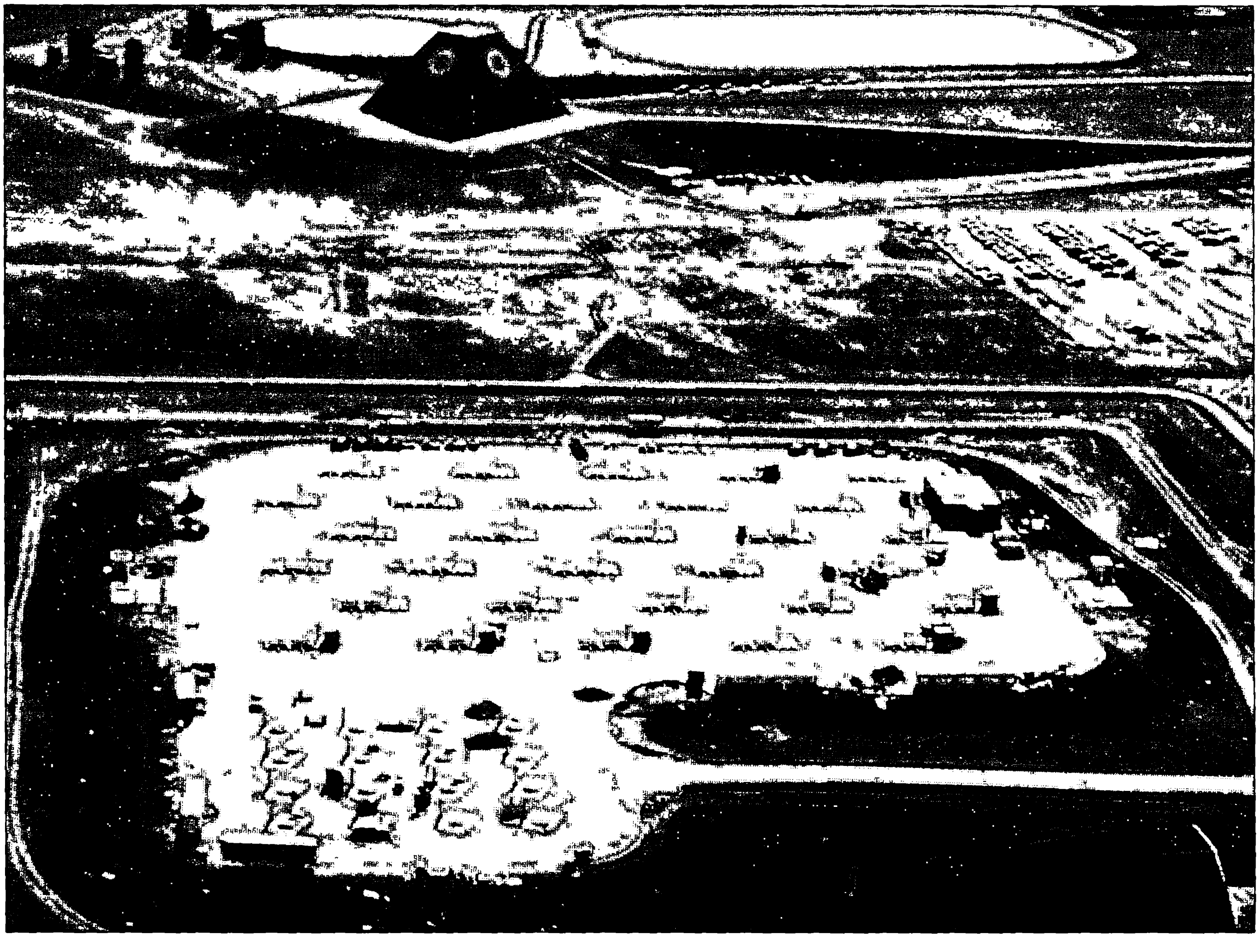
The Soviet leadership first opposed limits on missile defenses. But it soon became apparent that the Soviets were involved in a debate of their own, over both ABMs and the advisability of entering negotiations on strategic arms. Eventually, Soviet leaders came to see arms control as an important means of certifying and protecting their attainment of strategic nuclear parity with the United States. And like their U.S. counterparts, Soviet officials apparently calculated that agreed limitations would better serve Soviet security in the long term than an unlimited offense-defense competition—a realization probably spurred by the clear superiority of U.S. ABM and MIRV technology.

But this resolution of the Soviet debate did not come until well after the United States began to press for arms talks. In December 1966, in response to continuing pressure for U.S. deployment of an ABM system (including a Joint Chiefs of Staff newly united in favor of the Army's proposal), President Lyndon Johnson decided to include several hundred million dollars for construction of an ABM system in the following year's budget. But at McNamara's suggestion, Johnson decided to withhold the funds pending an attempt to negotiate an ABM agreement with the Soviet Union. Unfortunately, at the June 1967 summit meeting in Glassboro, New Jersey, Soviet Premier Alexei Kosygin resisted Johnson and McNamara's arguments for strict ABM limitations, and no agreement to initiate strategic arms negotiations was reached. Faced with this Soviet reluctance to limit ABM systems, President Johnson decided to proceed with construction of a "light" nationwide ABM system based on Nike-X technology, dubbed Sentinel.

> ***"The Antiballistic Missile Treaty is the most substantive and important arms control agreement ever reached by the two superpowers."***
>
> *—Harold Brown, 1989*
> *Former Secretary of Defense*

McNamara announced the Sentinel decision in a remarkable speech on September 18, 1967. Most of the speech was devoted to the case against deployment of a "thick" ABM system, arguing that no ABM could protect U.S. urban society from Soviet attack and that such a system would inevitably accelerate the arms race and destabilize the nuclear balance. Only at the end of the speech did McNamara reveal the decision to deploy a "thin" ABM system, ostensibly to defend against the developing Chinese missile threat.

The Sentinel decision, coming in the midst of increasing antimilitary sentiment over the Vietnam War, launched a wave of criticism from scientists and congressmen, which escalated into public protests when it was revealed that nuclear-armed Sprint interceptors



Defunct ABM: *The one ABM site completed in the United States was located at Grand Forks, North Dakota, to protect missile silos. The Safeguard system included Sprint and Spartan missiles in underground launchers (foreground) and the phased-array Missile Site Radar (background). A larger Perimeter Acquisition Radar designed for long-range tracking was built some distance away.*

would have to be deployed in the immediate vicinity of the cities to be defended. But for the moment, initial steps toward deployment went forward largely unimpeded.

On July 1, 1968, the day of the signing of the Nonproliferation Treaty, President Johnson was finally able to announce that the Soviet Union had agreed to Strategic Arms Limitation Talks (SALT). But the Soviet occupation of Czechoslovakia in August, on the eve of the scheduled announcement of a summit meeting and a date for the talks forced Johnson to postpone the negotiations, leaving the ABM issue for President Richard Nixon's administration to grapple with. The same month, U.S. MIRV testing began.

From the outset of his administration, President Nixon abandoned his campaign call for "clear-cut military superiority" over the Soviet Union, accepting the more modest goal of "sufficiency" and thereby laying the foundation for SALT. In March 1969, after a review of the U.S. strategic posture, Nixon announced his conclusion that an ABM population defense could not be achieved and his decision to reorient the Sentinel program to defend missile silos, under the name Safeguard. But the change of name and mission only intensified the ABM debate—particularly as the Sentinel technology was not well-suited to its new role. In August 1969, the administration won Senate approval for the first phase of Safeguard by only a single vote—in part by arguing that the system was needed as a SALT bargaining chip. In October, President Nixon announced that he had agreed with the Soviet leaders to begin talks on strategic arms.

THE SALT NEGOTIATIONS

The SALT negotiations finally began on November 17, 1969, in Helsinki, Finland. In the first rounds of talks, both sides proposed strict limits on ABM systems, but major differences over offensive limitations soon emerged. These disagreements reflected large differences in the makeup of the two sides' strategic forces, particularly the heavy Soviet reliance on large land-based ICBMs, and the Soviet desire to weigh in the balance both the strategic forces held by U.S. allies and U.S. forward-based weapons on aircraft carriers and foreign bases.

With the disagreements over offensive limitations delaying progress, the Soviet Union soon switched course and proposed that the sides agree on an ABM Treaty while leaving offensive forces to a subsequent negotiation. But the United States insisted on a dual agreement, hoping to use its ongoing ABM deployment program to gain Soviet concessions on offensive arms. In May 1971, Henry Kissinger, Nixon's national security adviser, and Anatoly Dobrynin, then Soviet ambassador to the United States, reached agreement in a "backchannel" negotiation that a comprehensive ABM accord would be accompanied by a more limited agreement on offensive arms, leaving more complete offensive limitations to SALT II.

A year later, on May 26, 1972, President Nixon and Soviet leader Leonid Brezhnev signed the SALT I agreements, including both the ABM Treaty and the Interim Agreement on offensive arms. The ABM Treaty banned nationwide ABM systems, while allowing each side to maintain the ABM site it then possessed, and to build one of the type then being built by the other side, for symmetry's sake. The Interim Agreement froze each side's missile launchers at the level then operational or under construction for five years, but did not place any limits on MIRVs (allowing a major buildup in missile warheads on both sides) or on bomber forces.

The U.S. Senate gave its advice and consent to ratification of the ABM Treaty on August 3 by a vote of 88-2, and both houses of Congress gave similarly overwhelming approval to the Interim Agreement. The accords entered into force on October 3, 1972. Two years later, President Nixon and General Secretary Brezhnev signed a Protocol to the ABM Treaty, reducing the number of permitted ABM sites from two to one.

FROM SALT I TO STAR WARS

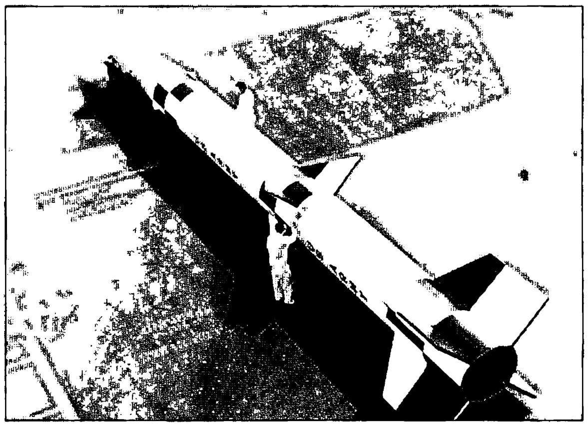
After the ABM Treaty entered into force, both the United States and the Soviet Union continued research and development of ABM systems. The single U.S. Safeguard ABM site was completed in 1975, but was soon deactivated, as the extremely limited protection it offered was judged not to be worth the cost of continued operation and maintenance. U.S. ABM research and development continued, focused primarily on close-in defenses for hardened concrete missile silos, rather than wide-area defenses. The Soviet Union has maintained an ABM system at the permitted Moscow ABM site, which it is now modernizing, and has continued an active ABM development program.

During the 1970s, the U.S.-Soviet Standing Consultative Commission (SCC) successfully managed the few ABM compliance and implementation issues that arose, and in 1977 conducted the first treaty-mandated ABM Treaty Review Conference, reaffirming the accord's importance. At the same time, follow-on strategic arms talks continued, and the SALT II Treaty was finally signed in 1979.

But anti-Soviet sentiment in the United States was on the rise, fueled by Soviet behavior in regional conflicts and by the rapid increase in Soviet missile capabilities as the Soviet Union followed the U.S. lead in deploying MIRVs. When the Soviet Union occupied Afghanistan in December 1979, President Jimmy Carter's administration had no choice but to ask the Senate to defer consideration of SALT II. In the same period, the potential threat to U.S. silo-based missiles led to renewed consideration of ABMs as a possible response: a close-in defense known as the Low-Altitude Defense System (LoADS) was analyzed as a possible add-on to the "racetrack" multiple-shelter basing mode then being proposed for the MX missile, should the Soviet missile threat grow too rapidly for the multiple-shelter scheme alone to provide adequate protection.

> ***"In the long reach of history, if the nuclear era lasts, it will seem like a surprisingly sensible thing that the superpowers did in 1972—agreeing not to duplicate in the defensive field the foolish, costly, dangerous escalating competition that they had been slaves to for over 20 years in the offensive weapons field."***
>
> *—Gerard C. Smith, 1987*
> *Chief U.S. Negotiator of the ABM Treaty*

The downward trend in U.S.-Soviet relations contributed to the election of President Ronald Reagan and reached its nadir in the early years of his term, with the Soviet shoot-down of a civilian airliner and Reagan's description of the Soviet Union as an "evil empire." Reagan brought to the presidency a belief in the urgent need to build up U.S. military forces and a deep skepticism about arms control. Reagan had also long yearned for a defense against nuclear attack, and his advisers made no secret of their disdain for the ABM Treaty. Richard Perle, then the top arms control official in the Department of Defense, told Congress in 1982 that the treaty "was a mistake in 1972, and the sooner we face up to . . . that mistake the better."



The Success of the ABM Treaty

The ABM Treaty is the most important and successful arms control agreement to date. The fundamental goal of the treaty has unequivocally been achieved: neither superpower has deployed a nationwide defense against strategic ballistic missiles.

No one can know for certain what might have happened had there never been an ABM Treaty. Conceivably, neither side would have built nationwide ABM systems. The Nixon administration only barely managed to gain Senate approval for the first phase of Safeguard, and the Soviet ABM deployment already appeared to be slowing by the late 1960s.

Without any agreed restrictions on ABM deployments, however, each side would have been forced to consider ABM developments and limited deployments on the other side as a likely prelude to a nationwide defense, creating enormous pressure for offensive and defensive responses. The Soviet Union has demonstrated a willingness to spend hundreds of billions of dollars on defensive systems of only limited effectiveness—as evidenced by their investment in an air-defense system including over 9,000 anti-aircraft missile launchers, which the U.S. Air Force is confident it could penetrate. Given that proclivity, it seems likely that in the absence of ABM limitations, the Soviet Union would have proceeded with a nationwide ABM deployment once ABM technology improved. The Soviet Flat Twin and Pawn Shop radars developed in the early 1970s, for example, could have offered more rapid deployments at lower total costs than the technology of the Moscow ABM. At the time the ABM Treaty was signed, U.S. intelligence reportedly predicted exactly such a deployment, involving some 8,000 to 10,000 ABM launchers by 1980—confronting the United States with 80 to 100 times the ABM firepower the Soviet Union has today.

Had the Soviet Union built such a widespread ABM system, the United States would have been forced to respond, with offensive countermeasures and probably with a large ABM deployment of its own. Like the Soviet Union, the United States might have waited for the next generation of technology, such as the Site Defense system designed to protect U.S. ICBMs. To provide effective protection for U.S. ICBMs as currently based, thousands of ABM interceptors would have been required. Political pressure to respond to Soviet defenses might well have led to U.S. deployment of city defenses as well.

Had such widespread ABM systems been deployed on both sides, the buildup in offensive forces since 1972 would surely have been even larger than it has been. Former Secretary of Defense James Schlesinger has reported that the U.S. government was considering deployment of as many as 40,000-50,000 warheads to ensure that its forces could penetrate projected Soviet ABMs. In addition, offensive countermeasures such as chaff, decoys, radar jammers, and maneuvering reentry vehicles would likely have proliferated in enormous quantities.

Similarly, the Soviet Union would almost certainly have been forced to undertake an even larger offensive buildup in the face of thousands of U.S. ABM interceptors and increased U.S. offensive forces. There is no doubt that the Soviet Union could have devoted greater resources to offensive forces than it has. Indeed, the CIA estimates that Soviet spending on intercontinental attack forces has fallen by nearly a third since its peak in 1974.

Thus, while neither the ABM Treaty nor the Interim Agreement succeeded in stopping the buildup in offensive strategic forces that was under way in 1972, the pace and scale of that buildup would have been greater had the ABM Treaty not nipped the possibility of a missile-defense race in the bud. As McGeorge Bundy, George Kennan, Robert McNamara, and Gerard Smith have written, "the continuing and excessive competition that still exists in offensive weapons would have been even worse without the ABM Treaty, which removed from the calculation of both sides any fear of an early and destabilizing defensive deployment."

Moreover, by restricting defenses, the ABM Treaty made it possible to restrict offensive weapons, leading directly to the SALT I and SALT II accords. Those who argue that the logic of the ABM Treaty has failed because cuts in offensive forces have not yet been achieved ignore the fact that the Soviet Union has agreed in START to substantial reductions in strategic forces, but only on the condition that the ABM Treaty is preserved.

By averting such a defensive and offensive buildup, the ABM Treaty has contributed substantially to the stability and predictability of the strategic balance, and to the assured effectiveness of U.S. strategic forces. While even a massive Soviet ABM coupled with much larger Soviet offensive forces could not have prevented the United States from maintaining a powerful deterrent, the uncertainties and risks for U.S. security would inevitably have grown.

The sheer economic costs of the arms competition that would likely have resulted in the absence of the ABM Treaty would have been staggering. The U.S. Arms Control and Disarmament Agency has estimated that simply completing four ABM sites, one-third of the planned Safeguard program, would have cost over $15 billion more than was spent on the single site eventually constructed, in 1989 dollars. The far larger ABM deployments that would have been necessary to protect U.S. ICBMs would have cost many tens of billions of dollars, and the likely increases in U.S. offensive forces would have been expensive as well. One hundred billion dollars is a very conservative estimate of the costs that have been avoided by preventing an offense-defense race over the last two decades.

Continuation of the ABM Treaty would certainly save much more over the next two decades. Even the official, highly optimistic cost estimate for a limited first-phase missile defense comes to $55 billion, to which must be added the costs of developing and deploying more expensive planned follow-on phases of the defense system, and the cost of modifying and increasing offensive forces to counter Soviet defenses that would almost inevitably emerge if the ABM Treaty were abandoned. Over the longer term, former Secretaries of Defense James Schlesinger and Harold Brown have each predicted that an all-out effort to build a true population defense would cost as much as $1 trillion—all of which could be saved by remaining within the ABM Treaty.

"The ABM Treaty has forestalled an explosion of offensive development on both sides. Back in the 1960s when the Soviet Union first started to deploy defenses around Moscow, the United States government was examining expanding offensive forces up to 40-50,000 reentry bodies, or warheads, in order to penetrate those defenses. The ABM Treaty has been the cornerstone of restraint for the last 13 years."

—James Schlesinger, 1985
Former Secretary of Defense

The success of the ABM Treaty continues today, nearly two decades after its signing. While there are some genuine compliance issues on both sides, the ABM Treaty has clearly been a major restraint on both Soviet ABM programs and the U.S. SDI effort. The only Soviet violation of the accord—the early warning radar near Krasnoyarsk—is now being dismantled, and was always ill-suited for an ABM role. Its dismantlement clearly demonstrates the treaty's continued relevance in limiting Soviet programs. (See Chapter VII, "Soviet Compliance With the ABM Treaty.") The ABM Treaty's effectiveness can be enhanced by negotiations to clarify other ambiguities, thereby continuing its successful record into the twenty-first century.

But while funding for strategic forces was significantly increased in the first years of his administration, missile defenses remained in the background. A 1981 Defense Science Board study of the space laser concept advocated by a few senators was unenthusiastic, and Air Force studies flatly rejected the 1982 "High Frontier" proposal put forward by retired General Daniel Graham, a former Reagan military adviser. In 1982, the second five-year ABM Treaty Review Conference again reaffirmed the accord, albeit with far less enthusiasm than the 1977 review.

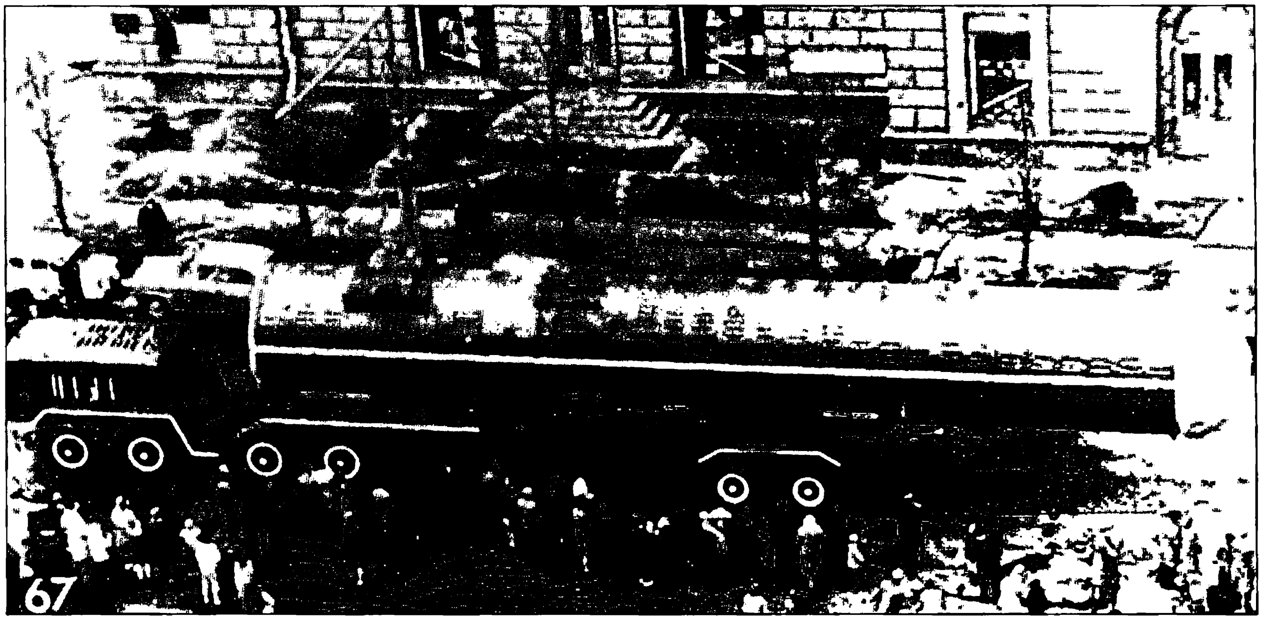
SDI AND THE NEW ABM DEBATE

On March 23, 1983, President Reagan launched the program that soon became known as "Star Wars"—officially the Strategic Defense Initiative—with a speech calling for an all-encompassing shield that would render nuclear weapons "impotent and obsolete." Reagan's speech was based on his own yearning for an answer to the nuclear problem, urged on by a handful of missile-defense enthusiasts such as Edward Teller, known as the "father of the hydrogen bomb." Detailed studies of the idea were carried out only after Reagan had made his public commitment.

SDI soon became the focus of intense controversy, both domestically and internationally. Critics raised many of the basic arguments of the ABM debates of the 1960s, zeroing in on the technical weaknesses, cost, and troubling strategic and arms control implications of the program. The Soviet Union angrily criticized the program as an aggressive American effort to recapture military superiority and gain the ability to attack the Soviet Union without fear of retaliation. NATO countries expressed concern over the risks of an ABM race.

The years following Reagan's speech saw increasing U.S.-Soviet conflict over the future of SDI and the ABM Treaty. In the summer of 1983, the United States announced that it had detected a large radar under construction near the Soviet city of Krasnoyarsk. The Reagan administration soon charged that this radar violated the treaty, and that other Soviet activities constituted "probable" or "potential" violations. The Soviet Union struck back with a list of charges of its own, and argued repeatedly that the entire SDI program was fundamentally contrary to the purpose of the ABM Treaty.

In 1985, Soviet arms negotiators returned to the table after a prolonged walk-out over the deployment of U.S. intermediate-range nuclear missiles in Europe, and the Nuclear and Space Talks began. The Defense and Space portion of those negotiations, covering the future of SDI and the ABM Treaty, have remained virtually deadlocked from the outset, with the positions of the two sides essentially reversed since the late 1960s: Now it is the Soviet Union that favors strict ABM limitations, and the United States that seeks to pave the way for testing and eventual deployment.



Early Soviet ABM: *The Soviet Galosh ABM interceptor, first displayed in a Moscow parade in 1964, was soon deployed in the Moscow ABM system. The giant missile was larger than the U.S. Minuteman ICBMs it was intended to intercept, and could not have competed effectively in an offense-defense race.*

The impasse in the Defense and Space negotiations deepened when, in October 1985, the Reagan administration announced a radical reinterpretation of the ABM Treaty, exempting the exotic technologies being developed in the SDI program from the treaty's restraints on development and testing. That so-called broad interpretation was immediately denounced by the Soviet Union, many NATO allies, and by U.S. experts—including all but one of the negotiators of the ABM Treaty. The Reagan administration soon made a partial retreat, insisting that the new interpretation was "fully justified," but agreeing to respect the traditional view of the treaty for the time being. (See Chapter VI, "The Reinterpretation of the ABM Treaty.")

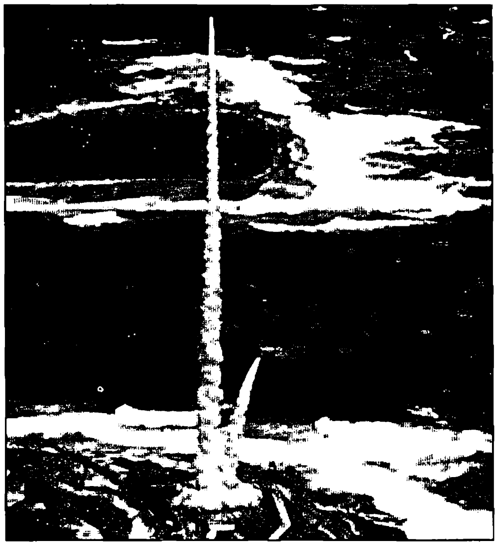
The central importance of the ABM issue in U.S.-Soviet relations became apparent at the Reykjavik summit in October 1986. After intense expert negotiations had laid the foundation for a strategic arms reductions treaty (START) and Reagan and Soviet leader Mikhail Gorbachev had discussed even more visionary ideas such as the elimination of all offensive ballistic missiles or even all nuclear weapons, the summit collapsed in rancor over the SDI issue. Reagan insisted on freedom to test under the broad interpretation and an eventual right to deploy, and Gorbachev called for all SDI work to be limited to the laboratory: at that moment, neither side seriously explored potential compromises.

In the months after Reykjavik, the SDI issue erupted again in the U.S. domestic debate. Leaks from high-level meetings indicated that the Reagan administration was considering carrying out SDI tests that would violate the traditional interpretation of the ABM Treaty, to pave the way for "early deployment" of a limited defense which would destroy the treaty completely. Congressional and allied reaction was strong, and by the end of the year, after a fierce partisan struggle, strong majorities of both houses of Congress approved an amendment sponsored by Senators Sam Nunn (D-GA) and Carl Levin (D-MI), limiting SDI tests to those described by the Defense Department as complying with the traditional interpretation of the ABM Treaty.

With the warming of U.S.-Soviet relations and the increased support for arms control since 1987, SDI's fortunes have declined, and the ABM Treaty's prospects have improved. The SDI issue virtually vanished from the public agenda during 1988, and Congress dealt the program its first real decline in funding—a trend which has accelerated since, with the rapid decline in perceptions of the Soviet military threat and the consequent reductions in the overall military budget.

At the same time, U.S.-Soviet frictions over the ABM issue have moderated considerably. In September 1989, the Soviet Union removed the greatest remaining procedural roadblock to START by announcing that it was prepared to complete a START agreement even if no agreement on the interpretation of the ABM Treaty could be reached—though the Soviet Union would consider U.S. violation of the traditional view as potential grounds to withdraw from a START agreement. At the same meeting, the Soviet Union finally offered to dismantle the Krasnoyarsk radar without preconditions, thereby removing another major START stumbling block.

Nevertheless, President Bush and his administration continue to give strong rhetorical support to the discredited broad interpretation of the ABM Treaty and have maintained the SDI program's ever-more-exclusive focus on preparing for near-term deployment of nationwide defenses. It now appears that when START goes to the Senate for ratification, the Senate will be forced to confront continuing disagreement between the Bush administration and the Soviet Union over the interpretation of the ABM Treaty. The long controversy over the meaning and future of the ABM Treaty is not yet over.



Two Sprint ABM interceptors are test-fired.

III. How the ABM Treaty Works

The ABM Treaty prohibits nationwide defenses against strategic ballistic missiles in the United States and the Soviet Union, thereby avoiding an expensive and dangerous missile-antimissile race. The terms of the treaty form an interlocking structure designed to make the general prohibition effective. Each of the substantive articles of the accord is key to the whole, for each is carefully designed to block a potential avenue for evasion or circumvention.

To make certain that the treaty's security benefits would be lasting, the terms of the ABM Treaty were designed not only to prohibit deployment of a nationwide missile defense, but to ensure that it would require several years of observable activity to build such a defense, preventing either side from gaining the ability to "break out" of the accord more rapidly than the other could respond. As a result, the ABM Treaty has enabled both superpowers to confidently plan their strategic missile forces in the knowledge that the other side cannot rapidly construct nationwide defenses against them, providing the fundamental ground rules of the strategic environment for nearly two decades. (For the text of the ABM Treaty and summaries of important additional statements, see Appendices A and B.)

The ABM Treaty begins with a preamble, outlining the agreed rationale for an accord strictly limiting missile defenses: "Effective measures to limit antiballistic missile systems would be a substantial factor in curbing the arms race in strategic offensive arms and would lead to a decrease in the risk of outbreak of war involving nuclear weapons." Further, such limits would "contribute to the creation of more favorable conditions for further negotiations on limiting strategic arms."

Article I then sets out the agreement of each side "not to deploy ABM systems for a defense of the territory of its country and not to provide a base for such a defense." This is the treaty's fundamental prohibition.

Article II defines the ABM systems and components limited by the treaty. The term "ABM system" is defined functionally, including any "system to counter strategic ballistic missiles or their elements in flight trajectory." The components of such a system are listed as "currently consisting of" ABM missiles, ABM launchers, and ABM radars—the most visible elements of the ABM systems of 1972. The word "currently" was specifically inserted to make clear that this listing of components is simply illustrative of those "current" in 1972, and does not exclude new types of components from limitation. (See Chapter VI, "The Reinterpretation of the ABM Treaty.")

Article III then sets out the very limited deployments of ABM systems permitted by the accord. It begins by forbidding any ABM deployment not specifically allowed: "Each Party undertakes not to deploy ABM systems or their components except. . ." It then permits only two ABM sites, one to defend the national capital and one to defend an ICBM field (respectively, the types of ABM systems the Soviet Union and the United States were deploying at the time the treaty was negotiated). Each site can have no more than 100 fixed launchers for single-warhead ABM interceptors. Specific restraints are also placed on the radars at each site. A 1974

Protocol reduced the number of permitted sites to one, which can be of either type. The Soviet Union has continued to maintain the single permitted ABM site, while the United States dismantled its single system, considering the operational costs more than its very limited protection was worth.

With the permitted ABM defenses limited to a single site armed with only 100 ABM launchers, the firepower and scope of the permitted defense are far too small to pose any threat to either side's offensive deterrent forces, each of which consist of thousands of ballistic missile warheads. If the treaty were amended to allow a significantly larger number of deployment sites—as some have recommended in order to facilitate construction of a U.S. Accidental Launch Protection System (ALPS) or a limited defense of strategic forces—the much larger permitted ABM infrastructure, including more widespread ABM radars, would give either side the ability to expand its defenses much more rapidly, eroding the treaty's buffer against "breakout" from the accord.

By banning all deployments not explicitly allowed, Article III implicitly prohibits the deployment of ABM systems and components other than interceptors, launchers, and radars, such as lasers or particle beams used to perform the same functions, even at permitted fixed, land-based ABM deployment areas. Agreed Statement D makes this ban explicit, providing that future ABM components "based on other physical principles" and "capable of substituting for" ABM interceptors, launchers, and radars, can only be deployed if both parties agree to amend the treaty to provide specific limitations on them, analogous to the treaty's limits on traditional-technology ABM components.

Article III's restraints on the scope and firepower of permitted ABM systems are reinforced by Article V. The first paragraph of Article V prohibits development, testing, and deployment of all mobile ABM systems and components, including those that are "sea-based, air-based, space-based, or mobile land-based." This broad ban on mobile ABMs, prohibiting them from proceeding beyond research, is critical to the treaty's effectiveness, for ABM systems based on mobile components would be inherently expandable beyond the single permitted site, creating a danger of rapid "breakout" toward a nationwide defense. Space-based ABMs, in particular, would inherently provide nationwide coverage. Requiring little site preparation, mobile ABMs might be rapidly deployed once produced, further undermining the treaty's protections. Mobile ABM components would also make numerical limits on deployment more difficult to verify. Thus, the Reagan administration's radical "reinterpretation" of the ABM Treaty, which held that the restraints on development and testing of mobile ABMs do not apply to the futuristic technologies being pursued under the Strategic Defense Initiative, would gut one of the critical provisions of the agreement.

The second paragraph of Article V bans the development, testing, and deployment of multiple-launch or rapidly reloadable ABM launchers, which might otherwise have undercut the limit on defensive firepower imposed by the 100-launcher ceiling. Agreed Statement E broadens that limitation to include a similar ban on multiple-warhead interceptors, which could have had a similar effect.

> ***"The ABM Treaty is a document of historic significance. It is a comprehensive, precisely drafted contract to govern ABM relations of the superpowers into the unlimited future. For as long as it endures, it rules out a race for defensive missile systems which had threatened to be a major new and dangerous form of arms competition."***
>
> *—Gerard C. Smith, 1987*
> *Chief U.S. Negotiator of the ABM Treaty*

Article V's limits begin at the development stage. No prohibitions were placed on research, which would have been very difficult to verify. During the ABM Treaty negotiations, it was recognized that the line between permitted "research" and prohibited "development" is difficult to define. Soviet negotiators implicitly accepted the U.S. interpretation of "development" as a stage following research, when prototypes or breadboard models of ABM components left the laboratory and were ready for field testing, but no formal agreed interpretation was sought. The experiments now being conducted under the Strategic Defense Initiative are pressing the somewhat ambiguous line between permitted research and prohibited development and testing. (See Chapter VIII, "U.S. Compliance With the ABM Treaty.")

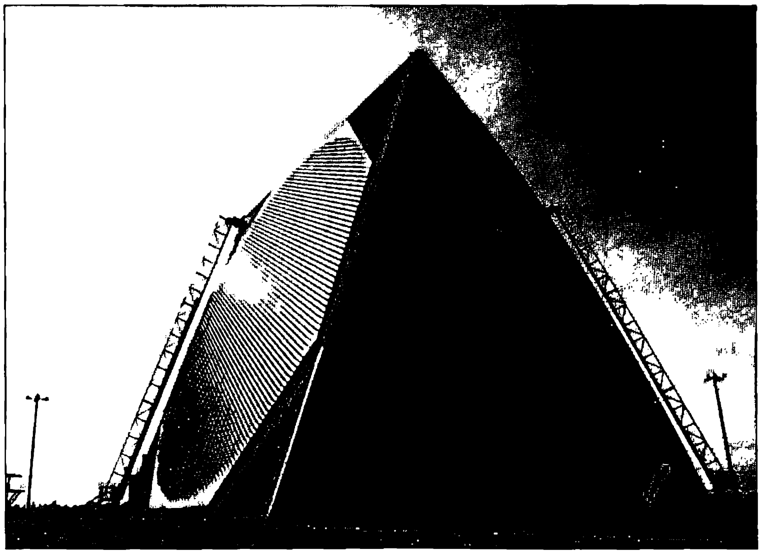
Article VI addresses the possibility that non-ABM systems such as air defenses or antisatellite (ASAT) weapons might be upgraded to serve as missile defenses, thereby circumventing the accord. Article VI prohibits giving any such non-ABM components "capabilities to counter strategic ballistic missiles," or testing them "in an ABM mode." The phrase "testing in an ABM mode" was clarified in agreed interpretations negotiated in the Standing Consultative Commission (SCC) in 1978 and 1985.

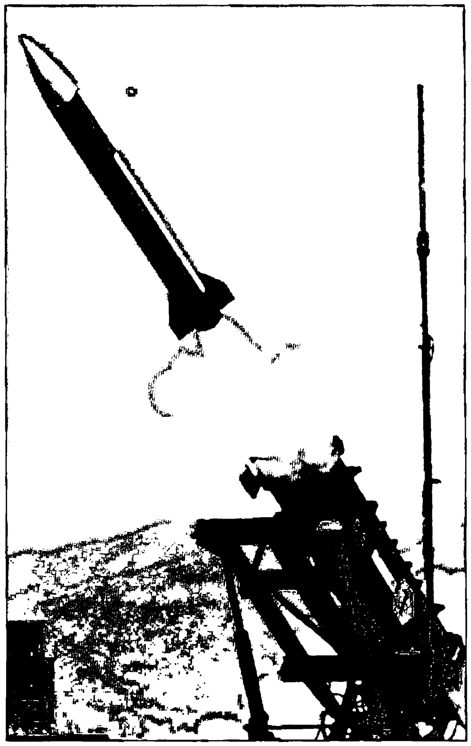
The second paragraph of Article VI addresses the dual-capable technologies issue as it applies to large radars. The treaty's restraints on radars are particularly important, since large radars are the guiding eyes of traditional-technology ABM systems and take years to build. The beginning of construction of large numbers of radars in violation of the ABM Treaty would provide ample warning of an effort to construct a nationwide missile defense. A ban on all radars that might have an ABM potential was not possible, however, since radars capable of detecting and tracking ballistic missiles are necessary for other essential purposes, such as early warning and treaty verification. (In current SDI concepts, large radars are now being superseded in part by infrared sensors, creating new dilemmas—particularly as these new technologies also have important early warning and verification potential.)

To address these conflicting concerns, Article VI permits early warning radars, but limits future deployments of such radars to the periphery of the country and oriented outward. Located that way, an early warning radar's coverage is almost entirely outside the country's territory, hobbling its ability to serve as a battle-manager for a missile defense. Moreover, early warning radars on the periphery of a country's territory would be especially vulnerable to attack, making it less likely that either side would rely on them as the basis for a widespread missile defense. Agreed Statement F broadens the radar restraints by prohibiting the deployment of *any* new large "phased-array" radars—a type that can be rapidly electronically steered to track large numbers of targets simultaneously, offering greater ABM potential than any other type—except as ABM radars at agreed ABM sites or test ranges, early warning radars limited by Article VI, or for space tracking and treaty verification. Phased-array radars for all other purposes are limited to a size too small to offer any significant ability to search the sky for ballistic missiles. (The Soviet Union has now acknowledged that its early warning radar at Krasnoyarsk violates these provisions, and has agreed to dismantle it. Two U.S. phased-array early warning radars also raise serious issues. See Chapter VII, "Soviet Compliance With the ABM Treaty," and "The Radars at Thule and Fylingdales Moor," p.100.)

Other articles address other potential avenues for circumventing the treaty's restraints. In Article IV, permitted testing of fixed, land-based ABMs is limited to agreed test ranges and a total of no more than 15 test launchers, preventing test ranges from being used as a guise for a widespread ABM deployment. Article IX prohibits either side from deploying ABM systems and components outside its national territory, or transferring them to other states not limited by the accord. Agreed Statement G extends the "no-transfer" provision to include transfers of "technical descriptions or blue-prints specially worked out for the construction of ABM systems and their components."

Verification of the ABM Treaty depends on "national technical means," (NTM) a euphemism for photo-reconnaissance satellites and other technical intelligence systems used to collect information on treaty-limited activities. Verification is greatly facilitated by





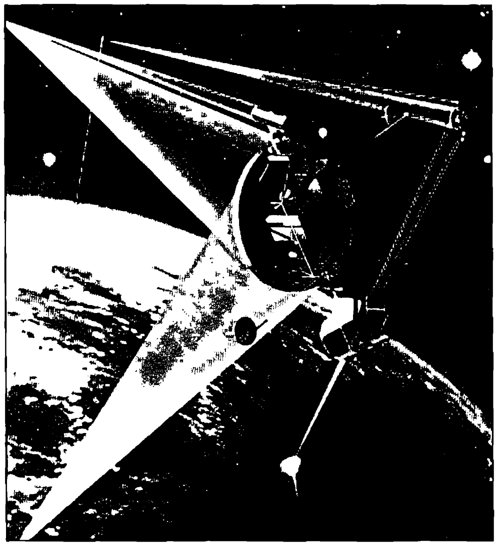
Key Restraints: *The ABM Treaty prohibits giving an ABM capability to systems designed to intercept aircraft or short-range missiles, such as the U.S. Patriot missile (right), or testing such systems "in an ABM mode." The treaty also places strict limits on large phased-array radars, like the U.S. Pave Paws early warning system (above). Such radars, which take years to build, are the guiding eyes of traditional ABM systems, but can also be used for other purposes, from early warning to space surveillance.*

Article XII, which bars deliberate concealment of ABM activities and interference with the other party's NTM.

Article XIII established the U.S.-Soviet Standing Consultative Commission, to discuss measures to implement the accord, additional agreements to improve its effectiveness, and questions of compliance with the agreement. The SCC has effectively resolved many ambiguities and compliance disputes, providing an essential mechanism for reinforcing arms control agreements. (See "The Standing Consultative Commission," p.77.)

Under the terms of Article XV, the ABM Treaty is "of unlimited duration," signalling that the accord was intended to last as far into the future as either side could then predict. Either side may, however, withdraw from the treaty after giving six months' notice, if "extraordinary events related to the subject matter of this treaty have jeopardized its supreme interests." Notice must include a statement of the reasons for withdrawal. Although not specifically included in the treaty's terms, the accepted principles of international law permit either party to withdraw or to take appropriate and proportionate responses if the other party commits a "material breach" of the accord.

Together, the provisions of the ABM Treaty have successfully prevented either superpower from deploying any large-scale defenses against strategic ballistic missiles. However, there are ambiguities in the ABM Treaty's provisions which are becoming more critical as ABM-related programs in both the United States and the Soviet Union begin to come close to the boundaries. Just as the U.S. Constitution's guarantee of freedom of speech must constantly be interpreted in the age of electronic media, any agreement covering as broad and complex a technological area as ballistic missile defense will need refinement as specific technical issues arise. The ABM Treaty explicitly envisioned periodic reviews and possible updating, and gave the SCC that task. To maintain the substantial security benefits provided by the ABM Treaty, the United States and the Soviet Union will have to work together to clarify and strengthen the treaty regime, updating its provisions for the new technologies of the twenty-first century. (See Chapter XII, "Reaffirming the ABM Treaty.")



A space-based mirror reflecting the beam from a ground-based laser.

IV. The Strategic Defense Initiative

On March 23, 1983, President Reagan called on the scientific community to create a defense which would make "nuclear weapons impotent and obsolete." The Strategic Defense Initiative program that developed from that call has become one of the most expensive, complex, and controversial military research programs in U.S. history. SDI research has consumed some $20 billion through Fiscal Year 1990, and the Bush administration hopes to spend tens of billions more on the program over the next five years. President Reagan's dream of an all-encompassing space shield was just that—a personal dream, divorced from the technical and strategic realities. As described in Chapter I, the immense destructive power of nuclear weapons creates fundamental barriers to any meaningful protection of the U.S. population from the ravages of nuclear war. Indeed, President Reagan's own advisers knew that what he was promising could not be delivered: the chairman of the Joint Chiefs of Staff, the secretary of defense (later a strong convert), and the secretary of state all reportedly objected to the speech in the form he gave it. In congressional testimony earlier the same day, the Air Force general then in charge of laser-weapon research had recommended on technical grounds against accelerating the program.

While deploring the misleading rhetoric used to advance the program, few SDI critics ever opposed some level of ABM research. Such research has been under way for decades, to explore new technologies and hedge against potential Soviet advances. But for the first time since the ABM Treaty was signed, the SDI program set U.S. ABM work on a course toward near-term testing and deployment of a nationwide missile defense, putting it on a collision course with the ABM Treaty. This, then, is the underlying issue in the SDI debate: Are the technologies of SDI sufficiently promising to justify moving toward deployment, when such a deployment program would inevitably mean abandoning the ABM Treaty, with all that implies?

CRITERIA FOR DEPLOYMENT

In 1985, after two years of seemingly unstructured growth in the SDI program, with few clearly articulated strategic, technical, or cost guidelines, the Reagan administration finally began outlining a set of criteria that any missile defense system would have to meet to be considered for deployment. The Bush administration has left these criteria largely unchanged.

The three most fundamental tests were outlined in a February 1985 speech by Paul Nitze, then President Reagan's senior arms control adviser. President Reagan subsequently incorporated the criteria into a presidential directive for the SDI program, and Congress has written them into U.S. law. First, missile defenses must be "effective," technically capable of doing the job they were designed to do, whether defending cities or military targets. Second, defenses must be "survivable" against attack. As Nitze pointed out, vulnerable defenses "would themselves be tempting targets for a first strike. This would decrease rather than enhance stability." Third, defenses must be "cost-effective at the margin"—meaning that it would be cheaper to maintain the capability of the defense than it would be for the Soviets to increase their forces or deploy countermeasures to overcome it. If every $10 billion expenditure on missile defenses could be defeated by Soviet countermeasures costing only $1 billion, there would be little point in proceeding.

In response to the "cost-effectiveness" criterion, the Defense Department first tried to substitute the vaguer concept that defenses must be "affordable," in comparison to other national priorities. But then-SDI Organization Director Lieutenant General James Abrahamson eventually accepted the cost-effectiveness at the margin concept, while maintaining affordability as an important additional test that defenses must meet. Abrahamson eventually specified that the total cost must be "a lot less" than the $1 trillion estimate put forward by former Secretaries of Defense Harold Brown and James Schlesinger.

As described below, during 1987 the Reagan administration outlined a plan for building missile defenses in several "phases" of increasing capability. As that plan was put forward, several additional criteria relevant to each phase of defense deployment were announced, by both then-Secretary of State George Shultz and then-Secretary of Defense Caspar Weinberger. First, each phase of a missile defense program must be designed to be "an integral part of the whole system," and therefore "phase one must look forward to phase two, three, and beyond." In other words, defense components that would only be effective in the near term and would not be part of a long-term system should not be built. Also, since a system based exclusively on technologies that might be available in the near term would soon be overwhelmed by Soviet countermeasures, no decision on deployment should be made until the feasibility of follow-on technologies to reinforce the system is established—a point the Joint Chiefs of Staff have emphasized. Last, but perhaps most fundamental, each phase of the defense must enhance deterrence, rather than undermining it.

In essence, the announcement of these criteria acknowledged the problems critics of missile defenses had long pointed out, but held out the hope that each would somehow be overcome. The enormous costs of defenses would have to be reduced; their vulnerability to attack would have to be resolved; their susceptibility to being countered at lower cost by more missiles or offensive countermeasures would have to be overcome; their destabilizing effect would have to be avoided; and so on. As Nitze conceded, the criteria will be difficult to meet. Indeed, the ABM Treaty was based on a considered judgment that these tests could not be met—that the enormous destructive power of nuclear weapons would always give the offense an advantage in the cost-effectiveness competition, and that virtually any missile defense would be costly, destabilizing, and readily countered.

THE PHASED DEPLOYMENT

As of mid-1990, SDI plans remain based on the vision of "phased deployment" of missile defenses outlined by the Reagan administration in 1987. In this concept, several separate "phases" of defenses would be built, with ever-more-advanced technologies being added incrementally to increase the system's capability over time.

"There is no defense in science against the weapon which can destroy civilization."
—Albert Einstein, 1946

The SDI program is now heavily focused on preparing for near-term deployment of the first, "Phase I" missile defense. This Phase I system would rely on comparatively well-understood technologies, such as interceptor rockets, rather than the lasers and particle beams often envisioned as a "Star Wars" system. As the first phase, it would be only a very partial system, designed to meet a Joint Chiefs of Staff "requirement" that calls for intercepting only 40 percent of a 4,700-warhead "leading edge" attack—leaving 60 percent of the missile warheads in a Soviet attack untouched. Such a system would have no significant ability to defend U.S. cities. Rather, it is designed primarily for the more achievable task of providing a limited screen for military targets: supporters emphasize the protection it might offer to U.S. strategic forces and command centers, strengthening deterrence, rather than replacing it as Reagan's public statements often envisioned. Critics argue that the Phase I system would not fill this role effectively either, as Soviet countermeasures might soon render the Phase I system obsolete, and the impact on U.S. deterrent capability of Soviet defenses deployed in response might more than offset the protection the system could offer. (See "The Technology of Near-Term Deployment," p.28, and Chapter X, "Nationwide Missile Defenses or the ABM Treaty?")

Under current plans, the Phase I system would be augmented or replaced within a few years by a Phase II defense, which would probably add space lasers and new shorter-range interceptors to the system, as well as increasing the number of the space-based and ground-based rockets deployed in Phase I. Phase II would be designed to provide a higher level of effectiveness, and

Phases of a Missile's Flight

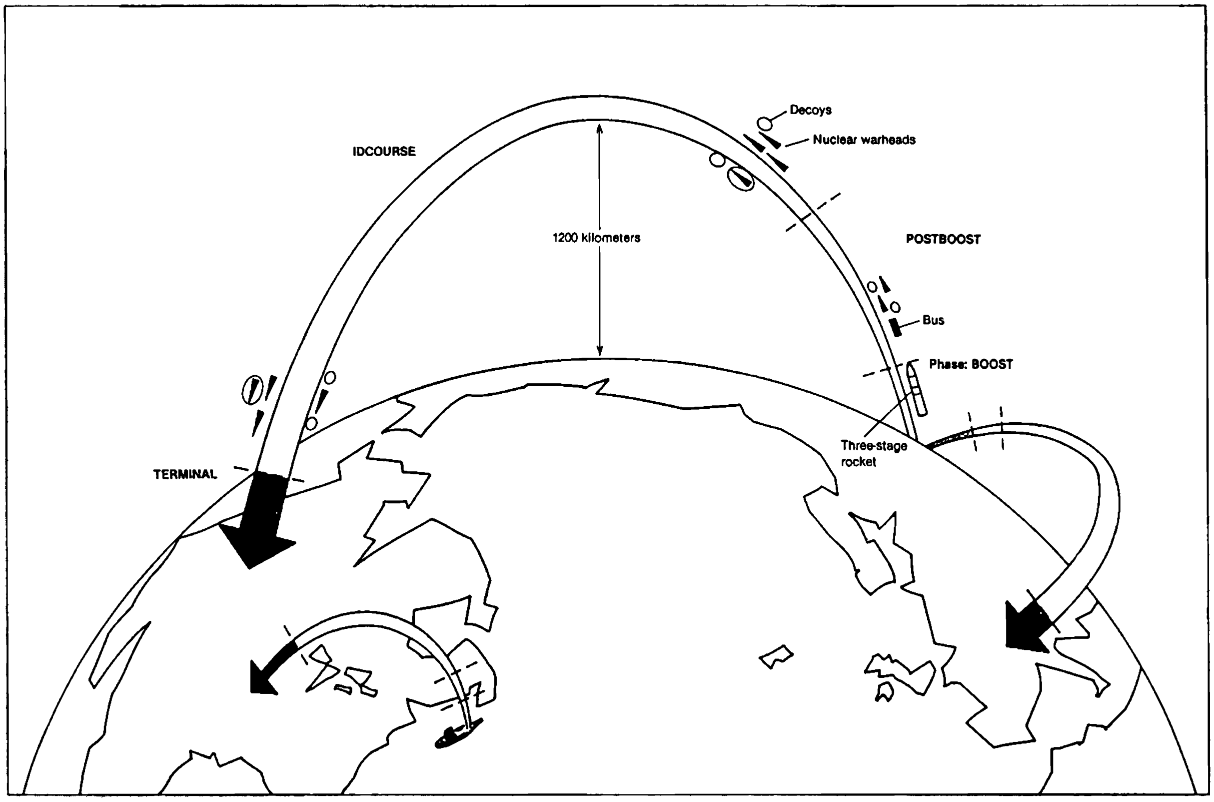
The flight of a long-range ballistic missile can be divided into four distinct phases, each presenting different opportunities and problems for the defense. Flight begins with the short *boost phase,* during which the missile's main rocket propels the warheads into space. In large liquid-fueled missiles such as the Soviet SS-18 ICBM, the boost phase lasts roughly five minutes. Solid-fueled missiles such as the Soviet SS-24 and the U.S. MX ICBMs, however, burn more rapidly, with the main rocket burning out after roughly three minutes of flight. In the future, so-called fast-burn boosters could be designed to burn out in roughly a minute, within the atmosphere, greatly complicating the problems of boost-phase defense.

During the *post-boost phase,* after the main rocket has burned out, a smaller rocket called the post-boost vehicle or "bus" maneuvers to place each warhead on the trajectory toward its separate target, and may release warhead-mimicking decoys or other penetration aids as well. In current ICBMs, the post-boost phase often lasts some five minutes, but as with the boost phase, future designs might reduce that time substantially.

After the warheads and decoys are released from the bus, they coast through space unpowered and unguided, much like cannon shells. This is called the *midcourse phase,* and takes some 20 minutes in the case of an ICBM.

At the end of the midcourse phase, the warheads reenter the atmosphere at approximately seven kilometers per second (16,000 miles per hour), encountering enormous atmospheric drag and heating. All but the most sophisticated decoys would be rapidly stripped away by the atmosphere. This stage is called the *reentry phase,* and typically lasts less than one minute.

Typical submarine-launched ballistic missiles have somewhat shorter ranges and flight times than ICBMs. While the boost and post-boost phases are generally of similar length, the midcourse phase is substantially shorter. Short-range tactical missiles generally do not have a post-boost phase, and the midcourse phase of flight through space may be extremely short.



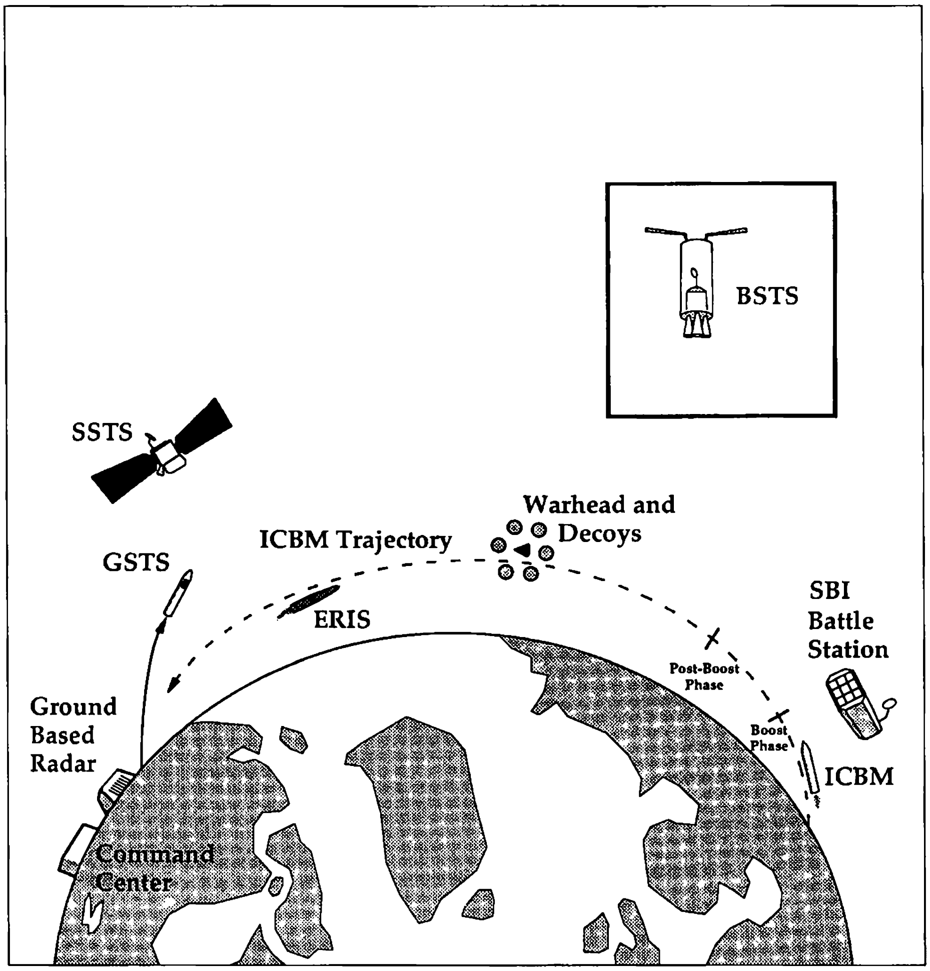
to respond to Soviet countermeasures to the Phase I system. Phase II would then be followed by Phase III, incorporating very exotic technologies such as ground-based free-electron lasers. The SDI Organization (SDIO) continues to argue that the eventual Phase III system might offer substantial protection to the U.S. population. To protect U.S. cities, such a defense would also have to deal with bombers and cruise missiles, which SDI is not designed to do. An Air Defense Initiative (ADI) has been organized, but has received only minimal funding to date.

While Phases II and III still play a major role in the public justification of the SDI program, SDIO has substantially reduced the planned funding for such longer-term technologies over the last several years, in order to preserve the budget for near-term deployment. And under current plans, even the Phase I system would not be completed until the early years of the twenty-first century, putting Phases II and III off into the distant future. As Senator Sam Nunn (D-GA), chairman of the Senate Armed Services Committee, has predicted: "We will all be dead before we get beyond Phase I."

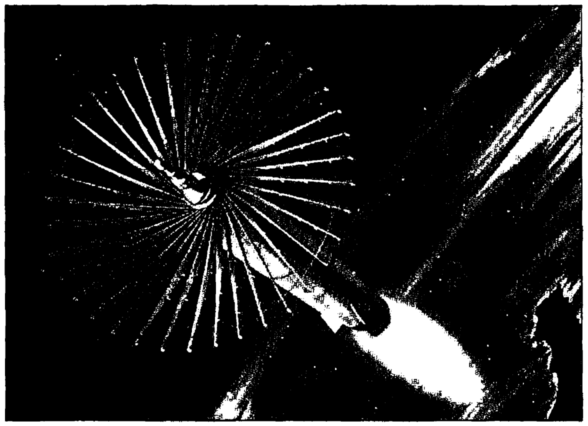
After conducting its 1989 strategic review, the Bush administration chose to leave this basic plan for SDI intact, while cutting back somewhat on planned SDI spending, and shifting near-term plans to focus on a variant of space-based interceptors known as "brilliant pebbles." Over the longer term, however, factors such as the clear decline of the Soviet military threat, technical obstacles, strategic issues, budget limitations, and arms control pressures are likely to lead to continuing shifts in the SDI program.

THE TECHNOLOGY OF SDI

Most press reports on the Strategic Defense Initiative have focused on the weapons of "Star Wars," from the X-ray laser to brilliant pebbles. But an effective missile defense would also require advanced sensors, to detect, track, and identify missiles; computers and communications, to manage the battle; and a variety of support equipment, such as rockets to lift the defense satellites into orbit. As a result, SDI is an extremely



Near-Term Deployment: *The first-phase missile defense would include space-based and ground-based interceptors, several types of sensors, and command and control to tie the system together. The space-based interceptor (SBI) concept (shown at right) has been replaced in the most recent design revision by individually orbiting missiles known as "brilliant pebbles." Over 4,000 brilliant pebbles would be placed in orbit to intercept Soviet missiles in the boost and post-boost phases of flight. Ground-based Exoatmospheric Reentry Vehicle Interceptor System (ERIS) rockets would attack the warheads in the midcourse phase. Boost Surveillance and Tracking System (BSTS) satellites in high geosynchronous orbits (inset) would provide early tracking. Midcourse sensors would include the Space Surveillance and Tracking System (SSTS), the Ground-based Surveillance and Tracking System (GSTS), and the Ground-based Radar.*



The Technology of Near-Term Deployment

While SDI began with a focus on exotic, long-range technologies such as lasers and particle beams, supporters soon became frustrated with this long-term approach and began to argue for "early deployment" of a limited missile defense based on better-known technologies. By early 1987, it became clear that the Reagan administration was seriously considering such a rapid deployment, which would require abrogating the ABM Treaty in the near term. Then-Attorney General Edwin Meese, among others, argued that a missile defense should be built as rapidly as possible, "so it will be in place and not tampered with by future administrations."

Supporters of early deployment, however, had vastly underestimated the remaining technical barriers to construction of a system—not to mention the political and budgetary obstacles. The SDI Organization (SDIO) now recognizes that no substantial missile defense can be fully deployed before the turn of the century, and that estimate remains highly optimistic. But despite this longer time-horizon, the SDI program remains focused on moving toward rapid deployment of a limited "Phase I" missile defense.

The planned Phase I system would rely on two layers of rocket interceptors, designed to home in on Soviet missiles and destroy them by direct collision. In February 1990, SDIO announced that it had revised the design of this first-phase defense, replacing the earlier "space-based interceptor" concept with miniaturized space rockets known as "brilliant pebbles"—though the Defense Science Board, the Pentagon's top scientific advisers, had recommended against such a change only two months before, arguing that the brilliant pebbles design was still preliminary and unproven. (See "Brilliant Pebbles: A New Miracle Weapon?" p.32.) The revised Phase I system would include over 4,000 brilliant pebbles interceptors, designed to attack Soviet missiles in their boost and post-boost phases. These space-based rockets would be backed up by 1,500-2,000 long-range Exoatmospheric Reentry-Vehicle Interception System (ERIS) rockets (sometimes known simply as ground-based interceptors, or GBIs), designed to attack Soviet missile warheads in the midcourse phase of flight.

The system would also include a variety of sensors. High-orbit Boost Surveillance and Tracking System (BSTS) satellites would provide boost-phase detection and tracking, though SDIO Director Lieutenant General George Monahan has told Congress that BSTS is no longer strictly necessary, since the brilliant pebbles would theoretically be able to detect rising missiles on their own. Midcourse tracking would be carried out by Space Surveillance and Tracking System (SSTS) spacecraft along with rocket-launched infrared sensors (known as the Ground-based Surveillance and Tracking System, or GSTS), and ground-based radars. A complex network of computers and communications would link the system together. While SDIO now estimates the cost of this system as $55 billion, that figure is unrealistic, ignoring many of the substantial costs involved.

Fundamentally, the near-term technologies to be used in the Phase I defense are simply not up to the task of providing an effective missile defense. As described in this chapter, this first-phase defense is intended only to intercept 40 percent of a first-wave Soviet attack, giving it no substantial ability to protect the people of the United States. Instead, it is intended primarily to protect military targets, such as ICBM silos, bomber bases, submarine ports, and command centers.

Soviet countermeasures, however, could probably prevent the Phase I system from achieving even these limited goals. The low-orbit SSTS sensor satellites are likely to be extremely vulnerable to attack, as Monahan has himself warned, and the pebbles are also likely to be vulnerable to attack, though they will be more survivable than the previous space-based interceptors.

In addition, studies by the Lawrence Livermore Laboratory and the congressional Office of Technology Assessment indicate that even relatively small decreases in the length of the boost and post-boost phases of Soviet ICBMs, which could potentially be accomplished with straightforward modifications to existing missile designs, would drastically increase the number of space rockets required for an effective defense. George Miller, director of weapons programs for Livermore, told Congress in early 1988 that in a competition between space-based ABM rockets and Soviet responses, "responsive measures are very straightforward and in my opinion much cheaper the marginal cost tremendously favors the offense."

In the longer term, true fast-burn missiles would make space rockets such as brilliant pebbles completely obsolete. As then-SDIO Deputy Director Louis Marquet said in 1987, "fast-burn boosters . . . could rise up and deploy their vehicles before the kinetic energy interceptors could reach them."

Similarly, the ERIS layer of the defense could be overwhelmed by swarms of light decoys. The defense simply cannot afford to shoot every decoy the offense puts up, and finding the real warheads among a cloud of tens or hundreds of thousands of decoys is likely to prove a virtually impossible task.

Moreover, the ability of the leaky Phase I system to protect U.S. strategic forces depends on a concept known as "adaptive preferential defense." This tactic would conserve the defense's resources in two ways—first, by defending only a specific set of targets (such as missile silos or other chosen military sites), sacrificing everything else; and second, defending only those targets among the group to be protected that are being attacked by the smallest number of warheads, so that fewer interceptors are needed to defend each target. But the rapid swerves of maneuvering warheads—which the Soviet Union has the technology to develop in the near term—would make it impossible to tell which targets individual warheads were heading for, defeating this "preferential" tactic.

SDIO has acknowledged that such countermeasures would eventually overwhelm a Phase I defense. The only disagreement between SDIO and its critics is over *when* these counters would defeat the system: critics argue that near-term defenses would be obsolete virtually as soon as they were deployed. While SDIO now argues—without publicly available evidence—that these countermeasures will take many years to put in place, as recently as 1987 SDIO itself warned that if the Phase I system were delayed until the turn of the century, it "may not be effective." Yet that is precisely when it is now scheduled to be built.

SDIO's response to critics who point out the possibility of such near-term counters to Phase I is to argue that a Phase II system will be able to deal with them, and will be available within a few years after Phase I is deployed. But even if that were true—which critics strongly doubt—that argument raises an obvious question: If Phase II will be so effective and available so soon, why bother with Phase I at all? Why not just go straight to Phase II? In fact SDIO has been doing the opposite—drastically cutting back on planned spending for longer-term technologies in the rush to develop and deploy a Phase I system doomed to rapid obsolescence. In the Bush administration's budget request for Fiscal Year 1991, for example, more than three-quarters of all the requested growth in SDI funding would be devoted to Phase I technologies.

Testing and deployment of a Phase I defense would require abrogating the ABM Treaty, allowing the Soviet Union to deploy a defense of its own and touching off a long-term offense-defense arms race. In the end, to abandon the ABM Treaty for a Phase I system facing such fundamental technical and strategic problems would clearly undermine U.S. security, rather than enhancing it. (See Chapter X, "Nationwide Missile Defenses or the ABM Treaty?")

broad research program, ranging from lasers to radars, from computer software to rocket nozzles, from new lightweight materials to new microchips for electronic sensors. In many of these areas, the more than $20 billion spent on SDI to date has brought substantial technical progress, though the barriers to an effective nuclear defense remain staggering. (See "Technical Progress in SDI," p.37.)

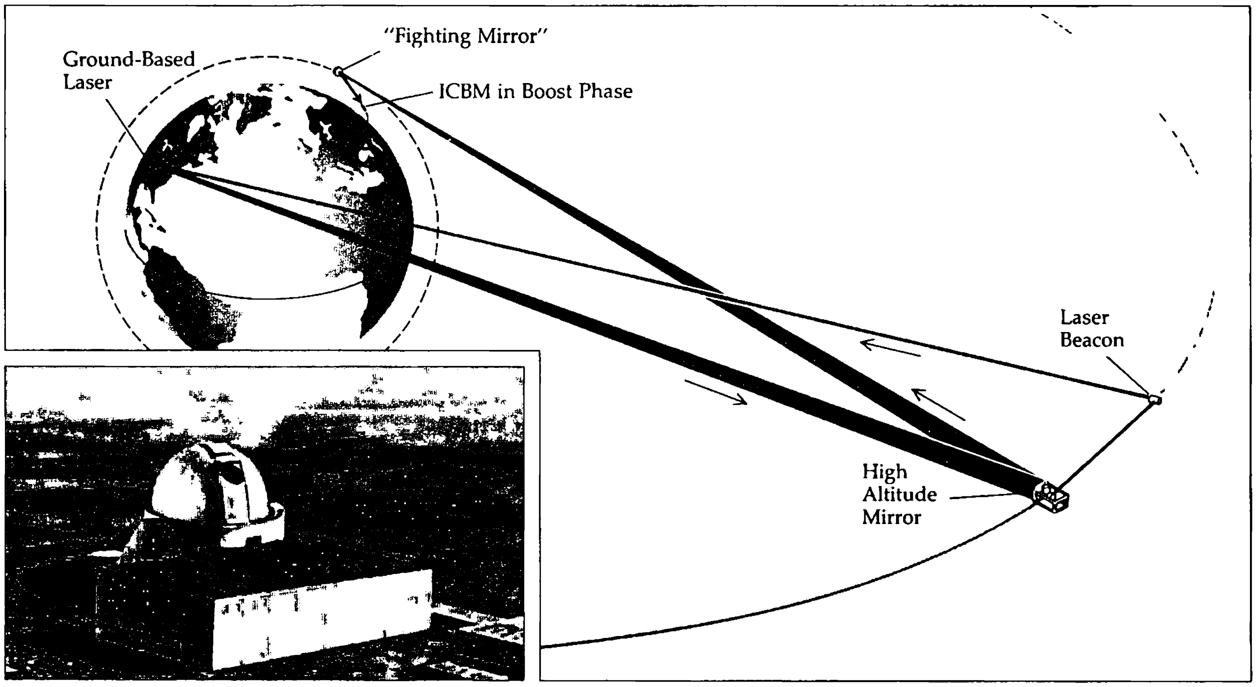
From its inception, the SDI program has focused on the concept of attacking Soviet ballistic missiles throughout their flight—a multilayered defense, reaching from the boost phase to reentry. (See "Phases of a Missile's Flight," p.26.) Advocates of such an approach argue that by combining a series of imperfect defenses, the overall system can reach a much higher degree of effectiveness. The best way to understand the technologies of SDI is to consider the technological obstacles facing each layer of the defense in turn.

The Boost Phase

The boost phase is a ballistic missile's most vulnerable moment. The fiery rocket plume is easy to detect, the large, vulnerable rocket is filled with explosive fuel, and intercepting one missile will destroy all of the nuclear-armed reentry vehicles (RVs) it may be carrying, along with any warhead-mimicking decoys or other antidefense countermeasures. SDIO has long emphasized that any effective defense against an advancing Soviet offensive threat will be "highly dependent" on success in the boost phase.

But boost phase defenses face major obstacles. First, time is short. The boost phase of the liquid-fueled Soviet SS-18 ICBM lasts for roughly five minutes, but newer solid-fueled missiles such as the SS-24 burn out in three minutes. Future "fast-burn boosters" might reduce the time available for boost-phase attack to well under a hundred seconds—a very short time to detect and attempt to intercept even a few nuclear-armed ballistic missiles, much less thousands of them.

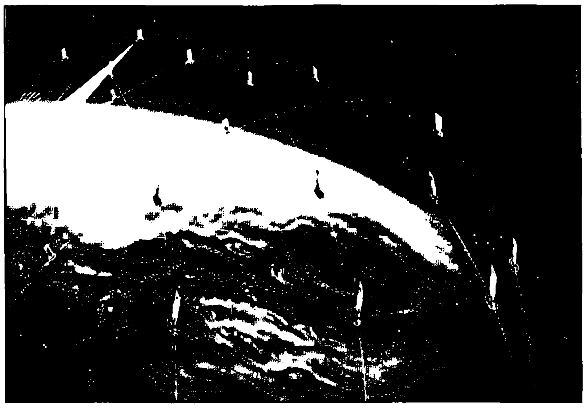
Second, to attack Soviet missiles as they rise over the Soviet Union, boost-phase weapons—or at least the "battle mirrors" to direct laser light on to Soviet missiles—must be based in space. (An alternative, "popping up" boost-phase weapons into space on warning of attack, would be easily defeated by faster-burning offensive rockets.) To be close enough to Soviet missiles to be effective, SDI weapon satellites would have to be placed in low orbits, where they would constantly circle the Earth. As a result, only a small fraction of them would be over the Soviet Union at any given moment: the precise fraction that could take part in the boost-phase battle depends on a variety of factors, particularly



Far-flung Beams: *One SDI concept envisions large ground-based free-election laser stations (inset) shining their beams up through the atmosphere to mirrors in geosynchronous orbit, at an altitude of 36,000 kilometers, which would reflect them to lower-orbit mirrors on the other side of the Earth. The lower orbit mirrors would then flash the laser beams on to Soviet missiles. This scheme involves extremely challenging technologies, and is still in the early stages of research.*

the range of the weapon in question. For near-term space-rocket defenses, roughly 10 satellites would have to be lifted into orbit for every one that would be in range of Soviet missiles at the moment of launch. Longer-term laser defenses, with their longer potential ranges, would reduce but not eliminate this "absentee ratio" problem.

Space basing also creates vulnerabilities. The defense satellites, orbiting alone or in small groups, regularly passing only a few hundred kilometers over Soviet territory, would be far more vulnerable to attack, overall, than the missiles they are intended to destroy—particularly as the satellites in many defense plans would be far fewer in number, and travelling in predictable orbits. (See below, "The Battle in Space.") This problem alone is so severe that it led Curtis Hines, department manager for systems analysis at the Sandia nuclear weapons laboratory, to conclude: "I think boost phase [defense] may be out of the question . . . Every time we look at it, it seems very difficult to ensure the survivability of space-based assets."



Smart Rock?: *The so-called brilliant pebbles concept, shown above, would involve over 4,000 miniaturized space rockets, designed to home in on Soviet missiles in the boost and post-boost phases of flight.*

Like other layers of defense, a boost-phase system would require both weapons and sensors. For the primary boost-phase detection and tracking role, most missile defense designs rely on satellites in "geosynchronous" orbit, 36,000 kilometers above the Earth, where the satellite's motion keeps pace with the Earth's rotation. These satellites would use infrared sensors to detect the blazing heat from the rocket boosters of Soviet missiles. The current concept for such satellites, a more sophisticated version of existing early warning spacecraft, is called the Boost Surveillance and Tracking System (BSTS). Additional lower-altitude sensors will be necessary in many defense concepts to provide more precise missile tracking and weapon control.

Several possible boost-phase weapons are being developed in SDI. The first-phase system would rely on space rockets, designed to home in on Soviet missiles and destroy them by direct impact. Similar concepts were examined in the improbably dubbed BAMBI project of the late 1950s and early 1960s, but were soon found to be beyond the reach of then-current technology, and vulnerable to offensive countermeasures. While substantial progress has been made in miniaturizing and reducing the cost of the components of such space rockets, critics argue that the concept faces many of the same fundamental problems today. (See "The Technology of Near-Term Deployment," p.28, and "Brilliant Pebbles: A New Miracle Weapon?" p.32.)

In particular, the range of such rockets is limited by how far they can fly before the target missiles release their warheads: as fast-burn boosters reduce the time available, the number of space rockets required rises dramatically, eventually making it impossible to maintain an effective defense—a point SDIO officials have long acknowledged.

One solution is to substantially increase the speed of the space projectiles by firing them from a device known as an electromagnetic railgun. (Such high-speed projectile technology might also be used for ground-based short-range missile defenses, or for new, more powerful tank guns.) Railgun development, however, has been slowed by substantial engineering obstacles, and now receives relatively little emphasis within the SDI program.

Instead, SDIO hopes to replace near-term space rockets with speed-of-light weapons such as lasers and particle beams, which could reach their targets almost instantly. Lasers would destroy Soviet missiles by heating the "skin" of their rocket motors until they failed, or by shattering the skin with the shock of intense laser irradiation. The atoms or subatomic particles of a particle beam would penetrate deep into the missile itself, damaging electronics or, at higher power levels, causing the missile to explode.

But these "directed-energy weapons" (DEW) remain unproven. An authoritative 1987 study by the American Physical Society (APS), the national physicists' professional organization, concluded that at least another decade of research was then needed to determine whether lasers and particle beams could provide an effective and survivable defense. The APS study warned that some potential countermeasures pose difficult obstacles, and that the survivability of DEW defenses is "highly questionable."

Research is being conducted on several possible DEW systems. For a Phase II missile defense, in the first decade of the twenty-first century, SDIO is hoping to build space-based chemical lasers. A "constellation" of

Brilliant Pebbles: A New Miracle Weapon?

Recently, SDI advocates have argued that a new variant on the concept of space-based ABM rockets, known as "brilliant pebbles," can quickly provide a cheap and effective defense. This concept has won public support from President Bush, and in February 1990, the SDI Organization (SDIO) announced that the basic design of the first-phase SDI system had been redrawn to rely on such "pebbles."

Such high-level enthusiasm is premature, for the brilliant pebbles concept—so called because the interceptors would be both smaller and smarter than previous interceptor concepts, which were sometimes known as "smart rocks"—remains in the very early stages of research. In a December 1989 study, the Defense Science Board pointed out that the brilliant pebbles design is still changing rapidly, and concluded that the concept faces a number of "critical issues" which will take a considerable time to address.

Moreover, the brilliant pebbles concept does not resolve the most fundamental problems of near-term missile defenses. The basic ideas of brilliant pebbles are quite similar in many respects to the "space-based interceptor" (SBI) concept that had previously been the planned space weapon for a Phase I defense. Both involve thousands of orbiting rocket interceptors, designed to home in on Soviet missiles and destroy them by direct collision, in the boost and post-boost phases of flight. There are three primary differences: Advocates of brilliant pebbles claim that the pebbles would be far smaller and cheaper than SBIs; each brilliant pebble would orbit individually, rather than being clustered in groups of 10 on space battle stations, as SBIs would be; and brilliant pebbles would theoretically be equipped with more advanced sensors and computers, allowing them to detect, track, and intercept Soviet missiles autonomously, without necessarily relying on other tracking satellites or detailed instructions from the ground—though such outside assistance would improve the brilliant pebbles' performance. Current concepts call for over 4,000 such weapons orbiting at altitudes of some 460 kilometers, though earlier proposals envisioned as many as 100,000 orbiting pebbles.

While the brilliant pebbles concept has brought forward some useful modifications to space-rocket designs, the basic idea is neither new nor particularly promising. In the late 1950s and early 1960s, the improbably dubbed BAMBI program (for ballistic missile boost-phase intercept) studied such autonomous, singly orbiting interceptors, but the project was canceled as too technologically demanding and too readily countered. In the SDIO's own past studies of designs for future missile defenses, each contractor reportedly examined and rejected such autonomous-rocket approaches.

Brilliant pebbles advocates argue that technological advances can overcome previous objections. But the claims being made on brilliant pebbles' behalf have an Alice-in-Wonderland quality, far removed from the world of serious engineering. When proponents first revealed the concept in 1988, it was claimed that each interceptor would weigh only five pounds and would cost only $50,000—nearly a thousand times less than the cost of the *cheapest* satellite now in the Air Force inventory, the NAVSTAR system. These claims were put forward even though each brilliant pebble was described as packed with a dazzling array of high-technology equipment, including a complex supercomputer miniaturized to the size of a cigarette pack, revolutionary sensors designed to provide very high resolution over a very wide field of view, rockets capable of accelerating the pebble to tens of thousands of kilometers per hour, and shielding to protect it from Soviet attack. Within a year, the weight estimates put forward by advocates had ballooned by nearly 20 times, and cost estimates by 10 times; the following year saw the high end of the cost estimate nearly triple again, to $1.4 million per interceptor.

Teams of engineers at Rockwell and Martin Marietta have been struggling to miniaturize and cut the costs of the earlier SBIs for years, but brilliant pebbles advocates continue to claim that their version of space rockets can be made substantially smaller, much sooner, and at a price-per-interceptor less than one-third the most optimistic estimates for the SBI system—though each brilliant pebble would be assigned far more advanced tasks.

Such claims are more salesmanship than serious technical judgment. As one SDIO technology officer put it, "There's no magic other than the marketing going on." Already, SBI engineers have begun to criticize the claims put forward by brilliant pebbles advocates, finding flaws in proposed brilliant pebbles designs. Claims for brilliant pebbles' low cost are based in large part on their supposed reliance on "off-the-shelf" technologies, but a study by JASON, a group of independent scientists the SDI Organization asked to study the brilliant pebbles concept, found that such readily available technologies would not be adequate, since they would be vulnerable to nuclear electromagnetic pulse (EMP).

Perhaps the remarkable claims for brilliant pebbles should not be surprising, for the strongest proponents of the concept are the same scientists who championed the X-ray laser in the early 1980s, telling top officials that a single X-ray laser weapon "the size of an executive desk" could potentially shoot down the entire Soviet missile force. As described in this chapter, the director of X-ray laser research at the Lawrence Livermore weapons laboratory resigned in protest over these misrepresentations, and the funding for the program has since been cut back. Moreover, these same scientists are now arguing that manned bases can be set up on the Moon and Mars within 10 years, for only $10 billion, a task NASA estimates will take 25 years and $400 billion. A recent report from the research arm of the National Academy of Sciences directly criticized this Mars claim.

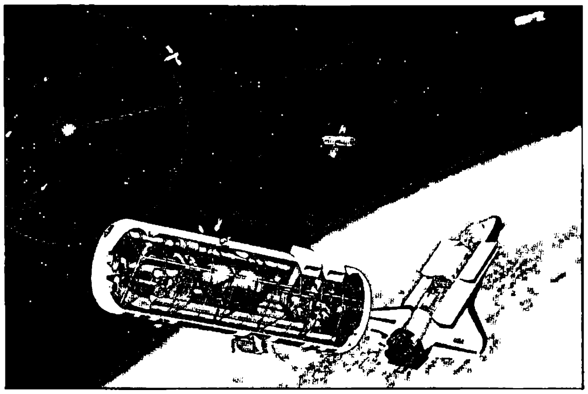
Whatever the credibility of current estimates of such parameters as weight, cost, and schedule, it should be remembered that brilliant pebbles are vulnerable to the same types of countermeasures as are other near-term defenses—another point reportedly described in detail in the still-classified JASON report. While the "singlet" missile concept offers substantially more survivability than SBIs clustered in groups of 10, it may still be vulnerable to attack. Scientists from Livermore itself, for example, have estimated that ground-launched antisatellite (ASAT) rockets might be able to shoot down the pebbles satellites for only one-fortieth the cost of the pebbles themselves. A 10-to-one ASAT advantage comes from the fact that the pebbles' low orbits would leave some 90 percent of them out of range of Soviet missiles at any given time, so the ASATs need only attack one-tenth of the pebbles orbiting the Earth to blow a hole in the defense. In addition, an ASAT reaching up from the ground would need only a fraction of the rocket mass required to place a brilliant pebble in orbit, accounting for the rest of the 40-to-one ASAT advantage. Moreover, the ASATs could rely on less complex sensors (while receiving instructions from the ground), and need not be equipped to survive for years in orbit. While survivability measures for brilliant pebbles such as maneuverability might even the balance sheet somewhat, it is unlikely they could overcome such an overwhelming initial advantage. Decoys for the brilliant pebbles satellites are unlikely to provide effective protection, as the complex and long-lived pebbles satellites are likely to be far more difficult to imitate cheaply and successfully than a missile warhead over only a few minutes of flight. In addition to such miniaturized rockets, brilliant pebbles might be attacked by ground-based lasers, where cheap power for burning through laser armor is readily available.

More fundamentally, brilliant pebbles would be defeated by fast-burn boosters, just as surely as the previous space-based interceptors would. Indeed, Los Alamos physicist Gregory Canavan, credited by chief pebbles proponent Lowell Wood as the originator of the idea, has acknowledged that if the Soviet Union introduced such fast-burning missiles "as rapidly as demonstrated Soviet technology would allow," such space rockets "would have little utility in the boost phase even when they were introduced."

The JASON group warned that here, too, the new technologies of defense can be applied to the offense as well: miniaturized rockets and guidance systems necessary for brilliant pebbles would also allow each warhead to carry its own guidance and propulsion—so-called "brilliant RVs," which could vastly complicate the problems of defense. Alternatively, each offensive missile could carry a tiny brilliant pebble of its own, to intercept defensive rockets before they reached the offensive missile.

In short, like other near-term defenses, brilliant pebbles could provide no lasting protection. Instead, abrogating the ABM Treaty to deploy such a system would only touch off an expensive and dangerous race of measure and countermeasure.

scores or hundreds of laser battle stations would be required—depending on each laser's capability and the total system effectiveness desired—each equipped with giant mirrors and tons of laser fuel for attacking Soviet missiles. SDIO estimates that each such laser battle station would weigh 220,000 pounds. Unless current satellite costs of roughly $10,000-$20,000 a pound are drastically reduced, each laser battle station would cost several billion dollars.



Particle Concept: *Space-based neutral particle beams would fire streams of hydrogen atoms at space targets. Such beams might be used for "interactive discrimination," sweeping over both decoys and warheads; heavier warheads would emit more radiation when struck by the beam, a distinction that separate sensors would observe.*

This space laser concept had a tumultuous history during SDI's first few years. After some initial enthusiasm, SDI studies pointed to the enormous cost of launching the lasers and fuel into orbit, and the vulnerability of the battle stations once in space. As Edward Teller, an ardent SDI supporter, put it: "Lasers in space won't fill the bill—they must be deployed in great numbers at terrible cost and could be destroyed in advance of an attack." In addition, Soviet construction of fast-burning missiles with surface shielding against laser attack could drastically increase the number or the power of the lasers required, further undermining the concept's cost-effectiveness. As a result, funding for such lasers was slashed. But since 1987, SDIO managers have recognized that no other directed-energy weapon is "mature" enough to be ready in time to back up the Phase I missile defense when it inevitably begins to lose effectiveness in the face of Soviet countermeasures. Hence, funding for chemical lasers has increased dramatically, though none of the fundamental problems identified earlier have been resolved. A major space laser experiment code-named Zenith Star is now planned for the late 1990s. (See Chapter VIII, "U.S. Compliance With the ABM Treaty.")

Neutral particle beams (NPBs) are another possible directed-energy weapon for the long term. Their beams would reach deep within a target missile rather than merely shining on its surface, making them difficult to guard against. But like chemical lasers, NPBs would require large, expensive, and vulnerable space platforms. Moreover, NPBs cannot pass far through the atmosphere, so a missile whose rocket burned out within the atmosphere could escape boost-phase attack. Currently, the emphasis in NPB research is more on use as a sensor for "discrimination" between warheads and decoys in the midcourse phase than on use as a boost-phase weapon. A major NPB space experiment called Pegasus is planned for the mid-1990s.

Another potential boost-phase weapon is the X-ray laser. If feasible, such lasers would be small and light, since they would be powered by nuclear explosions rather than conventional fuels. A single nuclear bomb, detonated in space, could theoretically power several separate beams, each attacking a different Soviet missile. The X-ray laser was the source of enormous early enthusiasm, with weapons physicist Edward Teller claiming that a single X-ray laser "the size of an executive desk" might someday defend against the entire Soviet land-based missile force. But the reality was far different, and Lawrence Woodruff, who then headed nuclear weapons work at the Lawrence Livermore Laboratory, including the X-ray laser program, resigned in protest of such distortions of its potential. Today, X-ray lasers remain in the early stages of research, their military utility still unproven, and funding for such research has been drastically cut back from earlier plans. If such research is eventually successful, X-ray lasers are now seen as far more likely to play an *offensive*, antisatellite role than to serve as an effective boost-phase missile defense, for the laws of physics create an offense-defense asymmetry: While X-ray beams cannot pass far through the atmosphere, a powerful X-ray laser could blast upward through the upper reaches of the atmosphere to attack a satellite from a rising rocket, more easily than a similar beam from the satellite could reach down into the atmosphere to intercept a missile. Testing such nuclear-driven lasers in space would violate not only the ABM Treaty, but the global Limited Test Ban and Outer Space treaties as well.

For the long-term future, SDI's leading boost-phase weapon is the free-electron laser (FEL), an advanced type of laser that could theoretically produce beams of great power with great efficiency. Considerable progress has been made in laboratory research on FELs over the last few years. Eventually, SDIO plans to develop high-power FELs with a wavelength capable of passing through the atmosphere, so that the FELs could be based on the ground, avoiding the tremendous cost and complexity of basing the huge laser and its fuel in space. (Space-based FELs are also possible, but have received much less emphasis to date.)

In this ground-based FEL concept, a ground-based mirror would shine the laser beam up through the atmosphere onto a huge mirror in geosynchronous orbit: complex adjustments in the shape of the ground-based mirror would be necessary scores of times each second, to adjust for atmospheric distortions. The geosynchronous mirror would reflect the beam to one of many "fighting mirrors" in low-Earth orbit, which in turn would reflect it onto a Soviet missile. Thus, within tens of seconds after the launch of a Soviet attack, a beam generated on a Colorado mountaintop might flash 36,000 kilometers into space and back again, flashing in a fraction of a second from one missile to the next, to destroy hundreds of Soviet missiles on the other side of the Earth within minutes. Such a beam would not work in cloudy weather, so a half-dozen or more separate laser sites would be required to ensure that at least one would have clear weather at the moment of an attack.

"In sum, given the state of present and foreseeable technology, a boost-phase or post-boost-phase intercept tier is not a realistic prospect in the face of likely offensive countermeasures and the vulnerability of those tiers to defense suppression."

—Harold Brown, 1985
Former Secretary of Defense

Needless to say, such a scheme involves a variety of extremely challenging technologies. The APS study concluded that much of the basic physics of the concept remained unproven, and questioned the survivability of both the necessary space-based mirrors and the ground-based FELs themselves, which would be both expensive and too large to hide or harden effectively. Even the basic question of whether a sufficiently high-power laser beam could get through the atmosphere has not yet been answered, and will not be for years to come. What has worked in the low-power atmospheric compensation experiments conducted to date may not work at the power level and frequency needed for a FEL weapon, because of the effects of such a high-power beam on the atmosphere itself, including the distortions caused by the heating of the air by the beam—a problem known as "thermal blooming."

In short, for the critical boost phase of a possible defense system, SDIO is relying in the near term on space-based rockets that even high-level SDIO officials have acknowledged could soon be countered; in the medium term on space-based lasers that SDI's strongest supporters have acknowledged would be vulnerable to attack; and in the longer term on concepts whose basic principles remain unproven, and may themselves prove vulnerable to attack or countermeasures—or may prove more suitable for offensive than defensive purposes.

The Post-Boost Phase

In current missiles, the post-boost phase lasts for several minutes after the missile's main rocket ceases firing, as the missile's "bus" releases its warheads and decoys. The sensors, weapons, and tactics of the post-boost phase are similar to those of the boost phase of flight, except that the small intermittently burning rocket of the bus is more difficult to detect and track than the missile's main rocket, and the bus becomes a progressively less valuable target as more and more of its reentry vehicles are released. A fast-burn booster that avoided interception in the boost phase might still be attacked in the post-boost phase of flight, unless the post-boost phase were also drastically shortened. Engineering studies indicate, however, that future modifications could greatly reduce the time required for releasing warheads in the post-boost phase. (See below, "The Responsive Threat.")

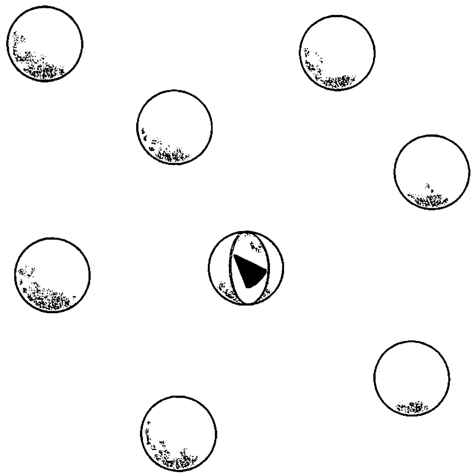
The Midcourse Phase

After the few minutes of the boost and post-boost phases, the reentry vehicles are released from the missile and coast through space, in the "midcourse phase" of the missile's flight. Midcourse defenses have much more time to operate than boost or post-boost defenses—typically some 20-25 minutes for an ICBM—but they must deal with a far larger number of targets as well, since each missile can potentially carry 10 or more RVs and hundreds of warhead-mimicking decoys. The need to detect, track, and identify hundreds of thousands of objects in less than half an hour poses an enormous challenge to the design of midcourse sensors and battle-management systems—particularly as the cold RVs and decoys emit tens of thousands of times less detectable energy than a burning missile rocket.

RVs and decoys might be tracked during the midcourse by a complex of several different kinds of sensors, including infrared sensors, radars, or laser radars. These would be based on satellites, on rockets launched into space during the attack, on aircraft, or on the ground. Current plans call for a variety of sensors working together. The satellite component of the midcourse sensor suite, however, is critical to most missile defense plans, and such large, expensive space-based sensors may be vulnerable to attack. SDIO Director Lieutenant General George Monahan has referred to the Space Surveillance and Tracking System (SSTS) satellites called for in current near-term missile defense plans as "fat, juicy targets," acknowledging that "we have a dependency here that I'm not real wild about."

To intercept RVs once they had been tracked and identified, both near-term and long-term plans rely on long-range ground-based missiles, called the Exoatmospheric Reentry Vehicle Interceptor System (ERIS). (Since ERIS is the version of this missile built by Lockheed, and the program has now been opened to competition, SDIO now often calls the overall idea simply the Ground-Based Interceptor or GBI.) Past ABM systems have used nuclear warheads on such long-range interceptors to ensure destruction of the incoming RV, but ERIS would be non-nuclear, using infrared sensors to home in on Soviet RVs and destroy them by direct collision. For a "thick" nationwide defense, thousands of such ERIS missiles would be necessary.

Hiding Warheads Inside Decoys



Decoy Dilemma: *In addition to designing decoys to look like warheads, warheads could be made to look like decoys, in a technique known as "antisimulation." For example, each warhead might be enclosed in a foil balloon, accompanied by dozens of virtually indistinguishable empty balloons.*

The critical problem in the midcourse is finding the real attacking RVs among the clouds of decoys and other "penetration aids" that accompany them. The APS study concluded that the offense could replace a single warhead on a missile with as many as 100 credible decoys, for the same weight—and since the Department of Defense estimates that the heavy Soviet SS-18 ICBM already has the capacity to carry four more warheads than it now does, each SS-18 could potentially carry as many as 400 decoys, without sacrificing any of its warheads. Studies have suggested that a massive Soviet attack in the future could include as many as a million decoys—a "threat cloud of frightening proportions," in Abrahamson's words, making "discrimination" between RVs and decoys "essential for effective ballistic missile defense."

But a variety of independent and Defense Department studies have concluded that such discrimination is likely to be extremely difficult. In 1987, for example, the Defense Science Board, the Defense Department's top panel of scientific advisers, questioned whether infrared sensors such as those planned for Phase I could discriminate RVs from "anything but the most primitive decoys and debris." Similarly, in 1986 then-SDIO Director Abrahamson acknowledged that infrared sensors and radars alone could not do the job, arguing that "interactive discrimination"—using particle beams or lasers to probe the RVs and decoys—"is a requirement." But for the first phase defense, no such interactive discrimination is planned.

For the longer term, SDIO envisions lasers or particle beams that would sweep over the cloud of incoming objects, and sensors that would observe the different reactions of RVs and decoys: lighter decoys, for example, would recoil more rapidly when "tapped" by a laser, and would give off far less radiation when struck by a particle beam.

For the moment, such interactive discrimination concepts are still little more than theoretical ideas. Moreover, some important objections have already been raised. The neutral particle beam concept, for example, which is the leading contender in current SDIO plans, depends on detecting radiation, and the detectors might be swamped by the radiation from nuclear blasts. And like a boost-phase defense, the scheme would require large, expensive space-battle stations, which might be highly vulnerable to attack.

In short, the problem of discriminating RVs from decoys in the midcourse phase is by no means solved—it remains a fundamental problem of defense against strategic ballistic missiles.

Terminal Defense

Of all the types of missile defense, terminal-phase defenses—intercepting attacking RVs as they streak through the atmosphere toward their targets—are best understood. Terminal defenses would be primarily ground-based, avoiding the complexity and vulnerability of space basing that bedevils boost-phase

Technical Progress In SDI

Many of the research programs sponsored by the SDI program have made significant technical progress—as would be expected after the expenditure of some $20 billion. This progress, while impressive in many respects, has been evolutionary rather than revolutionary, building on the two and a half decades of ballistic missile defense research carried out in the United States before SDI began.

The most substantial technical achievements in the SDI program can be divided into five general areas:

Miniaturization and Cost Reduction. SDI research has made excellent progress in shrinking and reducing the cost of a wide array of potential ABM technologies. Perhaps the most remarkable examples are in inertial guidance systems, where research in SDI and other programs has reduced the necessary weight—one driving factor in the size and cost of defensive interceptors—by more than 10 times. Painstaking engineering has also succeeded in substantially shrinking the size of space-rated computers, sensors, and maneuvering rockets.

Directed-Energy Weapons. SDI research has produced impressive advances in several directed-energy weapons (DEW) technologies, and has also provided a clearer understanding of the remaining roadblocks to an effective DEW defense. Progress in free-electron lasers has been particularly striking: huge increases in laser power have been achieved, as have impressive laser efficiencies. Headway has been made in other DEW areas as well, with significant increases in particle beam power; the first-ever operation of a particle beam in space; solid advances in beam pointing and retargeting approaches for both lasers and particle beams; and continued developments in laser mirror technologies, from adaptive optics for adjusting laser beams to compensate for the distortions of the atmosphere to reduced-cost techniques for fabrication of large mirrors.

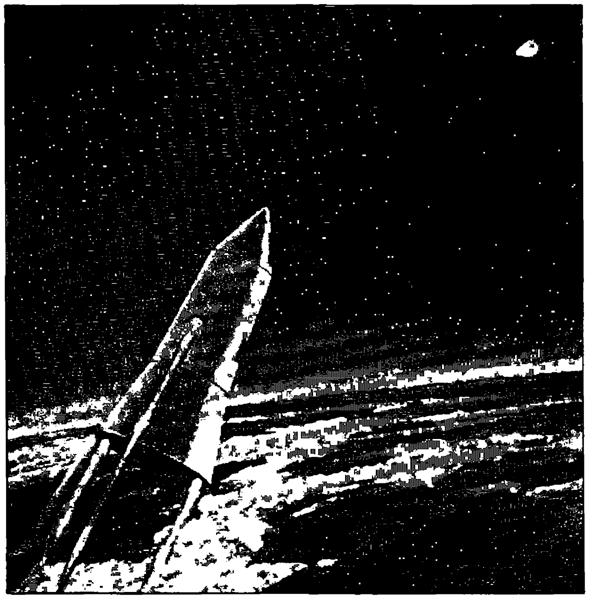
Data Collection. When the SDI program began, much of the most basic information needed to design a space-based missile defense was unavailable. SDI experiments have collected voluminous data on what burning missile rockets look like in space, on the sensor "signatures" of warheads, decoys, and other objects, and on the background radiation likely to be faced by missile-defense sensors. However, many of these phenomena would be drastically altered by high-altitude nuclear blasts, and questions of what sensors would see in the actual environment of a nuclear war cannot be fully addressed without violating the Limited Test Ban Treaty.

Sensor Fabrication. Building the sensors needed for an SDI system continues to pose substantial difficulties, but SDI research has made considerable headway. Larger, more capable infrared sensors have been built than ever before, and the number of electronic elements that can be put in the sensor focal plane array—a major determinant of the sensor's capability—has been substantially increased. More importantly, old focal-plane production techniques were so rife with difficulty that as few as one percent of the circuits produced were usable; new techniques have substantially increased production yields, potentially lowering the cost of future SDI sensors.

Kinetic-Energy Weapon Demonstrations. While few SDI critics doubted that it was possible to home in on a missile for a direct collision, full-scale demonstration of such "hit-to-kill" interceptors was a significant engineering step. The 1984 Homing Overlay Experiment, for example, directly smashed a reentry vehicle in space for the first time, while other interceptors have demonstrated similar interceptions of short-range tactical missiles within the atmosphere.

This is by no means an exhaustive list of the progress made in SDI research, or in other relevant programs. Headway has also been made in fields ranging from battle management to survivability concepts. The advances described above are only a few of the most striking.

Despite this progress, the barriers to effective defense posed by the fearsome destructive power of nuclear weapons remain overwhelming. Indeed, many of these advances are double-edged swords: Technology that can make a defensive interceptor cheaper and more effective can also be applied to make an offensive missile cheaper and harder to intercept. Technology will always advance, but there is no evidence that such advances will favor the defense over the offense.



Terminal Defense: *The High Endoatmospheric Defense Interceptor (HEDI) would intercept warheads after they reentered the atmosphere. By then, some decoys would have been stripped away by atmospheric drag. HEDI is not part of current designs for a Phase I missile defense, but might be included in a revised design or deployed later.*

concepts. The decoy problem faced by midcourse defenses would be greatly reduced by atmospheric drag, which would quickly strip away all but the heaviest and most sophisticated decoys.

However, it is widely acknowledged that terminal defenses alone cannot protect cities from a large-scale nuclear attack. Unless nearly all of the RVs in a major attack had been destroyed by previous defensive layers, a defense operating only in the last minute of flight would be quickly overwhelmed. Terminal defenses also face daunting countermeasures. Nuclear blasts from attacking warheads could create zones of "black-out" that would interfere with radars and other sensors. The radars themselves might be attacked—one of the critical weaknesses of the Safeguard ABM 20 years ago. Some types of decoys can successfully mimic warheads deep into the atmosphere, albeit at a substantial price in additional weight and complexity. And maneuvering reentry vehicles (MaRVs), which can zigzag to confuse defense interceptors as they speed through the atmosphere, would pose additional problems.

To defend cities or other "soft targets" unprotected from nuclear blasts, RVs must be intercepted at high altitude, so that if they explode when attacked (so-called salvage fusing) they will still not destroy their targets. On the other hand, a terminal defense designed only to protect hardened targets such as buried concrete missile silos can afford to rely on a less expensive close-in defense using short-range interceptors, since an attacking weapon would have to get within a few hundred yards of the target to destroy it. This also allows the defense to overcome some of the most obvious and effective countermeasures. (See Chapter XI, "Other Options for SDI.")

SDI has not focused on such close-in defenses, centering research attention instead on wide-area defenses using a high-altitude missile called the High Endoatmospheric Defense Interceptor (HEDI). Like ERIS, HEDI would be non-nuclear, designed to destroy incoming RVs by direct collision—"hit-to-kill." Tracking and discrimination for the terminal layer of defense would be provided by some of the same sensors that might operate in the latter stages of a midcourse defense, such as airborne infrared sensors (being developed in a project known as the Airborne Optical Adjunct) and ground-based radars.

Putting the Layers Together

An effective defense requires more than the myriad individual components and technologies described above. It requires pulling these together into an overall system, commanding the system, launching parts of it into space, and testing it. Many experts regard these "system integration" problems as the most daunting tasks facing the SDI program.

Command and Control. An SDI defense would involve a worldwide network of thousands of elements—all of which must work together in seconds or minutes, in the midst of an all-out nuclear war, with many parts of the system itself under direct attack. The task will require the development of new types of computers and communication systems. And it will require handing over most of the management of the battle to computers—there is too little time for much human decision-making.

A variety of approaches have been suggested for commanding such a global system. At one extreme, represented by current brilliant pebble concepts, each element might be largely autonomous, intercepting missiles after receiving a "go" command without extensive coordination with other elements of the system. At the other extreme, every action of the far-flung network of the system might be directed from one or a small number of command centers. The first approach would sacrifice efficiency to achieve simplicity, since without coordination some missiles would be attacked more than once, and others not at all. The other approach would be highly efficient, at the price of greater complexity and vulnerability to attack on or failure of the coordination centers. The operation of a future SDI system would probably fall somewhere between these extremes.

Coordinating such a global system is likely to pose extremely difficult problems. Managing the SDI battle by computer will require incredibly complex new computer programs, or software—a task, according to SDI's Fletcher Commission, "that far exceeds in complexity and difficulty any that has yet been accomplished in the production of civil or military software."

Such large and complex programs are notoriously unreliable when first introduced. No matter how talented the programmers who write them, or how intense the testing and simulation they undergo before use, "bugs" inevitably turn up in operation. Only after extended use and modification in a genuine operational environment do large programs achieve reliability. But the software systems for SDI would have to "work" the first time they were actually used, in the midst of an all-out nuclear war, while the system itself was under attack. Computers can "simulate" possible battles, and thereby help find many software problems —but such simulations can never root out all likely bugs, because they rest on assumptions about the specific tactics and weapons an attacker might use. And in a genuine attack, the unexpected is bound to happen.

Because of these apparently insurmountable problems, engineer David Parnas, who had devoted much of his career to the development of military software, resigned from SDIO's Eastport Panel on computer software, arguing that software for SDI could never be adequately tested and therefore could never be trustworthy. In 1988, the nonpartisan congressional Office of Technology Assessment (OTA) came to a similar conclusion, arguing that "there would be a significant probability that the first (and presumably only) time the BMD [ballistic missile defense] system were used in a real war, it would suffer a catastrophic failure."

Moreover, SDI's specific command and control efforts have been plagued with difficulties. In early 1988, the recently retired head of command and control for the Department of Defense, Donald Latham, called SDI command and control "a total and complete disaster," saying: "We spent $600 million and have nothing to show for it. We can't show, except for what I call viewgraph engineering, how it is supposed to work even for Phase I."

Space Launch. SDI managers have conceded that with space-launch costs currently over $3,000 a pound, the millions of pounds of space equipment necessary for the defenses planned for the long-term future simply cannot be economically lifted into space with existing rockets. SDIO is relying on development of an "Advanced Launch System" (ALS), which it is hoped might reduce launch costs by as much as 90 percent. But few experts expect the projected 10-fold reduction in launch costs to be achieved: similar promises were made in the development of the Space Shuttle, but it has proved even more expensive than previous systems. And budget cutbacks have now ended ALS design work, with the program retrenching to focus only on the engines such a rocket might someday need.

Testing. Any missile defense system would have to be extensively tested. Tests would range from laboratory experiments examining tiny subcomponents of an eventual defense to major space tests involving the interception of genuine ballistic missiles. But the final *system*, the interaction of the global network of sensors, interceptors, and command and control equipment, could not be tested in anything like the operational environment of an all-out nuclear war. The same is true of existing offensive strategic forces—but in that case, even if some weapons might fail, the rest pose a daunting deterrent. In the case of missile defenses, failure of a few critical elements of the system could cause the entire system to collapse. If the boost-phase defense fails to operate as expected, for example—perhaps because of an unexpectedly successful Soviet tactic for attacking the boost-phase defense satellites—far more RVs and decoys would reach the midcourse layer of the defense than planned, overwhelming the midcourse phase, whose failure would then overwhelm the terminal defense.

> ***"SDI remains, at best, a collection of hopes and technical experiments. . . . The TV networks can present the animations or animated cartoons (which they mislabel 'news') showing laser beams zapping Soviet missiles during the boost phase. For the moment, that all remains the gleam in the eyes of some technologists—a combination of Buck Rogers and P.T. Barnum."***
>
> *—James Schlesinger, 1989*
> *Former Secretary of Defense*

Most important, one must always keep in mind that unlike other complex systems, such as the telephone network, a missile defense must operate against a clever adversary determined to make it fail. The Israeli invasion of Lebanon provides a telling analogy: the Syrian forces were equipped with Soviet air defense missiles, which had "proven" their effectiveness with extended peacetime testing and considerable combat experience. Yet with innovative technologies and tactics such as radar jamming, the Israelis were able to completely confuse the Syrian defenses, leaving Israeli aircraft to swoop in and destroy the entire system without losing a single plane. The lesson is clear: A system that "works" in peacetime tests, no matter how rigorous, can still fail dismally in the face of an unexpectedly wily enemy. And the fearsome power of nuclear weapons gives the attacker a dramatically greater advantage.

In the end, to shift U.S. strategy to reliance on ballistic missile defenses would mean relying on a vast "system of systems," of unprecedented complexity, whose most important functions could never be realistically tested. If the system did not work the first time, it would never get a second chance.

THE RESPONSIVE THREAT

The Soviet Union will attempt to overcome U.S. defenses—that, if anything, seems certain. SDIO officials acknowledge that Soviet countermeasures would soon defeat a Phase I missile defense, but argue that by then more effective Phase II technologies would be available, to be replaced in turn by Phase III, and so on. In essence, SDI managers argue that U.S. defenses will stay ahead of ever-changing Soviet offenses, in a never-ending race—despite the enormous destructive power of nuclear weapons, and despite the huge head start the offense now has, with hundreds of billions of dollars worth of offensive missiles already deployed, and no missile defenses yet in place. Others are not so sanguine.

A variety of means are available for countering boost-phase defenses, the most critical link in U.S. long-term defense plans. The most obvious is to attack and destroy the defense satellites themselves. (See below, "The Battle in Space.") In addition, the boost phase itself

"There's no way an enemy can't overwhelm your defenses if he wants to badly enough."
—Richard DeLauer, 1989
Then Undersecretary of Defense

can be shortened from current times of three to five minutes, giving boost-phase defenses less time to operate. Studies indicate that even a moderate decrease in missile "burn time"—achievable with modifications of existing missile designs, rather than entirely new technology—could greatly reduce the effectiveness of the space-based interceptors or brilliant pebbles planned for the first-phase defense. (See "The Technology of Near-Term Deployment," p.28.)

Larger decreases in burn time would require new rocket designs. Studies done for SDIO at Lockheed and elsewhere indicate that using known propellant technologies, missiles can be designed to burn out in 60-80 seconds, at an altitude of 80-100 kilometers, while reducing the missile's payload by only 20 percent. The Defense Intelligence Agency (DIA) has reportedly estimated that the Soviet Union could begin deploying fast-burn boosters within seven years after a decision to do so, and then-SDIO Deputy Director Louis Marquet made an identical estimate in 1987—meaning that planned near-term boost-phase defenses might be obsolete as soon as they were deployed. Since the Soviet Union regularly replaces its nuclear missile force with new designs, and there is little evidence that such "fast-burn boosters" would cost dramatically more than other possible replacements, the added cost of building a substantial force of such missiles could be relatively small.

Such fast-burn boosters would make it impossible for weapons that cannot penetrate the atmosphere effectively—such as neutral particle beams and X-ray lasers—to attack missiles in the boost phase. Even for weapons that can theoretically penetrate the atmosphere, such as free-electron lasers or space-based chemical lasers, the APS study concluded that fast-burn boosters would create "extreme demands," requiring drastic increases in the rate at which targets could be attacked, or the number of battle stations required. Overall, such fast-burning missiles are one of "the most worrisome countermeasures," according to Richard Wayne, director of component and systems research at Sandia National Laboratory, posing "a very significant challenge to boost-phase attack."

An attacker would also seek to reduce the length of the post-boost phase. Again, while the post-boost phase of current missiles like the SS-18 lasts some five minutes, studies indicate that this time can be reduced significantly by relatively straightforward modifications. In the longer term, missiles could be redesigned to release their RVs and decoys almost instantaneously, perhaps by abandoning the concept of a large bus dispensing RVs and decoys and instead equipping each RV with its own tiny rocket and decoys—an approach considered briefly in the 1960s when MIRVs were being developed. While such missile designs would add complexity and expense, the costs and technological barriers appear far less than those facing development of a multilayered missile defense.

Other potential countermeasures to boost-phase laser attack include rotating the missile to prevent the laser beam from focusing on a single spot, or adding a layer of laser armor to the missile. The APS study characterized both these approaches as "relatively simple," concluding that they could potentially be added to existing missiles and would substantially increase the difficulty and cost of some types of laser defenses. In addition, the offense can "cluster" missiles in a small area, so that only a few orbiting defense battle stations would be within range during the few minutes of an attack: such clustering costs the offense little, particularly in the case of mobile missiles.

In the midcourse phase, an entirely different set of potential countermeasures comes into play. As described earlier, each missile may release hundreds of decoys to confuse the midcourse defense. In space, with no atmospheric drag, light decoys and heavy RVs would travel the same paths at the same speeds, indistinguishably. Not only can the decoys be made to look like RVs, but the RVs themselves can be made to look like decoys—a technique known as "antisimulation." (As physicist Richard Garwin once put it, "If you want to prevent assassination, it's cheaper to dress the king as a beggar than to dress a hundred beggars as kings.") For example, each RV could be enclosed in a spherical aluminum-foil balloon, accompanied by hundreds of similar empty balloons, each with a tiny battery to provide the same small amount of heat as that given off by the room-temperature RVs. To the naked eye, to infrared sensors, and to radar, all the balloons would appear identical, whether they contained an RV or not. To confuse matters further, each balloon could be painted or shaped differently, or given a different temperature, regardless of its contents.

Pointing to data from the February 1988 Delta 181 experiment, SDI supporters have argued that radars might be able to observe the different external "wobbles" of decoys and warheads. But the scheme of placing the warheads inside decoy balloons would likely obscure such differences, and if a further counter to such discrimination is needed, waving aluminum-foil strips attached to the outside of the decoys could cover any "wobble" effects.

In addition to decoys, the offense may use nuclear explosions to blind the sensors, aerosol clouds in space to confuse infrared sensors, thousands of radar-reflecting wires known as "chaff" to stymie radars, or may jam or attack radars and sensor satellites. If "interactive discrimination" techniques are ever developed, further sophisticated countermeasures are likely—such as the waving aluminum-foil strips described above, which could thwart efforts to measure precisely how rapidly a decoy or RV moves when "tapped" by a laser pulse. If fast-burn boosters require releasing some decoys while the missile is still rising through the upper atmosphere, tiny retro-rockets might be attached to the RVs, to slow them down just as much as the last wisps of atmosphere slow down the decoys.

Submarine-launched missiles using so-called depressed trajectories—much faster, lower flight paths achieved at the price of using more fuel for a given range—also pose a potent antidefense countermeasure. Such depressed trajectories would substantially shorten missile flight times, and the missiles would spend very little time in space, reducing the opportunities for midcourse defense. Moreover, such missiles would not appear "over the horizon" of ground-based radars used in midcourse and terminal defenses until moments before impact, because of their low flight. Both superpowers have the necessary technology to develop such depressed-trajectory missiles, but with the ABM Treaty preventing deployment of substantial missile defenses, neither side has yet chosen to do so.

"The problem that confronts us in solving the ballistic missile defense system has been likened to both the Manhattan Project and the Apollo Project. I do not believe that this is a particularily apt analogy . . . we did not have to worry about the moon moving out of its orbit to dodge us, hiding by some stealth technology, or shooting back as we approached."

—Louis Marquet, 1987
Then Deputy Director of SDIO

Similarly, the terminal phase faces countermeasures that will become more sophisticated as time goes by. The United States has been flight-testing maneuvering reentry vehicles (MaRVs) designed to zigzag to confuse enemy defenses for over two decades, and plans to test even more sophisticated, high-acceleration designs in the 1990s. The Soviet Union has not yet tested MaRVs for its strategic missiles, but has the basic technology required to develop them—particularly since U.S. terminal defenses would not be deployed until well into the twenty-first century, under current plans. And the Soviet Union could soon emulate the sophisticated decoys and radar jammers developed by the United States for use against terminal defenses.

In short, the technology of offensive countermeasures is likely to improve continually, just as the technologies of defense will. Indeed, many of the technologies being developed in SDI are double-edged swords: what makes a defensive interceptor cheaper and more effective is likely to do the same for an offensive missile. A recent study of brilliant pebbles commissioned by SDIO, for example, pointed out that the same technologies, if feasible, could be used to create devastating countermeasures, including "brilliant RVs," warheads which could maneuver in space to foil defenses. But few of the likely offensive countermeasures involve technological difficulties or likely costs even approaching those of multilayered defenses against nuclear missiles.

The substantial arsenal of technical and tactical responses available to the offense poses virtually insurmountable barriers to achieving Nitze's criterion of cost-effectiveness at the margin. As former Secretary of Defense James Schlesinger has said, "The cost ratio between defense and offense is still strongly weighted against defense and will remain so." SDIO has yet to explain why it believes the opposite—that it will take longer and cost more for the Soviet Union to develop missiles that burn slightly faster, or that release aluminum-foil balloons, than it will for the United States to develop and build a global, high-technology defensive system. We must recognize that despite all the recent changes, the Soviet Union remains a determined and powerful nation, certain to act to protect the power of its offensive strategic deterrent. As Senator Sam Nunn joked in early 1988, "Some fervent SDI cheerleaders, in their effort to sell early deployment, are trying to convince us that we are in a contest with the Little Sisters of Mercy, rather than the evil empire."

THE BATTLE IN SPACE

Deployment of either near-term or long-term SDI systems would mean relying on weapons and sensors in space. But defense satellites are likely to be extremely difficult to protect against offensive attack. Unlike missiles, which can be launched in great numbers at any moment on trajectories chosen by the attacker, satellites in most missile-defense plans are likely to be comparatively small in number, high in cost, and travel in predictable orbits, day after day, allowing a potential attacker to choose the moment and place to attack. Moreover, in the low-Earth orbits necessary for SDI weapons, only a small fraction of the orbiting satellites would be over the Soviet Union and able to participate in the critical boost-phase battle at the moment of a mass attack. Destroying those few satellites could punch a hole in the defense for offensive missiles to go through. Hence, disrupting a space-based defense through antisatellite (ASAT) attack is likely to be an easier and cheaper job than intercepting missiles in a large-scale nuclear strike.

The possible means of attacking satellites are even more varied than the means of intercepting missiles described above. Ground-launched rockets carrying nuclear weapons already pose a potent threat. Soviet nuclear ABM interceptors such as the Galosh, for example, could use their huge nuclear warheads to destroy satellites over a wide area. While a satellite could be hardened to some extent against the effects of nuclear blasts, a sufficiently nearby detonation would still destroy it. Alternatively, ground-based rockets could be designed to smash satellites by direct impact, much as SDI's long-range interceptors would do to warheads, an approach that could potentially reduce the size and cost of the necessary rockets. SDI supporters argue that attacking rockets could be intercepted—but even more than long-range missiles, such rockets in the future are likely to be hardened, fast-burning, and carry dozens of decoys.

Rocket Attack: *Ground-based rockets could attack defense satellites, releasing a homing warhead and a cloud of decoys to make the antisatellite (ASAT) weapon difficult to intercept. Future ASATs may also be fast-burning and maneuverable, yet are likely to be substantially cheaper than defense satellites.*

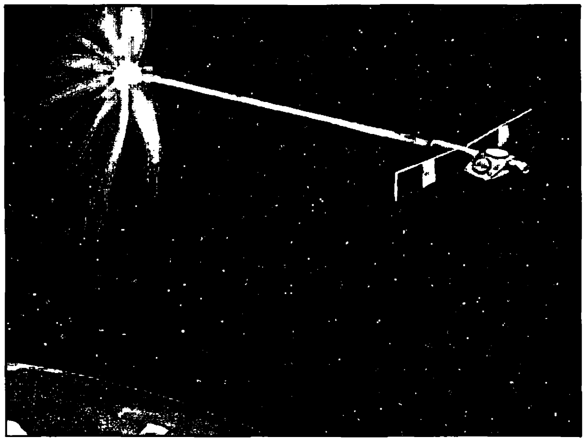
Space mines—small, comparatively simple satellites that could be placed in orbits close to defense satellites and designed to explode on command—also create substantial survivability questions. The basic technology needed for such mines already exists. While space mines could probably not remain secret, little could be done about them short of destroying them—and relying on such an antimine attack would create a highly unstable situation, with enormous pressures to strike first in a crisis.

The technologies of space-based defenses themselves would pose particularly deadly threats to satellites. Because the space battle stations are likely to be fewer in number and less hardened to attack than reentry vehicles, for example, technological developments in SDI are likely to create powerful antisatellite weapons long before they provide effective defenses. As former Secretary of Defense Harold Brown put it, "Everything that works well as a defense also works somewhat better as a defense suppressor." As a result, SDI research is rapidly sowing the seeds of its own defeat—the technologies of ASAT weapons that are likely to make it prohibitively expensive and difficult to protect defense satellites from attack.

SDIO argues that for every threat to space-battle stations, there will be a counter to protect them. Satellites could be hardened, maneuverable, capable of shooting back at ASATs, and so on. But for every defensive counter, there will be an offensive response, setting off yet another branch of the technological arms competition. And with small numbers of expensive, predictably orbiting defense satellites, ASAT attacks on a space-based defense are likely to remain far easier than the defense's own mission of stopping a massive ballistic missile attack. Edward Teller summed up the problem in 1983 congressional testimony: "I believe we should not deploy weapons in space . . . To put objects into space is expensive. To destroy space objects is relatively easy."

Moreover, the inherent overlap between "defensive" and "offensive" space weapon technologies raises substantial dangers of its own. If both sides deploy space-based directed-energy weapons such as lasers, either side's defense satellites could be attacked at the speed of light, with no warning—creating what one SDI official described as "the re-enactment of the 'Shootout at the OK Corral.'" Shockingly, OTA found that "SDIO and its contractors have conducted no serious study of the situation in which the United States and the Soviet Union both occupy space with comparable BMD systems," a situation which "could place a high premium on striking first at the other side's defense," increasing the risk of nuclear war.

Some space weapons might have other offensive capabilities as well. Free-electron lasers, for example,



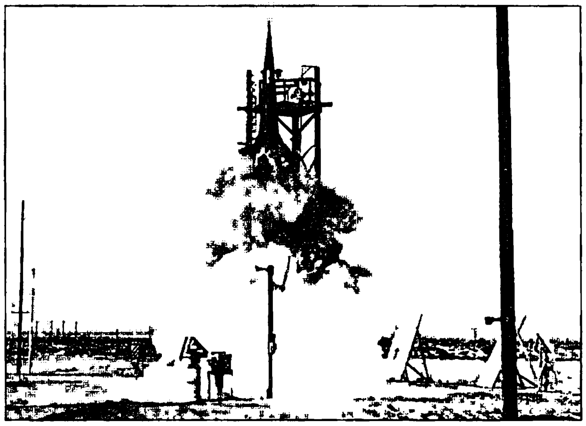
Beam Threat: *Space-based directed-energy weapons would be more effective in destroying predictably orbiting satellites than in defending against a missile attack, threatening the survival of space-based missile defenses.*

would theoretically be able to shoot down through the atmosphere to attack aircraft or ground targets. Such lasers could potentially set dozens or hundreds of fires, putting targets such as oil refineries or exposed individuals in jeopardy of speed-of-light attack from space. Such weapons in Soviet hands would raise a host of troubling security issues. In short, putting weapons in space—even ostensibly "defensive" ones—could create an entirely new dimension of warfare. The potential dangers are so great that Vice Admiral William Ramsey, deputy commander of the U.S. Space Command, publicly contradicted the Reagan administration's policy in 1988, arguing that "we should have as a national objective an environment in space where weapons are not introduced."

THE COSTS OF SDI

SDI supporters argue that the official $55 billion cost estimate for a Phase I missile defense represents "the price of SDI." But such estimates are profoundly misleading.

The $55 billion estimate, made in February 1990, replaces a $69 billion estimate provided only 16 months before, which in turn had replaced a $115 billion estimate made a year before that—changes the General Accounting Office has gently labeled "optimistic." As Senator Nunn has remarked: "Every time we get to the selling stage, the charts go down. When we get into the building stage, the costs go up." Studies of other weapon systems indicate that the final cost is often roughly two-and-a-half times the cost estimated at this early stage of development. If the Phase I SDI system



How Much Has Changed Since 1972?

SDI supporters often compare the task of building an effective missile defense to the Apollo project: if our vision is bold, nothing is impossible for U.S. technology. But there is a critical difference: the moon did not shoot back. Putting a man on the moon was an engineering task, pitting technology against a fixed, definable objective with only natural obstacles standing in the way. Building a strategic defense means combatting an intelligent, resourceful adversary determined to prevent the defense from achieving its goals, and likely to use ever-changing means of countering the defense. Technological advances benefit the offense as well as the defense.

In 1972, a consensus was reached in both the United States and the Soviet Union that the available defense technology could not compete with the offense to provide effective protection. The ABM Treaty was the direct result. Neither side expected that judgment to change: the treaty that was negotiated was of unlimited duration, intended to last into the indefinite future. SDI supporters, however, argue that there has been a technological revolution since 1972, that advances in computers, software, optics, and directed-energy weapons have fundamentally changed the offense-defense balance, making an effective defense possible for the first time in the nuclear age.

In fact, however, while there have been dramatic advances in many specific technologies, the most critical technical problems facing strategic defenses today are remarkably similar to those encountered two decades ago.

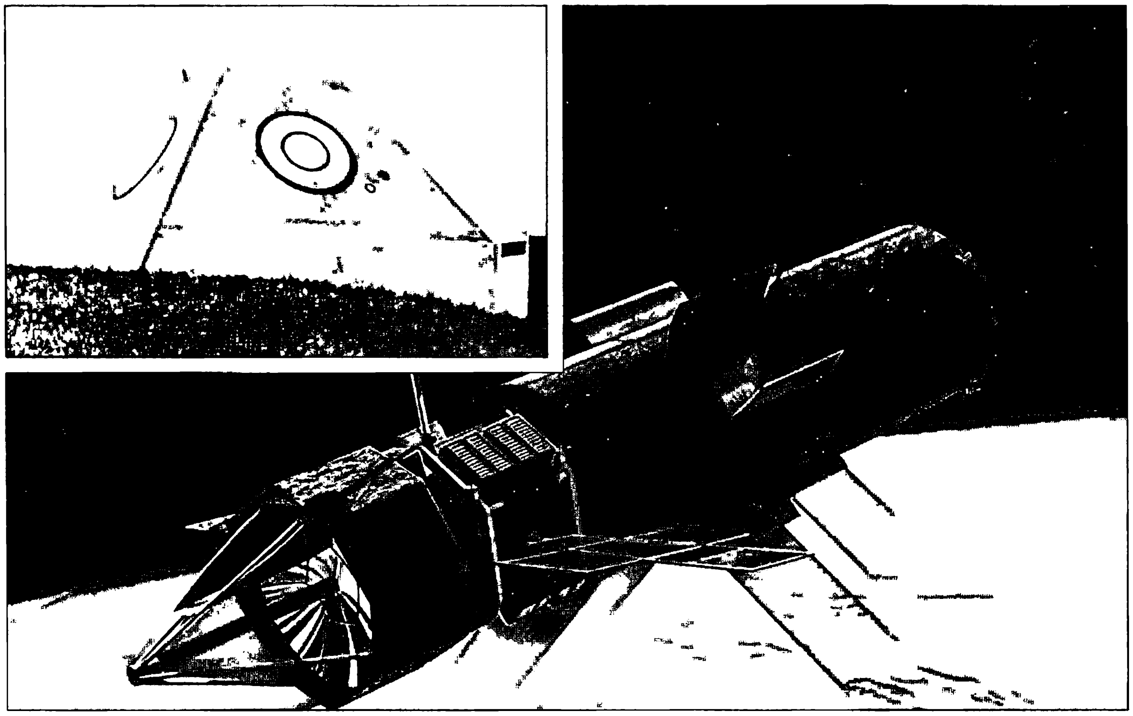
Vulnerability. The defenses of the 1960s were dependent on a small number of large and expensive radars, which were critically vulnerable to attack. Destruction of those radars would have left the defenses blinded and helpless. The dramatic advances in technology over the last two decades have changed everything except the basic problem: In proposed SDI defenses, vulnerable and expensive radars are replaced by equally vulnerable and even more expensive sensor satellites—and now large ground-based radars are again being considered, with all their vulnerabilities. Futuristic directed-energy schemes depend on enormously expensive and critically vulnerable space-based platforms for lasers or particle beams, or on small numbers of ground-based free-electron laser stations, too large and expensive to realistically protect. Progress in technology has made it cheaper to shoot down ballistic missiles; the same progress has also made it cheaper to build offensive countermeasures, and to shoot down defense satellites.

Decoys. In the 1960s, warhead-mimicking decoys posed a critical problem for area defenses against ballistic missiles. The defense simply could not afford to waste its interceptors on decoys, and discriminating the warheads from the decoys in space was an insurmountable problem. The same is true today. Despite the revolutions in infrared sensors and the computers to analyze their images, SDI Organization (SDIO) officials have acknowledged that in the long run, such sensors cannot successfully handle the discrimination job—particularly against "antisimulation," warheads that look like decoys as well as decoys that look like warheads. SDIO officials hope to solve the decoy problem with "interactive discrimination," perhaps using neutral particle beams. But such schemes remain on the drawing boards, and appear to face critical problems of their own. Without effective discrimination, a defense will surely fail, as SDIO has long acknowledged.

Testing and Reliability. If a Soviet attack comes, a defense against ballistic missiles would have to work. There would be no opportunity for a second try if the defense failed its first time out. But it could never be tested in anything remotely resembling the operational "environment" of a full-scale nuclear attack. Computer simulation could help, and there have been major advances in simulation techniques over the last two decades. But it is impossible to simulate an environment without knowing what that environment would be, and there remain (and will always remain) enormous gaps in our knowledge of what would happen in a major nuclear war. In particular, it is impossible for software designers or simulators to predict beforehand every tactic the Soviets might use. The issue of adequate testing of a defense was a critical problem in the 1960s, and it remains a critical problem today.

In short, the more things change, the more they remain the same. Robert Cooper, the director of the Defense Advanced Research Projects Agency during Reagan's first term, and one of the men who organized the early SDI program, put it this way in 1987 congressional testimony: "The issues facing strategic defense research today are identical [to those of the 1960s]. The only differences are that the Soviet missile force has expanded by tenfold in numbers of warheads and technology has matured by 15 years. We still seem no closer to our goal."

More fundamentally, the judgment that in the nuclear age, the offense has an inherent advantage over the defense is not based on any specific technologies of offense and defense, but on the incredible destructive power of nuclear weapons. One thermonuclear weapon can devastate one city, leaving scores of square miles in ruins. The Soviet Union possesses over 10,000 such weapons capable of reaching the United States. It is an awesome threat—one that is not likely to be rendered "impotent and obsolete" any time in the foreseeable future. Until that somehow changes, an effective ABM Treaty will continue to serve U.S. security.

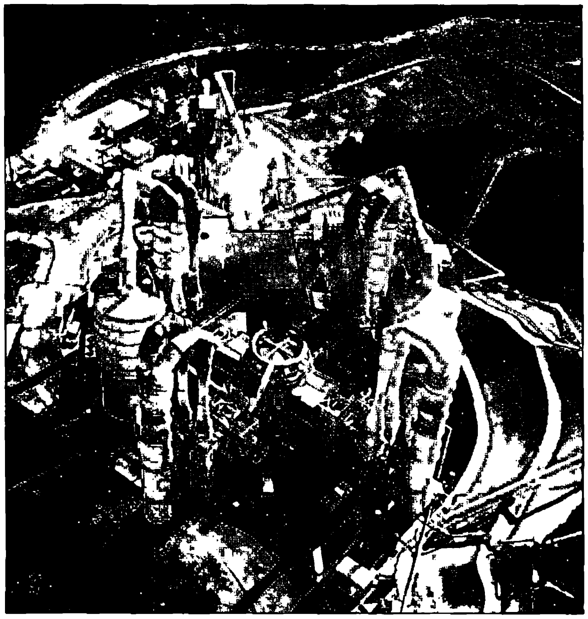


Sitting Ducks: *One critical problem facing the missile defenses of the 1960s was their reliance on large and vulnerable radars such as the Missile Site Radar for the Safeguard ABM (inset). Future defense designs would rely on even more expensive and vulnerable space-battle stations (above).*

followed a similar pattern, its cost would be nearly $140 billion.

Moreover, the $55 billion estimate covers only a small fraction of the projected costs of SDI, excluding both inflation and the substantial costs of operation and maintenance of the system. Most important, the estimate covers only the cost of Phase I, excluding the much higher costs of developing and deploying follow-on defenses—including the costs of advanced research already underway. A study by one of the national nuclear weapons laboratories projected a $541 billion cost for Phase II, still just one step along the missile defense road. Similarly, a 1982 Defense Department study estimated that a comprehensive space-laser defense would cost $500 billion. Former Secretaries of Defense James Schlesinger and Harold Brown have both estimated that the full cost of an SDI system intended to approach President Reagan's dream of a population shield could reach a staggering $1 trillion—over 18 times the $55 billion down-payment now being discussed.

In the end, it is impossible to put a final price tag on a missile-defense system, for there will be no final system. As the technology of Soviet offensive countermeasures improves, the technology of the U.S. defense would have to be constantly upgraded. Just as we regularly deploy new and modified tanks and planes, we would have to constantly build new types of defenses, in an unending technological race. Brown has estimated that such a competition could ultimately cost $100 to $200 billion *every year*, into the indefinite future. In the end, the costs of deploying nationwide missile defenses would be comparable to adding an entire new military service to the defense budget, equivalent to the Army, Navy, or Air Force.



SDI Research: *The sprawling Alpha laser complex is an example of both the progress made in SDI research and the substantial obstacles yet to be overcome. While Alpha has demonstrated significant advances in chemical laser technology, the huge array of support equipment at the current Alpha site will have to be eliminated for space-basing, and experts question whether even such slimmed-down space lasers could provide a survivable and cost-effective defense.*

Already, SDI research is draining funds from other military and civilian priorities—a point which has reportedly led the Joint Chiefs of Staff to recommend reducing the program's budget, and focusing it on research rather than near-term deployment. Soon after retiring, for example, Admiral William Crowe, chairman of the Joint Chiefs during SDI's heyday, recommended that the program be cut back by nearly two-fifths from President Bush's Fiscal Year 1991 budget request, to no more than $3 billion a year—a level of spending which would support a very substantial research program, but not preparation for widespread deployment. With the heavy funding for SDI, many scientists in a variety of fields, from optics to high-energy lasers, have been redirected from other civilian and military work, creating a significant "brain drain." Robert Cooper, director of advanced military research during President Reagan's first term, told Congress in 1987 that "I know a number of worthy [military] research and development programs that suffered strongly" from diversion of research funds to SDI.

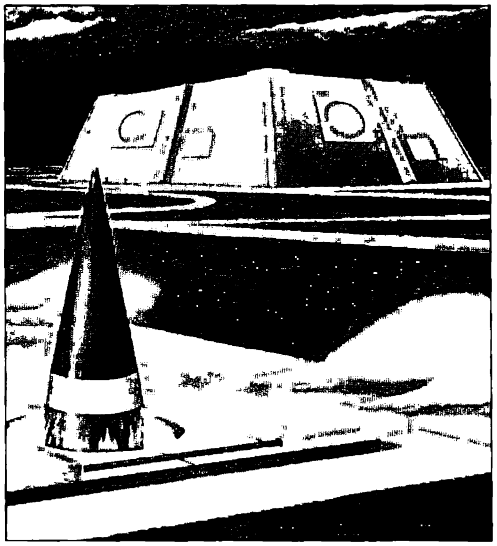
When these large budgets are criticized, SDI supporters often point to the potential for civilian or military spin-offs from the program, such as improved computers. But while any multibillion dollar program inevitably does create new technologies that have other applications, it is virtually always cheaper to develop them directly. Indeed, the military services, the most likely beneficiaries of spin-offs from SDI, have been noticeably unenthusiastic about the program, concerned over the diversion of resources from more pressing military priorities.

CONCLUSIONS

SDI research has made significant progress on a variety of fronts. But the obstacles to effective population defense posed by the immense power of nuclear weapons and the vulnerability of modern society are overwhelming and enduring.

More limited missions, such as partial protection of military targets, or defense against accidental missile launches, are more technically plausible. But the potential benefits of such defenses must be carefully weighed against their costs and risks. (See Chapter X, "Nationwide Missile Defenses or the ABM Treaty?" and Chapter XI, "Other Options for SDI.") No foreseeable defense technologies are sufficiently promising to justify serious consideration of abandoning the ABM Treaty.

Indeed, perhaps the most important result of the SDI program to date has been an ever-clearer understanding of how misplaced Reagan's initial optimism was, and how unattainable his dream remains. While supporters often claim that SDI progress has been even greater than expected, the facts are just the opposite. In 1983, President Reagan's Fletcher Commission on SDI estimated that five years of research and $26 billion would provide the information necessary to decide whether Reagan's population shield could be built. After those five years and more have passed, with some $20 billion expended, SDIO now expects that years more research and tens of billions of dollars in additional funding will be needed just to reach a decision on a far more limited Phase I system. What was once controversial is now accepted: technology alone cannot save us from the nuclear danger.



The Gazelle short-range interceptor for the Moscow ABM system.

V. The Soviet ABM Program

Soviet work on ballistic missile defense faces the same fundamental technological obstacles that confront the SDI program. As former Secretary of Defense Harold Brown once remarked, the "laws of physics are the same in the United States and the Soviet Union."

Nevertheless, advocates of the Strategic Defense Initiative have repeatedly warned of massive Soviet strategic defense programs and potential Soviet ABM breakthroughs in their efforts to justify a U.S. drive toward development and deployment of a first-phase missile defense. Reagan administration officials, in particular, repeatedly argued that the Soviet Union devotes more resources to strategic defense than the United States, leads in some key missile defense technologies, and "may be preparing" to break out of the ABM Treaty by deploying a nationwide missile defense. Such assertions, however, were based on selective and misleading uses of intelligence information. A fuller examination of publicly available U.S. intelligence estimates indicates that while the Soviet ABM program is active and well-funded, it lags substantially behind the United States in the most critical technologies for an effective missile defense, and offers no evidence that the Soviet Union is preparing to abandon the ABM Treaty.

AN SDI SPENDING GAP?

The Soviet Union has an active and well-funded strategic defense program. The program emphasizes air defense against bombers and cruise missiles, and also includes widespread civil defense efforts, a newly modernized ABM system at the single permitted site, early warning, antisatellite (ASAT) weapons, and other activities. An entire branch of the Soviet armed forces, the Voiska PVO (formerly PVO Strany) is devoted to strategic defense, including air-defense, ABM, and ASAT programs.

Unfortunately, SDI advocates have often confused the Soviet ABM program with this broader program. President Reagan raised fears of an SDI spending gap by comparing the Defense Department's estimate that the Soviet Union has spent the equivalent of $200 billion on all strategic defense efforts over the past decade to the much smaller U.S. SDI program. But Soviet ABM work comparable to SDI is only a small part of that overall figure. Air defense alone accounts for nearly $150 billion of the 10-year total, according to Defense Department estimates. Indeed, the CIA told Congress in 1987 that only $6 billion of an earlier estimate of $150 billion for 10 years of Soviet strategic defense had gone specifically to ABM activities—though neither the $6 billion nor the total estimate included research and development.

The Defense Department and the CIA have not published specific estimates of Soviet spending on ABM research and development, from which more realistic comparisons to SDI might be drawn. Indeed, the CIA has testified that the U.S. intelligence community is unable to accurately separate spending on strategic defense research and development from more general military research work, meaning that the U.S.

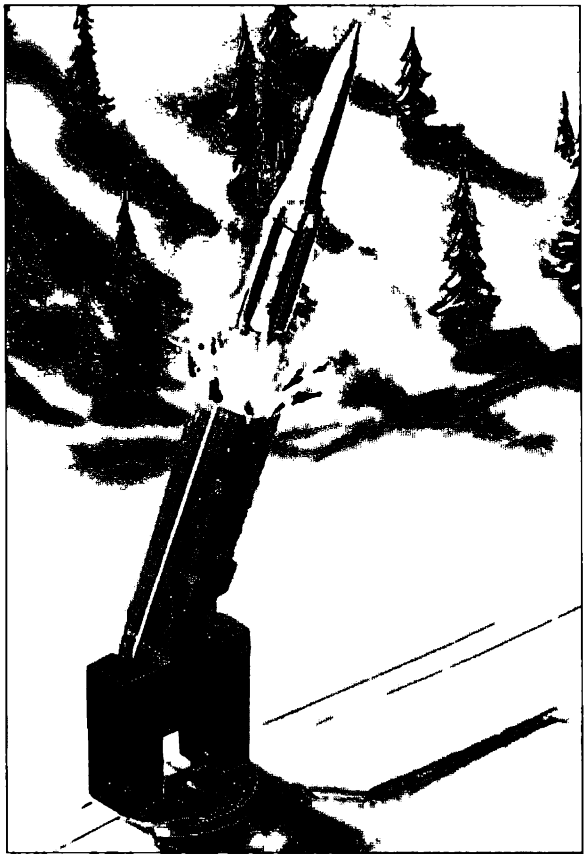
government itself has no accurate picture of how much the Soviet Union is spending for its programs comparable to SDI. Hence, no direct comparison of U.S. and Soviet spending on activities comparable to SDI can be made. It is clear, however, that the Soviet ABM program is active and generously funded.

More important, of course, than the amount the Soviet Union is spending is what it is getting for its investment.

AIR DEFENSE AND CIVIL DEFENSE

Like the U.S. effort, the postwar Soviet strategic defense program began with a focus on defense against nuclear-armed bombers, which then posed the primary threat. Unlike the United States, however, the Soviet Union never deemphasized air defenses. Facing the possibility of air attack not only from a large U.S. bomber force but from Europe and China as well, the Soviet Union today maintains the world's largest air-defense system, including more than 9,000 strategic surface-to-air missile (SAM) launchers and over 2,000 interceptor aircraft, coordinated by some 10,000 air-defense radars. However, the Defense Department estimates that the vast majority of U.S. bombers would be able to penetrate Soviet air defenses. Indeed, in 1983, then-Undersecretary of Defense for Research and Engineering Richard DeLauer told Congress that 90 percent of U.S. cruise missiles could penetrate Soviet air defenses.

Similarly, the Soviet Union has long maintained a major civil-defense program, including underground shelters for the leadership and mobile and underground command posts, at a cost estimated to run to billions of dollars every year. But this effort would be of little value in protecting the Soviet population without large-scale evacuation of cities, and would not protect the basic infrastructure of Soviet society.



Redesigned Interceptor: *A modified version of the long-range Soviet Galosh ABM interceptor missile is deployed in the new Moscow ABM system. The Defense Department believes such midcourse interceptors could be overcome by countermeasures such as chaff and decoys.*

PAST SOVIET ABM PROGRAMS

Soviet development of ABM systems began by the 1950s, concentrated at the Sary Shagan test range. The rapid pace of ABM-related developments in the early 1960s seemed to indicate that a large-scale ABM program was under way. Soviet leaders soon began to boast about their ABM capabilities, with Defense Minister Marshal Rodion Malinovsky telling the 22nd Communist Party Congress in 1961 that "the problem of destroying missiles in flight has been successfully solved," and General Secretary Nikita Khrushchev claiming the following year that the Soviet Union "can hit a fly in outer space."

At the same time, actual ABM deployments followed a more ambiguous course. In 1961, construction began on what some analysts argued was a primitive ABM system near Leningrad, but it was soon abandoned. In 1963, construction of what came to be known as the Tallinn system began, provoking a debate within the U.S. intelligence community over whether the system included an ABM potential. While a consensus was eventually reached that the Tallinn system was a long-range, high-altitude air-defense system with little ABM capability, there was a major debate within the U.S. government during the ABM Treaty negotiations as to whether this system could be upgraded for an ABM role. This "SAM-upgrade" issue became a major subject of the ABM Treaty negotiations. (See Chapter IX, "Grey-Area Systems and the ABM Treaty.")

In 1962-1963, construction began on a genuine ABM system at Moscow. The system utilized the nuclear-armed Galosh ABM interceptor, first paraded in Moscow in 1964. The huge Galosh missile was larger than the Minuteman missile it was presumably intended to intercept. The system relied on the large Dog House radar for long-range tracking and battle management (supplemented by the Cat House radar added in the 1970s), backed up by smaller mechanically steered tar-

Modernized ABM: *The Soviet Pillbox radar is a critical part of the new Moscow ABM system. Relying on large radars such as Pillbox and two layers of nuclear-armed interceptors, the Moscow defense is based on technology similar to that of the U.S. Safeguard system, abandoned in the mid-1970s.*

get tracking and interceptor guidance radars. Originally, the Soviet Union appeared to be planning eight ABM complexes at Moscow, each armed with 16 interceptor launchers. In addition, U.S. intelligence estimates initially predicted that thousands of Galosh launchers would be deployed throughout the country. But in 1968 construction of the Moscow system slowed, perhaps because of technical difficulties with the system, and only four of the complexes, totaling 64 launchers, were ever completed. In 1972, the ABM Treaty limited the Soviet Union to two ABM sites totaling 200 ABM interceptors, which was reduced to one site with 100 interceptors in a 1974 Protocol.

This first Moscow ABM system had serious weaknesses, including the vulnerability of the radars to attack or "blackout" by nuclear blasts, their inability to cope with such "penetration aids" as decoys and chaff, and the small size and enormous cost of the system, particularly as compared to the relatively cheap increases in offensive warheads made possible by U.S. multiple-warhead missiles, or MIRVs. As a result, U.S. intelligence agencies judged that it had little ability to protect Moscow against a U.S. attack.

THE SOVIET ABM PROGRAM TODAY

The Soviet Union has continued an active missile-defense research and development program since the ABM Treaty was signed, including both traditional ABM components and new technologies such as lasers. In addition, the Soviet Union has maintained the single permitted ABM site at Moscow, and has recently completed a major upgrade of that system. The Soviet Union has not, however, proceeded to deploy the extensive nationwide missile defense that was predicted in the absence of the ABM Treaty. (See "The Success of the ABM Treaty," p.16.) And as Massachusetts Institute of Technology expert Stephen Meyer has pointed out, "There is no evidence that the Soviets have an 'SDI-skiy'—an organized undertaking to devise an integrated strategic defense at the earliest possible deployment date (as with the U.S. SDI)."

Traditional Technologies

The new ABM system at Moscow represents front-line Soviet ABM technology. It has been under construction since 1978, and has consumed a large portion of Soviet missile-defense spending over the last decade. The new system is a two-layer defense, relying on improved versions of the Galosh missile for intercepting warheads outside the atmosphere, and a high-acceleration interceptor called Gazelle, similar to the U.S. Sprint interceptor, for shooting down warheads within the atmosphere. Both interceptors are nuclear-armed. The system reportedly includes 100 interceptor launchers, the maximum allowed by the ABM Treaty. The system will rely on radar coverage from the huge phased-array Pillbox radar at Pushkino, near Moscow; there is some doubt whether Pillbox alone will be able to handle the battle-management role, however, and older Soviet radars such as the Dog House and Cat House may well be retained.

In many respects—the radar technology involved, the two layers of nuclear-armed interceptors (a large one for exoatmospheric interception and a smaller, highacceleration missile for intercepts within the atmosphere)—the new Moscow system is similar to the U.S. Safeguard ABM system, which was abandoned in the mid-1970s because of its vulnerability to attack, its susceptibility to relatively simple countermeasures, and its high cost. Apparently the Defense Department now has a similar view of the Moscow system: in 1987, Lawrence W. Woodruff, deputy undersecretary of defense for strategic and theater nuclear forces, told the House Armed Services Committee that "the Soviets have been developing their Moscow defenses for over 10 years at a cost of billions of dollars. For much less expense we believe we can penetrate these defenses with a small number of Minuteman missiles equipped with highly effective chaff and decoys."

Both the Reagan and Bush administrations have raised the possibility that the Soviet Union could rapidly "break out" of the ABM Treaty and deploy a nationwide ABM system, using "rapidly deployable" ABM radars developed in the 1970s coupled with new early warning radars now under construction, perhaps backed up by air-defense systems upgraded for an ABM capability. On closer examination, however, this scenario is impossible to sustain. The "rapidly deployable" radars were part of a development program that appears to have been abandoned, and most of the few that were ever built have now been destroyed; the early warning radars would be extremely vulnerable to attack, and are poorly suited to the "battle-management" role assigned to them in this scenario; and upgraded versions of current Soviet air-defense systems would have only the most marginal capability against modern strategic missiles. In any case, such a patched-together system relying on small radars and non-ABM technologies would inevitably be far less effective than the technologies of the Moscow ABM, or of the U.S. Safeguard system of a decade and a half ago, neither of which offer the possibility of an effective defense against a determined attack. (See Chapter VII, "Soviet Compliance With the ABM Treaty.")

Exotic Technologies

The Soviet Union also has an active program investigating possible weapons applications of new technologies, including the technologies under development in SDI, as Soviet leader Mikhail Gorbachev acknowledged in a 1987 interview with NBC News. But while the Soviet program in exotic technologies is well-funded, it lags substantially behind U.S. programs in virtually all of the critical technologies of missile defense, including sensors, computers, and both the types of lasers considered most promising for ballistic missile defense applications.

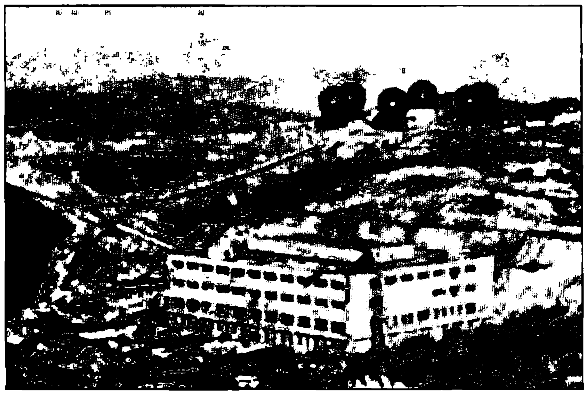
Prior to the announcement of the U.S. SDI program, U.S. intelligence agencies took a rather relaxed attitude toward Soviet exotic-technology ABM programs. In 1982, the Defense Department indicated that it considered the Soviet shift from pure research on lasers to preliminary tactical weapon programs "premature," and that while the Soviet Union had a substantial particle beam program, "no direct correlation between Soviet particle beam work and weapons-related work has been established." Similarly, despite the extreme tone of the first edition of *Soviet Military Power* in 1981, the volume did not mention exotic technologies in its discussion of Soviet strategic defense programs.

But after President Reagan's 1983 SDI speech, these Soviet advanced-technology research programs became the subject of increasingly exaggerated and distorted public statements. Top Reagan administration officials and other SDI advocates charged that Soviet efforts in fields such as laser weapons were dramatically larger than U.S. programs, and that the Soviets held a technical lead in many of these areas. Both of these assertions are directly contradicted by unclassified intelligence estimates. In the specific case of lasers, for example, the Defense Department has estimated that duplicating the Soviet laser program in the United States would cost roughly $1 billion annually. SDI-sponsored work on a variety of laser technologies amounted to over $700 million in Fiscal Year 1990. It should be remembered, however, that all of that amount went to lasers for ballistic missile defense, while much of the Soviet figure was devoted to lasers for air defense and various tactical applications. Taking that into account, the Defense Department's own estimate suggests that the overall funding for the Soviet research effort on lasers specifically for an ABM role is probably somewhat smaller than the comparable U.S. program, not larger. In addition, the extreme inefficiencies of the Soviet economy are known to reduce the productivity of Soviet high-technology researchers by comparison to their American counterparts: Soviet engineers, for example, often have to make many of the parts they need themselves, rather than simply ordering them from a catalog. As a result, Robert Cooper, then director of the Defense Advanced Research Projects Agency, told Congress in 1984 that the United States could match Soviet laser efforts with less than half their level of spending. Similarly, as described in more detail below, intelligence estimates directly contradict claims that the Soviet Union leads the United States in laser technologies.

> ***"The new Moscow ABM system . . . has major weaknesses. With only 100 interceptor missiles, the system can be saturated, and with only the single Pillbox radar at Pushkino providing support to these missiles, the system is highly vulnerable to suppression."***
>
> —Soviet Military Power, *1989*

A 1988 speech by Yevgeni Velikhov, vice president of the Soviet Academy of Sciences and a top science and arms control adviser to Gorbachev, provides some insight into Soviet thinking about such exotic-technology ABM efforts and the history of the Soviet program in these fields. According to Velikhov, a major effort in ground-based beam weapons for terminal ABM defenses was begun in the late 1960s. (Enthusiasm for this project was likely inspired by the invention at about that time of the gas-dynamic carbon dioxide laser, the first laser capable of weapon-level power.) But the severe technical barriers to such a system—and its lack of any real advantage over missile interceptors for such terminal defenses—soon resulted in the cancellation of the project. Velikhov described "the empty structures on the testing ground" at Sary Shagan as "the only remainder" of this program; in 1989, Velikhov arranged for a group of Americans to visit the Sary Shagan site, where they were shown these "empty structures"—described by Soviet officials as having originally been intended for a high-power laser pumped by chemical explosions—as well as several small research lasers.

Velikhov also described a Soviet debate in the early 1970s over space-based rather than ground-based "Star Wars" weapons. That idea was also rejected as infeasible. Later, according to Velikhov, V. N. Chalomey (a major Soviet ICBM and cruise missile designer) raised the possibility of a defense based on space-based interceptors, "similar," as Velikhov put it, "to the U.S. 'rapid deployment' project." Because of Chalomey's position, he was able to put the idea directly to General Secretary Leonid Brezhnev. A commission was set up to study the concept, and after a "heated debate," it was rejected. (The 1976 publication of a book by spokesmen for the National Air Defense Forces calling for a widespread ABM defense, which provoked a brief debate in the Soviet military press, may have been related to this internal discussion. Presumably the proposal was made before the total failure of the Soviet infrared-guided antisatellite weapon from late 1976 to 1982 revealed the weakness of Soviet efforts in the technologies that would be needed for such space interceptors.) Velikhov argued that acceptance of Chalomey's proposal would have led to "fantastic expenditures," but "no greater security."



Soviet Laser: *A major Soviet laser station is under construction in the mountainous region near the Afghan border, near the city of Dushanbe. Some Defense Department analysts have argued that the Dushanbe facility will be powerful enough to serve as an antisatellite weapon, but other experts disagree.*

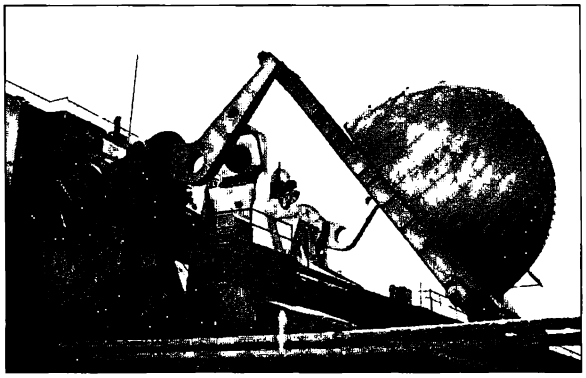
Velikhov's speech again makes clear that the Soviet Union has long had a substantial program exploring the potential of advanced technologies for ballistic missile defense. While it appears that each of these deployment proposals was rejected, the Soviet Union maintains an active research program.

Lasers

Lasers have been the main focus of Soviet research on directed-energy weapons (DEW). The Soviets are pursuing research and development of high-energy lasers for a variety of potential weapon and sensor applications, including antipersonnel weapons, air defense, laser radar, ASAT, and ABM, among others. While such estimates are notoriously unreliable, U.S. intelligence agencies have judged that roughly 10,000 technicians are involved in Soviet high-energy laser efforts, and as mentioned above, the Defense Department has estimated that duplicating the Soviet laser program in the United States would cost roughly $1 billion annually.

The advent of glasnost has drastically increased the amount of available information about Soviet laser programs. Soviet high-energy laser work is under way at a number of different sites, including several facilities at the Sary Shagan test range, a new laser site near the city of Dushanbe, close to the Afghan border, and research centers in the Moscow and Leningrad areas, among others.

One laser at Sary Shagan, in particular, has long been the focus of U.S. concern, with the Defense Department describing it as "believed capable of an antisatellite mission." (Reportedly, however, there was more uncertainty within the U.S. intelligence community over the laser's capabilities than this statement suggests, with the CIA expressing doubt as to its likely weapon capabilities.) In July 1989, the Soviets invited a group of U.S. observers to examine the previously top-secret facility, which was found to include a 20-kilowatt carbon-dioxide laser, and a ruby laser system combining the beams of 19 five-watt lasers—both many hundreds of times less than needed for an effective ABM weapon, and far below the power needed to serve as effective ASATs. The mirrors used to reflect the laser light were uncooled (making them incapable of carrying high laser power), and lacked the adaptive optics a major weapon laser would need to correct for atmospheric distortions. By comparison, the largest U.S. weapon laser has a power of roughly two megawatts (100 times greater than that of the carbon-dioxide laser seen at Sary Shagan), with a shorter-wavelength beam



Beam Weapon: *Exterior of a Soviet laser facility at Sary Shagan, showing the large protective dome for the laser beam director (partly obscured). This facility had been the focus of Defense Department warnings that the Soviet Union might already have a laser antisatellite capability, but U.S. visitors in 1989 found that the power of the lasers at the site was far less than needed for effective weapons.*

more readily focused on distant targets, and a beam director incorporating both cooling and adaptive optics. Yet the Defense Department acknowledges that this U.S. laser would have only the most limited antisatellite capabilities. Congressman John Olin, one of the visitors and an engineer who was once a vice president of General Electric, said: "it pretty clearly is not a power laser and doesn't represent any threat as a weapon." Soviet scientists at the site indicated that the facility is used for laser radar research, tracking aircraft several times a week, and occasionally attempting to track satellites, so far without success.

While this visit demolished the view that this particular laser was capable of an ASAT or ABM mission, it does not indicate that the Soviet Union lacks a substantial laser weapons program. As the Defense Department pointed out in the days after the visit took place, the Soviet Union has a number of lasers at other sites (including others at the Sary Shagan test range), some of which are more powerful than the one the U.S. observers visited at Sary Shagan. However, intelligence officials have confirmed that the laser the U.S. group visited at Sary Shagan was the key facility U.S. intelligence had been most concerned about—in part because of its large beam director—and not a "Potemkin laser," as some SDI supporters charged.

Overall, the Sary Shagan laser episode suggests two conclusions. First, there are potentially large uncertainties in judging the capabilities of indoor technical research programs by observing their external characteristics. (U.S. concerns may have been provoked in part by the building's overall consumption of five megawatts of electric power, and the large (1.5 meter) beam director for the laser.) Second, at least in this case, U.S. intelligence successfully identified the facility as a major laser site, though it was far from gaining a weapons capability. It appears extremely unlikely that the Soviet Union could successfully hide a major development and testing program for the much larger lasers that would be needed for ASAT or ABM roles.

The Soviet Union is also building a laser facility in the mountains near the southern city of Dushanbe. Soviet officials have indicated that the Dushanbe laser is intended only for satellite tracking and atmospheric science, not as a weapon. While many U.S. intelligence officials reportedly find the Soviet description plausible, some Defense Department analysts argue that the facility may ultimately be powerful enough for an ASAT role. (While *Soviet Military Power* has argued that the electric power available from a nearby dam "exceeds that needed solely for satellite tracking," suggesting an ASAT application, there is no evidence that the laser facility will consume all the power from the dam.) General Vitaly Shabanov, the Soviet deputy minister of defense for armaments, indicated in a 1988 interview that the laser at Dushanbe would be a "solid-body" laser, arguing that it would only be powerful enough "to detect objects moving in outer space," not to damage them. If Shabanov's description of the technology to be used at Dushanbe is accurate, it lends credence to the view that the facility is unlikely to be weapon-capable, for solid lasers have never been seriously considered for weapon applications in the United States: While high power can be achieved in such lasers, the resulting heat build-up in the solid laser material requires extremely brief pulses, with long cool-down periods between them.

Another major Soviet laser research laboratory is located at Troitsk, near Moscow. In August 1989, the Soviet Union opened this previously off-limits facility to a group of members of the U.S. House Armed Services Committee, accompanied by intelligence officials. The group observed a one-megawatt carbon-dioxide laser—far more powerful than the laser at Sary Shagan, but without a beam director. One of the visitors was John Hammond, the former head of directed-energy weapons technology for the SDI Organization, who described the laser as "impressive," but indicated that the United States had developed similar lasers 10 years ago, and said: "Militarily, there was not much significance to this laser."

Yet another Soviet laser research program focused on airborne lasers; a moderate-power laser was packed into an Ilyushin 76 transport aircraft. This aircraft was destroyed by a fire in 1986 and has not been replaced. Like the Troitsk facility, this effort was apparently similar to an abandoned U.S. program of the 1970s, the Airborne Laser Laboratory.

Much of the Soviet high-energy laser effort is devoted to carbon-dioxide and carbon-monoxide lasers, such as those observed during the Sary Shagan and Troitsk visits. These are the only laser types in which the CIA has publicly estimated the Soviet Union has achieved higher power levels than the United States. But this "gap" is largely the result of the United States having abandoned such lasers for ASAT or ABM applications, because a variety of technical difficulties make it effectively impossible to achieve the required brightness levels with such lasers; before shifting its focus to more promising lasers, the United States had held the lead in these carbon-oxygen lasers as well. Given the difficulty of achieving high brightness with such lasers, continuing Soviet work on them is probably intended for tasks other than space weapons, such as air defense or laser radar, or for gathering data for the design of other types of lasers.

"In the key technologies needed for a broader defense—such as data processing and computer software—we are far, far ahead."
—Lieutenant General James Abrahamson, 1984
Then Director of SDIO

In the United States, two laser technologies are considered most promising for ballistic missile defense applications—chemical lasers in the near term, and free-electron lasers in the longer-term future. The CIA reported in 1985 that the United States had consistently maintained a roughly five-year lead over the Soviet Union in the power levels achieved with chemical lasers, with the maximum U.S. power level then estimated to be four to five times that achieved in the Soviet Union. The U.S. lead in chemical lasers has been confirmed by subsequent Defense Department estimates, which indicate that the Soviet Union is also "slightly behind" in free-electron lasers. As West Point physicist Thomas Johnson has pointed out, the United States is now building a large free-electron laser for preliminary ABM-related tests, but "there is no evidence that the Soviet Union is doing so, too."

Excimer lasers are also considered to have weapon potential, particularly for ASAT applications. Here, too, Defense Department officials report that the United States leads. And the 1987 American Physical Society (APS) report on DEW estimated that even U.S. excimer lasers remained some 10,000 times less powerful than needed for effective ABM weapons.

There have been press reports of a substantial Soviet program in explosively pumped iodine lasers (which may have been the original purpose of the empty laser structures observed at Sary Shagan). While the United States is also pursuing iodine lasers (primarily for ASAT applications rather than for ABM), it has abandoned the flash-pumping technique in favor of chemical excitation of the iodine, in a technology known as the chemical oxygen-iodine laser (COIL). It is not publicly known whether the Soviet Union is pursuing this technology, or how much progress it has made.

Lastly, the Soviet Union has published articles on the possibility of nuclear bomb-pumped X-ray lasers. Estimates of Soviet progress in this area are classified. As described in the previous chapter, however, such X-ray lasers face significant technical obstacles that have led the United States to cut back on previously planned funding for them. Even if they prove to be feasible, U.S. experts now believe that they are more likely to play an offensive ASAT role than a defensive antimissile role. In 1987, the APS report concluded that "what has not been proven is whether it will be possible to make a militarily useful X-ray laser." A comprehensive ban on nuclear tests, which the Soviet Union has proposed, would prevent either side from completing development of bomb-pumped X-ray laser weapons.

In short, while the Soviet Union has a substantial and well-funded laser weapon program, Defense Department estimates suggest that the portion of that program devoted to ABM is smaller than the ABM laser effort in the United States, and the United States leads in both the laser technologies U.S. experts consider most promising for ABM applications.

Other Exotic Weapons

The Soviet Union is conducting research on kinetic-energy weapons for potential ASAT and ABM applications. The Soviet Union tested a ground-launched ASAT system intermittently from 1968 to 1982, but it had only limited capabilities as an ASAT, being capable of only low-altitude attack, slow, and readily countered. A somewhat more advanced infrared-guided version failed every test. The SDIO believes that infrared rather than radar-guided interceptors will be needed for an effective kinetic-energy ABM system, and successfully demonstrated such an interceptor in 1984, but the Defense Department told Congress in 1987 that there are "no convincing signs" of Soviet work on infrared-guided ABMs.

Particle beams receive less emphasis than lasers in the Soviet directed-energy weapons program. Soviet achievements in the basic physics and engineering of particle accelerators are impressive. In the late 1960s, for example, Soviet researchers invented the radio-frequency quadropole, a device which allows far more compact designs for particle beam generators, and is now used on both sides. But much of the Soviet program has been devoted to research on inertial-confinement fusion, and it is impossible to judge how much is directly related to weapons development. While U.S. intelligence estimates generally give Soviet particle beam efforts high marks, particle beam programs in both the United States and the Soviet Union are still in the laboratory stage, and face substantial technical obstacles. The United States has successfully operated a small particle beam in space, firing it from a sounding rocket, which the Soviet Union has not. In 1985, the CIA argued that "the technical requirements are so severe that we estimate that there is a low probability they will test a prototype [of a space-based particle beam weapon] before the year 2000." Given the lack of major reported developments in the Soviet particle beam program since then, it is likely that a new estimate today would move that date out even further.

The Soviet Union is also researching the possibility of radio-frequency or microwave weapons, which could be used to interfere with an adversary's electronic equipment. Because the electronics in a missile and its warheads can be hardened against the effects of such microwaves, however, these weapons are not expected to be effective in an ABM role.

Computers and Sensors

While the Soviet Union is making progress in such exotic technologies as lasers and particle beams, it lags far behind in the more difficult and critical technologies of computers and sensors. According to the Defense Department's 1988 SDI *Report to Congress*, "the Soviets remain an average of 10 years behind the West in civil and industrial technology applications of computers, although military applications may be somewhat less far behind. The Soviets are also at least 10 years behind in sensor applications," which "form the backbone of SDI tracking, pointing, and discrimination capabilities." "These limitations," the report concluded, "undoubtedly prevent the Soviets from deploying defenses with the level of sophistication and capability envisioned for SDI."

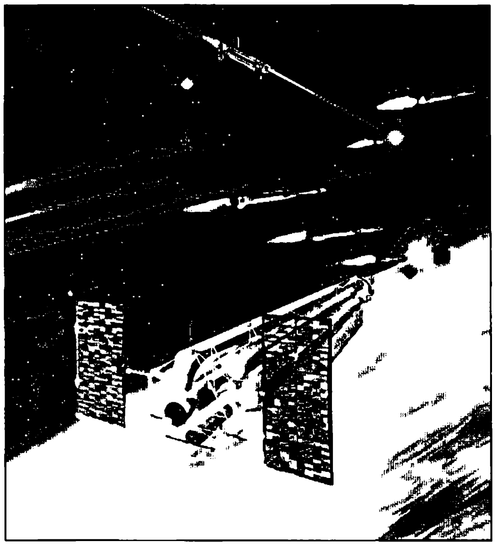
Consider, for example, the disparity between U.S. and Soviet infrared sensors—a type to be carried by every interceptor and sensor satellite in the entire first phase defense planned by the United States. The United States has successfully demonstrated an infrared-homing ASAT and an infrared-homing ABM interceptor. As mentioned above, the Soviet attempt at an infrared-homing ASAT failed every test and was eventually abandoned, and the Defense Department has reported that there are "no convincing signs" of Soviet work on infrared-guided ABMs. The United States has had an operational system of infrared satellites providing global early warning of missile attack since the early 1970s, while a similar Soviet system has only recently become fully operational after a series of failures, and still does not provide global coverage.

"There is evidence that the Soviets have not been doing as much as we thought [on ABM]. There's been a lot of hoopla about this stuff which I think has been misleading."
—Admiral William Crowe, 1990
Former Chairman of the Joint Chiefs of Staff

The U.S. technological lead extends to other technologies as well. A March 1990 Defense Department assessment found that in the 20 "critical technologies" for future military applications, the United States leads in 16, and the Soviet Union is "generally on a par" with U.S. work in three. Only in pulsed power—used to provide power for microwave weapons, hypervelocity guns, and the like—was the Soviet Union judged to have the lead "in some niches of technology." In 1988, then-Secretary of Defense Frank Carlucci estimated that across the broad spectrum of military technology, "our average lead-time over Soviet defense technologies is approximately 10 years." Overall, then, as *Soviet Military Power* pointed out in 1988, while considerable resources are devoted to the Soviet ABM program, the U.S. Strategic Defense Initiative enjoys "significant benefits from the West's broad and deep technical superiority."

PART TWO

THE EROSION OF THE ABM TREATY



An artist's concept of a particle-beam weapon.

VI. The Reinterpretation of the ABM Treaty

In October 1985, the Reagan administration announced a unilateral "reinterpretation" of the ABM Treaty. Under this "broad" interpretation, the treaty's ban on development and testing of space-based and other mobile ABM systems and components would not apply to exotic-technology ABMs such as lasers and particle beams, exempting many of the technologies under development in the Strategic Defense Initiative program from many of the treaty's restraints. The view of the treaty that had previously been generally accepted—now referred to variously as the "traditional," "narrow," or "restrictive" interpretation—holds that the treaty's limits apply to *all* ABMs, regardless of the technology on which they are based.

The Reagan administration asserted that its new interpretation was "fully justified," and the Bush administration has supported that view. But the broad interpretation is directly contradicted by each of the key sources of evidence for treaty interpretation under international and domestic law. The language of the ABM Treaty is clear on its face; since the treaty's signing, both parties have repeatedly stated that the treaty's limits do apply to exotic technologies, and have abided by that view in practice; the negotiating record shows that Soviet negotiators repeatedly indicated their understanding and acceptance of the U.S. proposal that the treaty apply to all ABM technologies; and during the Senate's ratification of the accord, the Nixon administration unambiguously presented the treaty in its traditional interpretation. The broad interpretation of the ABM Treaty has no basis in law. Moreover, by permitting unlimited development and testing of space-based exotic-technology missile defenses, the broad interpretation would eviscerate several of the ABM Treaty's key protections against rapid "breakout" from the accord. In the words of Ambassador Gerard C. Smith, chief U.S. negotiator of the ABM Treaty, the broad interpretation would render the agreement "a dead letter."

THE REINTERPRETATION CONTROVERSY

The broad interpretation was unexpectedly announced on a Sunday morning talk show on October 6, 1985, by then-National Security Adviser Robert McFarlane. The announcement came after an interagency meeting on October 4, which had discussed an analysis by State Department Legal Adviser Abraham Sofaer supporting this new view of the accord. Sofaer's study was undertaken in only two-and-a-half weeks, and none of the U.S. ABM Treaty negotiators except Ambassador Paul Nitze (who was then a top Reagan administration official) were consulted. Legal experts on arms control from the State Department and other agencies were excluded, and studies they had commissioned or written supporting the traditional view were not examined. Nitze, on the understanding that no definite decision had been taken at the October 4 meeting, prepared a memorandum afterward suggesting that the administration not publicly commit itself until Congress and U.S. allies had been consulted, but

Letter from Negotiators of The ABM Treaty

As negotiators of the 1972 ABM Treaty with the Soviet Union, we reaffirm our support for the treaty on the fourteenth anniversary of its signing. We concur with the view of six former secretaries of defense that this international agreement of unlimited duration makes an important contribution to American security and to reducing the risk of nuclear war.

We wish to confirm our view that the treaty prohibits the development and testing, as well as deployment, of all space-based and other mobile-based ABM systems and components, regardless of whether they use 1972-era or newer technologies. This view of the treaty is clear from the ordinary meaning of the treaty text, the treaty's negotiating record, the United States legislative history, and the subsequent practice of both the U.S. and the Soviet Union. We believe that a careful reading of the classified negotiating record will support our position.

We are convinced that the Soviet negotiators shared our view that the treaty bans the development, testing, and deployment of all space-based ABM systems and components. For fourteen years, Soviet statements and actions have been consistent with this view, and Ambassador Paul Nitze has testified that the Soviets have not violated the treaty's clear ban on developing space-based exotic ABMs.

The treaty's text unmistakably bans the development and testing, as well as deployment, of all space-based strategic defenses. Article V does so in unequivocal language that allows no exceptions To interpret Statement D in a way that would eviscerate Article V's ban on space-based ABMs, as some have suggested, would be tantamount to withdrawing from the treaty. The language of Article II clearly indicates that the listing of 1972-era ABM components is illustrative, not definitive. Hence, Article II does not limit Article V's ban on ABM development, testing, and deployment to those ABM technologies known in 1972.

We believe that the treaty's clear ban on the development and testing of all space-based ABM systems and components is crucial to its viability as a valuable agreement that promotes American security and could lead to progress in limiting U.S. and Soviet strategic weapons. We commend President Reagan for abiding by this traditional view of the treaty and urge him to continue to do so.

—*March 10, 1987*

Gerard C. Smith	**Phillip J. Farley**
J. Graham Parsons	**Royal B. Allison**
Raymond L. Garthoff	**John B. Rhinelander**
Harold Brown	**Lawrence D. Weiler**

McFarlane's announcement preempted any more cautious approach.

The reinterpretation immediately provoked a storm of controversy. The Soviet Union rejected it as "a deliberate deceit," and several U.S. allies expressed consternation over the abrupt change in policy. Many members of Congress attacked the broad interpretation, as did all of the senior U.S. negotiators of the accord except Nitze.

Within days, then-Secretary of State George Shultz announced that while the administration considered the broad interpretation "fully justified," the issue was "moot," since for the time being SDI tests would "continue to be conducted in accordance with a restrictive interpretation of the treaty's obligations."

But the issue was far from moot, for by challenging the basic limitations of the ABM Treaty, the Reagan administration had created an issue that would enmesh the SDI program in constant controversy and stymie efforts to complete a strategic arms reduction agreement for the rest of President Reagan's term in office.

The impact on arms control became clear the next month, when on the eve of President Reagan's first summit with Soviet leader Mikhail Gorbachev, then-Secretary of Defense Caspar Weinberger sent President Reagan a strongly worded letter warning him against any agreement "to limit the SDI program according to a narrow (and, I believe, wrong) interpretation of the ABM Treaty." Following Weinberger's advice, President Reagan insisted on the broad interpretation for the rest of his term, while the Soviet Union insisted that no offensive arms agreement could be reached unless the traditional view of the treaty was maintained—an issue that for nearly four years remained a major obstacle to completing a strategic arms reduction treaty (START). (See "The Defense and Space Talks," p.120.)

The broad interpretation also created enormous controversy in Congress. In a series of congressional hearings, and later in three written reports, State Department Legal Adviser Abraham Sofaer laid out the Reagan administration's legal rationale, arguing that the treaty text was ambiguous, that the secret negotiating record showed that Soviet negotiators had refused U.S. proposals to limit development and testing of exotic-technology ABMs, and that the record of Senate ratification supported the broader view.

Unlike the negotiating record, however, the ratification record was largely unclassified, and it soon became apparent that Sofaer's study of the issue had omitted or misrepresented a number of key statements. Sofaer was forced to withdraw his claim that this record supported the broad interpretation, blaming his ratification studies on "young lawyers" on his staff. Unfortunately, Sofaer's misleading account of the ratification record was not an isolated incident. When some senators began demanding access to the negotiating record on which Sofaer based much of his case for the broad interpretation, the Reagan administration initially refused, with Sofaer citing President George Washington's refusal to provide the negotiating record of the Jay Treaty to Congress as a precedent. But as Sofaer himself had described in his book on the Constitution and foreign affairs, Washington did provide the Jay Treaty record to the Senate; it was withheld only from the House, which has no constitutional role in treaty-making. Senator Sam Nunn (D-GA), chairman of the Senate Armed Services Committee, described Sofaer's argument as "sadly indicative of the kinds of half-truths, misrepresentations, and unsubstantiated assertions that have emanated from the Office of the Legal Adviser since the beginning of this controversy."

No longer able to argue that the ABM Treaty ratification record supported the broad interpretation, Sofaer instead asserted that in interpreting treaties, the president has wide latitude to disregard many of the explanations provided to the Senate at the time of ratification—a constitutional claim that became known as the "Sofaer doctrine."

"It is not clear whether [the reinterpretation] reflects incredibly shabby research and analysis done in haste or . . . a studied and disingenuous attempt to rewrite history."

—John Rhinelander, 1985
Legal Adviser to the
U.S. ABM Treaty Negotiating Delegation

The Sofaer doctrine represented a direct challenge to the Senate's power in treaty-making and ensured a major confrontation with Congress. The disagreement came to a head in early 1987, when leaks to the press suggested that the Reagan administration was leaning toward conducting expanded SDI tests that would violate the traditional interpretation and pursuing "early deployment" of a partial SDI system. Senator Nunn sent a strongly worded letter to the president warning that any such action would provoke "a constitutional confrontation of profound dimensions." Nunn soon completed a series of three studies of the reinterpretation (with a fourth study declassified later), concluding that Sofaer's legal analyses justifying the broader view were all in "serious error." He then joined with Senator Carl Levin (D-MI), who had earlier reached similar conclusions, to sponsor an amendment to the defense authorization bill barring any SDI testing beyond the bounds of the traditional interpretation. After a bitter partisan battle and a prolonged Republican filibuster, a modified version of the Nunn-Levin language was approved in late 1987. Similar language has been approved with far less controversy every year thereafter.

As Senators Nunn and Levin moved to limit SDI testing through the congressional power of the purse, Senator Joseph Biden (D-DE) attacked the constitutional basis of the Sofaer doctrine. The general issue of the Senate's power in treaty-making took on increasing importance as the Intermediate-range Nuclear Forces (INF) Treaty neared completion. After a prolonged and sometimes rancorous debate, the Senate overwhelmingly approved a condition to its acceptance of the INF Treaty reaffirming the constitutional principle that treaties must be interpreted on the basis of the understanding shared by the Senate and the executive branch at the time of ratification, unless the executive branch receives specific congressional approval for a change in interpretation.

When President Bush first came to office, his view of the ABM interpretation issue was somewhat uncertain. While Bush had supported the broad view during the 1988 campaign, Brent Scowcroft, Bush's choice for national security adviser, had called the Reagan administration's unilateral reinterpretation of its treaty obligations "unbefitting the United States" and recommended a reaffirmation of the traditional view. Vice President Dan Quayle and Secretary of Defense Richard Cheney, on the other hand, had been strong supporters of the broad interpretation. During early hearings, Secretary of State James Baker reserved judgment on the interpretation controversy. But after months of strategic review, the Bush administration reaffirmed the broad interpretation and left the Reagan administration's "broad-plus" position in the Defense and Space Talks unchanged.

In September 1989, the Soviet Union dropped its earlier position that no START agreement could be signed until the two sides reached agreement on the interpretation of the ABM Treaty. But the Soviet Union continues to make clear that any U.S. violation of the traditional view would be considered grounds for Soviet withdrawal from START. It now appears that this disagreement will remain unresolved when the START agreement is presented to the Senate for advice and consent, potentially setting the stage for another Senate battle over the ABM interpretation issue. (See "START Ratification and the ABM Treaty," p.157.)

TREATY INTERPRETATION

Under the principles of international law codified in the Vienna Convention on the Law of Treaties, the interpretation of a treaty is based first and foremost on its text, which "shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose." If the treaty's text is ambiguous, the next source of evidence is the manner in which the parties have interpreted it after its signing, referred to as the "subsequent practice." Only if neither the text nor the subsequent practice provides an answer is "supplementary" evidence, such as the negotiating record, to be considered. Under U.S. constitutional law, the president is given the power to interpret treaties for the United States, but in the words of the authoritative American Law Institute's *Foreign Relations Law of the United States*, the president "must respect" the understanding of any accord shared by the executive branch and the Senate at the time the Senate gave its constitutionally required approval for ratification.

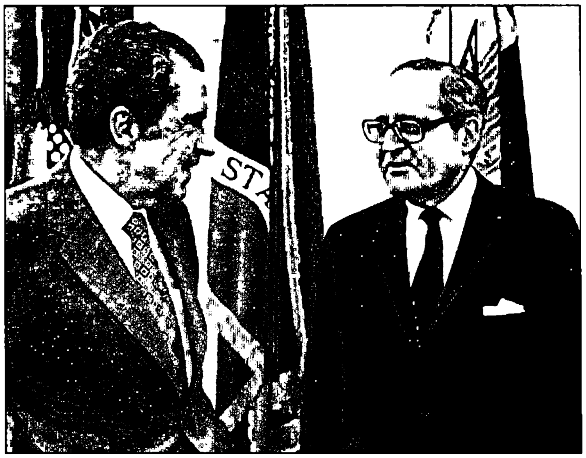
Unfortunately, the Reagan administration ignored these basic principles of law in interpreting the ABM Treaty. The decision to reinterpret the treaty was made solely on the basis of alleged ambiguities in the treaty's text and negotiating record, without reference to the subsequent practice of the parties, and the importance of the ratification record under U.S. constitutional law was denigrated.

No matter what record is used, however, the conclusion of a fair reading is the same. The treaty's text, the subsequent practices of both parties, the negotiating record, and the history of Senate ratification each support the traditional view of the ABM Treaty, prohibiting the development, testing, and deployment of all space-based and otherwise mobile ABM systems and components, regardless of the technological principles on which they are based.

THE TREATY'S TEXT

Several articles of the ABM Treaty have played key roles in the reinterpretation dispute. Most important are Article II, which defines the ABM systems covered by the accord; Article V, prohibiting development, testing, and deployment of mobile ABM systems and components; Article III, which sets out the limits on permitted fixed, land-based ABM deployments; and Agreed Statement D, which supplements Article III's deployment limitations by prohibiting deployment of future ABM systems and components—referred to as those "based on other physical principles." (For a complete text of the ABM Treaty, see Appendix A.)

Article II of the ABM Treaty defines "ABM system" *functionally*, including any "system to counter strategic ballistic missiles or their elements in flight trajectory." Article II then goes on to describe the components of such a system as "currently consisting of" ABM interceptors, ABM launchers, and ABM radars.



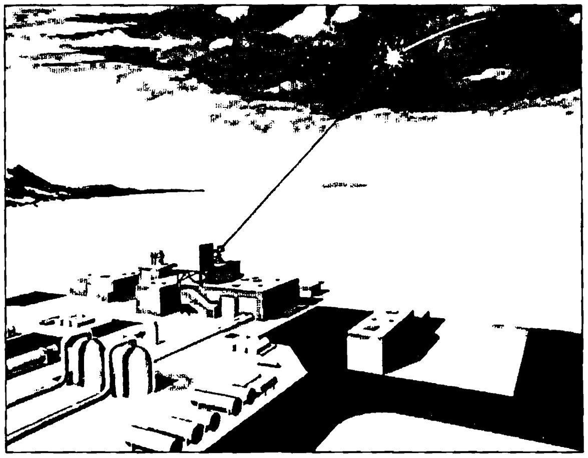
Presidential Orders: *President Nixon directed Ambassador Gerard Smith (right) and his negotiating team to gain an agreement prohibiting development and testing of all mobile ABM systems and components, regardless of the technology on which they were based. The instructions were intended to prevent the circumvention of the treaty through testing of exotic-technology ABMs.*

In Article V of the ABM Treaty, each party "undertakes not to develop, test, or deploy ABM systems or components which are sea-based, air-based, space-based, or mobile land-based." No exceptions are mentioned or implied.

How did the Reagan administration claim to find a loophole for exotic technologies in the clear ban of Article V? Sofaer argued that Article II's definition of ABM systems is ambiguous, and can better be read as excluding future technologies from the ABM Treaty's limitations. Under the broad interpretation, Article II is *not* a functional definition covering any system "to counter strategic ballistic missiles," but rather a *technology-specific* definition, covering only those ABM systems based on the components specifically listed. Hence, Article V's ban on development, testing and deployment of all mobile "ABM systems and components" applies only to the ABM technologies of 1972, and not to more futuristic technologies such as lasers or particle beams. Because Article V's language unambiguously applies to all mobile "ABM systems and components," the entire reinterpretation stands or falls on this reading of the definition of systems and components in Article II. The plain language of Article II, however, makes clear that the list of components is simply an illustrative set of those components ABM systems "currently" consist of, not an exhaustive list of all the components covered by the accord—a point made even clearer by the negotiating record, described below.

Article III sets out the very limited deployments of ABM systems permitted by the treaty. It begins by forbidding all deployments not explicitly allowed, and then permits only ABM interceptors, launchers, and radars at specified fixed, land-based sites—implicitly prohibiting the deployment of ABM systems and components other than interceptors, launchers, and radars. Agreed Statement D of the ABM Treaty is designed to make that implicit prohibition explicit. Although the language of Agreed Statement D is somewhat torturous, both U.S and Soviet negotiators agreed that it would prohibit the deployment of ABM systems and components "based on other physical principles" at the permitted fixed ABM sites unless both sides agreed to amend the treaty after discussion in the Standing Consultative Commission (SCC).

Under the broad interpretation, Agreed Statement D takes on much greater importance, becoming the only part of the ABM Treaty that puts any limits at all on future ABM technologies—a rather extraordinary role for an agreed statement supplementing the accord. Supporters of the broad interpretation have argued that since Agreed Statement D specifically envisions the possibility that future ABM systems and components might be "created in the future," development and testing of such technologies must be permitted. But by beginning with an explicit reference to "insur[ing] fulfillment" of Article III, Agreed Statement D makes clear that it primarily refers to the fixed, land-based ABMs discussed in Article III. Since development and testing of these fixed-based technologies is permitted by the treaty, there is no contradiction between Agreed Statement D's reference to "creation" of exotic-technology ABMs and Article V's ban on development and testing of all mobile ABMs, whether traditional ABM technologies or more exotic systems.



Large Laser: Some research exploring the ABM potential of exotic technologies such as lasers was underway when the ABM Treaty was signed, but at that time the lasers imagined for an ABM role would have required huge ground-based facilities, such as that shown in this artist's concept. As mobile ABM beam weapons seemed a distant prospect, Soviet resistance to U.S. proposals to restrain such exotic-technology ABMs focused on the proposed ban on deployment at fixed sites, not the prohibition on development, testing, and deployment of mobile ABM systems and components.

Sofaer questioned the traditional interpretation by arguing that it would render Agreed Statement D redundant: deployment of future systems would already be banned by Article III. But that is only true in part, for Agreed Statement D not only serves to make an implicit ban explicit—an appropriate role for an Agreed Statement—but also provides a necessary rough standard for judging when such future technologies become capable enough to be limited as ABM components, referring to the items limited as those "capable of substituting for" ABM interceptors, launchers, and radars. Future technologies that merely supplemented traditional components, rather than substituting for them—referred to as "adjuncts" during the negotiations—would be permitted. The status of such adjuncts was an important side issue during the ABM Treaty negotiations.

Just as important, Sofaer's argument ignores the simple fact that Agreed Statement D was agreed to before the final language of Article III was settled; at that time, it would not have been redundant at all. Indeed, as Senator Nunn and Ambassador Smith have both pointed out, the language of Agreed Statement D provides strong support for the traditional view, for it explicitly refers to future ABM technologies as "ABM systems" and ABM "components"—precisely the items limited by Article V and the rest of the accord.

Under the Vienna Convention, a treaty must be interpreted in light of its "object and purpose." The fundamental purpose of the ABM Treaty is clear: the parties agreed to prohibit construction of nationwide ABM defenses, and to other measures designed to prevent either side from gaining the ability to rapidly build such a nationwide system before the other could respond. The broad interpretation is fundamentally contrary to that object and purpose, for in denying that exotic ABM technologies qualify as "ABM systems" and "ABM components," it would exempt such technologies from virtually all of the treaty's restraints, with the sole exception of Agreed Statement D. Under the broad view, mobile "exotic" ABM systems could be developed and tested without limit, nullifying the purpose of Article V and potentially making possible rapid deployment of a nationwide missile defense. Article IV's restraints on ABM test ranges would be nullified as well, for there would be no limit on the number of such systems that could be built for test purposes, or where they could be tested, making it possible to construct a widespread system under the guise of "testing."

THE NEGOTIATING RECORD

Although international law gives much greater weight to the subsequent practice of the parties, the Reagan administration based its case for the broad interpretation almost exclusively on the ABM Treaty's "negotiating record." Sofaer argued that Soviet negotiators repeatedly refused to limit future systems and succeeded in gaining enough ambiguity in the treaty's terms to permit a broader reading. But Sofaer's analysis of the negotiating record, on which the Reagan administration based its conclusions, is deeply flawed, misrepresenting many key events—partly because of his failure to consult any of the U.S. negotiators other than Paul Nitze.

Every one of the other U.S. negotiators strongly rejects the broad interpretation. (Nitze himself unequivocally upheld the traditional view during the U.S. delegation's work in 1972, in detailed letters exchanged in 1977, and in public speeches as recently as May 1985, changing his mind only in September-October 1985.) Even William Sims, the lawyer who compiled and analyzed the negotiating record for Sofaer, strongly disagreed with Sofaer's conclusions, arguing that the ABM Treaty text and negotiating record "provide a document that I think is compelling, compelling in its support of the narrow interpretation."

With much of the relevant negotiating record now released, it is possible to follow the course of events in the negotiations. This "record" is not an agreed document between the United States and the Soviet Union, but rather a collection of materials largely giving the U.S. view of the proceedings, including cables, negotiating instructions, and memoranda describing conversations with Soviet negotiators. Nevertheless, the now-available excerpts from the negotiating record provide clear evidence for the traditional interpretation. (Subsequent quotes from the negotiating record are taken from portions released in studies by Sofaer and Senator Nunn.)

The negotiations over exotic-technology ABMs—what came to be known to the negotiators as "futures," or "other devices," and eventually as "other physical principles"—began in August 1971. A disagreement within the U.S. agencies involved in SALT over how to deal with future technologies was resolved when President Nixon signed a directive (National Security Decision Memorandum, or NSDM, 127) instructing U.S. negotiators to achieve the narrow interpretation—a ban on development, production, testing, and deployment of all mobile ABM systems and components, whether traditional ABM interceptors, launchers, and radars, or other ABM components "to perform the functions of these components." Since the United States then had a secret research program underway on fixed, land-based ABM lasers, testing of such fixed-site lasers was to be protected, though final deployment would be banned. In pursuing these objectives, U.S. negotiators were not allowed to discuss what new technologies might be applicable to the ABM mission, protecting the secrecy of U.S. programs. Overall, the objective was "to reach agreement on the broad principle that the agreement should not be interpreted in such a way that either side could circumvent its provisions through future ABM systems and components"—i.e., to forestall precisely what the Reagan administration attempted to do.

"The reinterpretation is little short of a scandal, born not of a careful reading of the treaty text and its negotiating record, but of an ideological opposition to the ABM Treaty and scorn for the entire arms control framework painstakingly built up over the last two decades."

—Gerard C. Smith, 1987
Chief U.S. Negotiator of the ABM Treaty

On August 17, 1971, the U.S. delegation tabled draft treaty provisions intended to accomplish these objectives. One paragraph was a version of what was to become Article V, requiring each side "not to develop or produce for or test or deploy in sea-based, air-based, space-based, or mobile land-based modes: ABM interceptor missiles, ABM launchers, ABM radars, or other devices to perform the functions of these components." The U.S. negotiators also tabled another paragraph that would ban all deployment of such "other devices," even at fixed, land-based sites. Chief U.S. Negotiator Gerard C. Smith told the Soviet negotiators that "the agreement would apply to all types of ABM systems, including possible future types. We believe that the agreement should reflect this explicitly."

The Soviet delegation's initial reaction was cautious. The Soviet negotiators did not, as Sofaer has argued, reject on principle all limits on future systems. Rather, Ambassador Vladimir Semonov, the chief Soviet negotiator, told Smith that the proposal would be "carefully studied." Soviet negotiators probed for more information on what the U.S. side meant by future systems, asking how such systems could be limited without being specified. Some of these questions were clearly devoted to "fishing" for information on U.S. exotic-technology ABM programs, which U.S. negotiators had been instructed not to provide. In the view of several key U.S. negotiators, Soviet reactions were also initially complicated by a lack of instructions

Soviet Agreement: *In negotiating Article V's ban on development, testing, and deployment of mobile ABMs, U.S. delegate Sidney Graybeal (left) asked Soviet negotiator Viktor Karpov (opposite) whether the language would cover "any type of present or future components." Karpov confirmed that it would.*

from Moscow on the future-technology issue, and by concerns that the U.S. "other devices" language was so broad it might be interpreted to cover air-defense systems—which Soviet negotiators were determined to leave out of the accord. Significantly, every objection voiced by Soviet negotiators to the new U.S. proposals related to the paragraph banning deployment of future systems even at fixed sites, not to the limit on development and testing of mobile exotic-technology systems. This greater attention devoted to the issue of fixed-site exotic technologies is understandable, for at that time, some two decades ago, the weapons-grade lasers each side was then researching were so large that the prospect of ABM-capable lasers or particle beams small enough to be made mobile or launched into space seemed to most analysts a distant one.

On September 3, the heads of the two delegations assigned work on what was to become Article V to a working group headed by Sidney Graybeal on the U.S. side and Viktor Karpov—now the Soviet deputy foreign minister—on the Soviet side. After several days of negotiations, Karpov proposed a new version of the mobile ban, which he said was an attempt to "merge the language" of the U.S. and Soviet drafts, while "[taking] into account the wishes of the U.S. side." Rather than the specific listing of ABM interceptors, launchers, radars, and "other devices," the Soviet draft substituted the general phrase "ABM systems and their components." In a meeting on September 15, Karpov argued that the general phrase referring to ABM systems and their components "obviates the requirement for the phrase 'other devices for performing the functions of these components'" contained in the U.S. proposal. Under questioning from Graybeal, "Karpov agreed with Graybeal's interpretation that the Soviet text meant 'any type of present or future components' of ABM systems." Based on that understanding, the ban on mobile ABMs was agreed with only small modifications. On September 24, the last day of that round of negotiations, the U.S. delegation unanimously reported to Washington that language on mobile ABM systems "including components for future ABM systems which are not fixed and land-based . . . was agreed ad referendum," accomplishing one of the key objectives of NSDM 127.

This clear agreement by the top Soviet negotiator on the subject that Article V covers "any type of present or future components" presents a substantial problem for the broad interpretation. Sofaer argues that Karpov might have been referring only to future modifications of 1972-era components—such as more powerful radars or faster interceptors. But the negotiating record provides no evidence to support Sofaer's view—and the clear meaning of the phrase "*any* type" contradicts it. Testifying before the Senate Foreign Relations Committee in 1988, Graybeal reported that the conversation at the September 15 meeting was more extensive and detailed than reported in the written record. He concluded that "the Soviets did understand that we were limiting future systems; and they did agree that Article V did provide such limitations . . . there is no question in my mind that Karpov understood."

The record of the negotiation of the definition of ABM systems and components in Article II, which was undertaken primarily in a working group consisting of Raymond Garthoff and Graham Parsons on the U.S. side, and Oleg Grinevsky and Nikolai Kishilov on the Soviet side, further confirms the traditional interpretation. Throughout the fall of 1971, there was disagreement over the definition issue, with the United States calling for a sweeping functional definition encompassing all possible ABM technologies, and the Soviet Union arguing instead for a technology-specific definition. The negotiating record strongly suggests that the Soviet position was related both to an effort to ensure that Soviet air-defense systems would not be encompassed within the ABM definition, and to continued disagreement over deployment—though not development and testing—of future ABMs.

The logjam was broken on December 20 and 21, 1971. Garthoff proposed a draft incorporating a functional definition of an "ABM system" as "a system to counter strategic ballistic missiles or their elements in flight trajectory." The following sentences then listed and defined ABM interceptors, launchers, and radars. In response, Grinevsky suggested that "there should be some connective such as 'namely' or 'consisting of.'" Garthoff then reminded the Soviet negotiators that "the Soviet side, as well as the U.S., recognized that there could be future systems," and therefore proposed "*currently* consisting of" as a better connective, making clear that the list of components was only illustrative of current technologies, and that the treaty would apply to future systems as well. Garthoff pointed out that the substantive issue of whether all deployments of future systems would be banned would be settled elsewhere, since Article II included only definitions and not specific obligations.

Grinevsky took this text to the rest of the Soviet delegation, and returned the following day with their agreement. Both Grinevsky and Kishilov highlighted the acceptance of "currently consisting of" as a significant Soviet concession, confiding that it had led to "a very delicate situation within the Soviet delegation," having "been strongly objected to by some members." These remarks made clear that the Soviet negotiators understood the importance of inserting the word "currently" before "consisting of," which had the effect of insuring that Article II covered all ABM technologies, as Garthoff had stated in suggesting it. This Soviet acknowledgement of the importance of the word "currently" is not mentioned in Sofaer's analyses, and was deleted from the excerpts from the record Sofaer released to the public.

With these two agreements—that Article V's ban on development and testing of mobile ABMs would cover "any type of present or future components" and that the definition of ABM systems in Article II would be a functional one, covering all systems "to counter strategic ballistic missiles or their elements in flight trajectory"—the U.S. negotiators had gained Soviet acceptance of the traditional interpretation. And the negotiations over the separate U.S. proposal to ban deployment of exotic-technology ABMs even at the permitted fixed ABM sites provide further evidence for the traditional view.

These deployment discussions quickened during the winter of 1971-1972, simultaneously with the progress toward agreement on Article II. In late November 1971, Soviet negotiators proposed a general ban on nationwide missile defenses in Article I, suggesting that this could serve as a "partial substitute" for a ban on deployment of all future-technology ABMs. While accepting the ban on nationwide defenses, with some modification, the U.S. delegation insisted that a specific ban on future ABMs was required. In resisting such a specific ban, Soviet negotiator Vadim Chulitsky unambiguously indicated Soviet understanding that Article V covered both present and future ABM technologies, arguing that "the prohibition on air-based, space-based . . ABM systems is adequate to cover the problem of future systems." Sofaer again argues that this reference to "future" systems might refer to future improved versions of interceptors, launchers, and radars, but Chulitsky explicitly indicated he was referring to "unknown systems," and that "no one knows what future systems might be."

Subsequent Practice: *In a 1976 discussion of SALT II, Soviet negotiator Viktor Karpov made clear his understanding that the word "currently" in the ABM Treaty's definition of ABM systems and components broadened the definition to encompass future technologies.*

After a major presentation of the U.S. case for a future-system deployment ban by delegate Harold Brown on December 10, Soviet negotiator Aleksandr Shchukin remarked that future technologies might make the permitted ABM deployments more efficient, and asked why such efficient systems should be prohibited. Nitze replied that agreed provisions such as the limit of 100 interceptors might be rendered meaningless by the greater capability of such future technologies. Under questioning from Nitze, Shchukin suggested that the Soviet side "could agree" that "no such deployment would take place" until both sides agreed on specific limitations on such systems in the Standing Consultative Commission. That concept was eventually codified in Agreed Statement D.

The subsequent negotiations over the details of Agreed Statement D and Article III secured Soviet agreement on a number of key points, including the American distinction between prohibited future "components," which would include devices "capable of substituting for" traditional components, and future "adjuncts," which would assist traditional technologies but not take their place, and would be permitted. These exchanges also include additional Soviet statements accepting the traditional view.

On January 14, for example, when Nitze described the agreement up to that point as providing that "under Article III and in the light of Article I" futures would not be deployed without prior agreement, Shchukin interjected "and also in the light of Article II"—making clear that the Soviet negotiators understood that Article II, with its "currently consisting of" language, applied to future ABM technologies. Similarly, during the January-February negotiations leading up to final agreement on Agreed Statement D, Soviet negotiators argued that since Article II referred to both ABM "systems" and "components," the agreed statement covering futures should do so as well, making clear that they considered such future technologies to be encompassed within the terms "systems" and "components." In late April, when the two sides agreed on a text of Article III prohibiting all deployment of "ABM systems and components" except as explicitly permitted, Grinevsky pointed out that "this would ban 'other systems'"—demonstrating yet again that the Soviet delegation knew and understood that references to "ABM systems and components" included future technologies.

Faced with these repeated Soviet affirmations that the treaty's scope was not limited to traditional technologies, Sofaer was forced into a remarkable admission in his 1987 analysis: "Discussions during the negotiation of Agreed Statement D, and thereafter during the final drafting of Article III's introductory language, indicate that the parties believed that Articles I, II, and III together expressed their intentions to bar deployment of all OPP [other physical principles] devices." In essence, this statement admits that *both* parties agreed that these articles—including the definition in Article II—covered future technologies. But Sofaer did not acknowledge that this destroys the entire case for the broad interpretation—for if the term "ABM systems and components" includes future technologies in Articles I, II, and III, the identical term must also include future technologies in Article V's absolute ban on all development and testing of mobile ABMs.

Sofaer selectively cites early drafts of a comprehensive analysis of the treaty's terms by delegation Legal Adviser John Rhinelander as strong evidence for the broad interpretation, since the drafts include footnotes highlighting the ban on development and testing of mobile ABMs, including exotic technologies, as not yet fully agreed. But had Sofaer consulted Rhinelander or analyzed these memoranda in full, he would have found that they did not reflect doubt over whether Article V applied to future ABMs: rather, there was ambiguity over whether the distinction between future-technology "components" and mere "adjuncts" supplementing traditional components had been fully agreed, and there was a possible loophole created by the order of the words that might have permitted development and testing of a mobile component if it was part of a larger fixed system. Neither doubt has any bearing on the validity of the broad interpretation, and in both cases, the issues were explicitly raised with the Soviets and resolved, with complete Soviet acceptance of the U.S. positions.

As a result, Rhinelander's final analysis of the treaty's terms, accepted unanimously by the entire U.S. delegation and relied on throughout the executive branch in preparing for the Senate ratification hearings, unambiguously supports the traditional interpretation—as even Sofaer acknowledges. The U.S. negotiators had scrupulously carried out the instructions of NSDM 127, gaining Soviet agreement to a ban on development, testing, and deployment of all mobile ABM systems and components, both "current" and "future," while permitting development and testing but not deployment of future ABM systems at fixed, land-based sites.

THE SUBSEQUENT PRACTICE OF THE PARTIES

Under international law, if the meaning of a treaty's text is ambiguous, the next source of evidence is the subsequent practice of the parties. If the subsequent actions and statements of both parties demonstrate their acceptance of a particular interpretation, that interpretation is binding on both. In the case of the ABM Treaty, the record shows that both the United States and the Soviet Union have adhered to the traditional interpretation since 1972, consistently repeating that the treaty bans development and testing of mobile exotic-technology ABMs.

In concrete actions, the United States has restricted all its ABM testing from 1972 to the present to conform with its reading of the traditional interpretation. (There have, however, been disagreements over the specific application of the traditional view to some SDI tests. See Chapter VIII, "U.S. Compliance With the ABM Treaty.") Similarly, Ambassador Nitze has testified that the Soviet Union has abided by the traditional view, and Sofaer acknowledges there is no evidence to the contrary.

Both superpowers have also expressed clear support for the traditional view in their statements, both in public and in private negotiations prior to the U.S. shift of position in October 1985. On the U.S. side, even Sofaer acknowledges that "the U.S. position in bilateral discussions [with the Soviet Union] appears to have been consistent with the restrictive interpretation throughout the period 1973 to 1985." Indeed, when the Defense and Space Talks opened in the spring of 1985, the U.S. position was explicitly based on the traditional interpretation. Publicly, the most comprehensive official analyses of U.S. arms control obligations since the ABM Treaty was signed have been the *Arms Control Impact Statements,* submitted annually to Congress by the president after detailed interagency review. For every year from the first comprehensive statement in Fiscal Year 1979 through Fiscal Year 1985, these statements clearly and unambiguously put forward the traditional interpretation. In the words of the 1985 statement, the "ABM Treaty prohibition on development, testing, and deployment of space-based ABM systems, or components for such systems, applies to directed-energy technologies (or any other technology) used for this purpose." A wide variety of other U.S. statements—including the reports of the Strategic Defense Initiative Organization itself, and speeches by Ambassador Nitze—confirm the traditional view. Before October 1985, there was not a single official U.S. statement directly supporting the broad interpretation.

Soviet statements also provide compelling evidence for the traditional interpretation, despite efforts by Sofaer and others to argue the contrary. Supporters of the broader view have pointed to a statement by then-Soviet Defense Minister Andrei Grechko during the Soviet ratification hearings, indicating that the ABM Treaty "does not place any limitations on the conduct of research and experimental work directed toward solutions of the problems of defense of the country against nuclear-missile strikes." But Grechko's statement does not contradict the traditional view: it simply reiterates that the treaty does not limit research, including laboratory testing, and permits development and testing of ABMs of the only type both sides then possessed—fixed and land-based. Indeed, Grechko did not even mention exotic-technology ABMs. Representatives of the U.S. Defense Department said much the same during the U.S. ratification hearings, urging in general terms that the United States continue ABM research and development—"research and experimental work," in Grechko's words—as permitted by the ABM Treaty.

An exchange during the SALT II negotiations in 1976 offers far more direct evidence on the key issues in the interpretation debate. In discussing how to ensure that a provision limiting multiple-warhead missiles would apply to future designs as well as those then known, U.S. negotiator Ralph Earle suggested the use of the word "currently," much as it had been used in Article II of the ABM Treaty. Viktor Karpov, by then promoted to chief Soviet SALT negotiator, replied that this use of the word "currently" was appropriate in the ABM Treaty "because of the unlimited duration," but not appropriate to SALT II, since that treaty would have a limited term (and presumably therefore would not need to cover technologies then unknown). Karpov's response makes clear that he understood how the word "currently" before "consisting of" in Article II of the ABM Treaty makes clear that the definition encompasses future technologies and not merely those explicitly listed.

After the announcement of SDI in March 1983, Soviet spokesmen repeatedly reaffirmed their view that the ABM Treaty banned testing of space-based lasers and other exotic technologies. For example, in an April 1983 interview, Colonel-General Nikolai Chervov, the head of the arms control directorate of the Soviet General Staff, cited Article V's ban on development, testing, and deployment of space-based ABM systems and components, arguing that it banned "antiballistic missile defense based on new physical principles—lasers, microwave radiation, beam weapons, and so forth." Many other Soviet statements criticized particular SDI tests involving lasers as possible violations of the treaty: While many of these charges were unfounded, they make clear that the Soviets regarded the obligation not to develop, test, and deploy space-based and other mobile ABM systems as including exotic technologies.

In early 1985, in a discussion of SDI in the U.S.-Soviet Standing Consultative Commission, Lieutenant General Viktor Starodubov, the chief Soviet representative, criticized SDI, reportedly indicating his view that the ABM Treaty bans development and testing of space-based systems and components based on exotic technology. Senator Nunn has concluded that this Starodubov statement and the 1976 Karpov-Earle exchange "unequivocally underscore" the traditional interpretation.

On June 4, 1985—more than four months before the Reagan administration announced its reinterpretation, and before Legal Adviser Sofaer had even begun analyzing the issue—*Pravda* carried a detailed and authoritative analysis of the ABM Treaty by Marshal Sergei Akhromeyev, then chief of the Soviet General Staff. Akhromeyev's article indisputably reaffirmed the traditional interpretation, specifically criticizing the view "that the development of 'exotic' antiballistic missile systems (laser and beam weapons, and so forth) is not only not forbidden by the ABM Treaty, but is even virtually encouraged by it." Akhromeyev pointed out that "the ABM Treaty (Article V) forbids the creation and testing of space-based ABM systems or components," and argued that:

> The provisions of the treaty apply to any systems intended, as defined in Article II of the treaty, to counter strategic ballistic missiles or their elements in flight trajectory. Since the ABM components being created within the framework of the 'Strategic Defense Initiative' are intended for precisely this purpose, that is, are designed to replace the interceptor missiles mentioned in the treaty, all the provisions of the treaty fully apply to them, above all the ban on the creation, testing, and deployment of space-based ABM systems or components.

Remarkably, Sofaer's study of the subsequent practice of the parties—not completed until nearly two years after the broad interpretation was announced, despite the central importance of subsequent practice to treaty interpretation under international law—fails to even mention this unambiguous official Soviet statement of the traditional interpretation, made months before the United States raised the issue.

In short, Sofaer's assertion that the Soviet Union began to "articulate the restrictive interpretation" only "after the United States announcement of its support for the broader interpretation in October 1985" is simply false. From 1976 to 1985, top Soviet officials repeatedly reaffirmed the traditional interpretation. And Sofaer has been unable to identify a single Soviet statement that specifically supports the broader view. Since the United States also consistently supported the traditional view until 1985, both in public and in private negotiations, that interpretation is binding on both parties under international law.

> ***"The committee can find no evidence to contradict the conclusion that the Reagan administration's 'reinterpretation' of the ABM Treaty constitutes the most flagrant abuse of the Constitution's treaty power in 200 years of American history."***
> *—Senate Foreign Relations Committee, 1987*

THE RATIFICATION RECORD AND THE SENATE'S POWER

The announcement of the reinterpretation of the ABM Treaty came as a particular surprise to the U.S. Senate, since it contradicted what the Senate had been told during the 1972 ratification hearings. As described above, Sofaer first denied any contradiction, arguing that the ratification record offered "fairly consistent support for the broader interpretation," but was soon forced to backtrack, asserting only that the record was ambiguous and "inconsistent." Sofaer added to that *factual* claim of inconsistency a *constitutional* claim, arguing that while the Constitution requires approval of any treaty by two-thirds of the Senate, the president is not bound to abide by the explanations of a treaty provided to the Senate unless those explanation meet a set of very stringent criteria. These criteria were most clearly and simply expressed in a 1988 letter from then-White House Legal Counsel Arthur Culvahouse, which indicated that only explanations which had been "authoritatively communicated," "clearly intended," and "generally understood and relied upon by the Senate in its advice and consent to ratification" would be binding.

The record, however, does not support Sofaer's factual claim of inconsistency, and his constitutional claim has been decisively rejected both by scholars of constitutional law and by the U.S. Senate.

The fact is that the Nixon administration unambiguously described the ABM Treaty to the Senate as banning development and testing of *all* mobile ABMs, whether based on traditional or exotic technologies. Former President Richard Nixon himself reaffirmed this point on April 15, 1988, saying: "As far as what was presented to the Senate was concerned, it was what we call the 'narrow' interpretation. There is no question about that."

The ratification process began with the transmittal of the ABM Treaty to the Senate, accompanied by a formal executive-branch analysis of the treaty's provisions. In the section describing the treaty's coverage of future-technology ABMs, that analysis describes the definition of ABM systems in Article II as wholly functional: "Article II(1) defines an ABM system in terms of its function as a 'system to counter strategic ballistic missiles or their elements in flight trajectory.'" Since the broad interpretation absolutely depends on reading Article II as a technology-specific rather than a functional definition, this letter provides clear support for the traditional view.

On the first day of Senate hearings, then-Secretary of Defense Melvin Laird was asked whether it would prohibit development of space-based ABM systems using lasers for boost-phase missile defense. In an authoritative written statement for the record, Secretary Laird replied: "With reference to development of a boost-phase intercept capability or *lasers*, there is . . . a prohibition on the development, testing, or deployment of ABM systems which are space-based, as well as sea-based, air-based, or mobile land-based . . . There are no restrictions on the development of *lasers* for *fixed, land-based* ABM systems" (emphasis added). This official, prepared statement unambiguously sets forth the traditional interpretation, arguing that the ban on development and testing of space-based ABMs applies to lasers, leaving development and testing permitted only at fixed, land-based sites. It was simply omitted from Sofaer's early studies of the ratification record.

Later in the hearings, in an exchange with John Foster, then director of defense research and engineering, Senator Henry Jackson asked whether the treaty would prohibit "land-based laser development." Foster said no. Jackson then pointed to Article V's ban on development and testing of mobile systems—still in the context of laser development—and pointed out that for mobile systems, "you can't do anything; you can't

Laser Loophole: *Under the broad interpretation, testing of space-based lasers and other ABMs "based on other physical principles" would be permitted, with no limits on the number or location of such test components, opening a potential for rapid "breakout."*

develop, you can't test, and finally, you can't deploy." After an exchange, Foster replied, "You can develop and test up to the deployment phase of future ABM systems and components *which are fixed and land-based*" (emphasis added). This exchange makes absolutely clear that both Senator Jackson and Director Foster understood that the treaty's distinction between prohibited development and testing of mobile ABMs and permitted development and testing of fixed, land-based ABMs applies to exotic technologies such as lasers.

In a later hearing, Senator Jackson initiated a lengthy discussion of laser ABM systems with General Ryan, then Air Force chief of staff, General Palmer, acting Army chief of staff, Lieutenant General Leber, ABM project manager, and several senators. The exchange focused on how the limits on development and testing of laser ABMs could be verified—making crystal clear that all present understood that there were such limits on development and testing of lasers, which the broad interpretation denies. At the end of the discussion, General Palmer summarized it by saying: "We can look at futuristic systems as long as they are fixed and land based The chiefs were aware of that and had agreed to that and that was a fundamental part of the final agreement."

The Senate's general understanding of the traditional interpretation is further demonstrated by the fact that Senator James Buckley, the treaty's most vocal critic and one of only two senators to vote against the accord, opposed it precisely *because* "Article V of the ABM Treaty, would have the effect, for example, of prohibiting the development and testing of a laser-type system based in space," arguing that such a system might provide an effective defense and should not be banned. Senator Buckley raised this argument both in testimony before the Senate Foreign Relations Committee and in the Senate floor debate.

In short, the ABM Treaty ratification record includes repeated authoritative statements of the traditional interpretation, including the secretary of state's transmittal letter and testimony by the secretary of defense, the director of defense research and engineering, and the acting Army chief of staff, as well as remarks by several influential senators demonstrating their understanding of that testimony. Sofaer has been unable to identify even a single statement explicitly supporting the broad interpretation to support his argument that the record is somehow "inconsistent." There should be no real question that the traditional interpretation was the general understanding shared by the Senate and executive branch at the time of ratification.

The claims by Sofaer and other Reagan administration lawyers that such explanations are not binding on the president unless "clearly intended," "generally understood," and "relied upon" by the Senate are not supported by U.S. constitutional law. In practice, acceptance of these criteria would open the way for reinterpretations of a vast range of treaty provisions, for in the Senate's consideration of the complex terms of most accords, it would be virtually impossible to prove that the entire Senate had not only understood and intended a particular meaning, but relied upon that meaning of that provision in giving its consent to ratification.

The Sofaer doctrine represented a fundamental challenge to the Senate, for if the Senate's understanding of a treaty is rarely binding on the president, the Senate's constitutional power in the treaty-making process is nullified. Moreover, as Senator Nunn concluded, the Sofaer doctrine:

> would compel the Senate to incorporate into its resolution of consent to any treaty an amendment or understanding for every explanation given by an executive branch witness that was deemed important, lest it be disavowed as unilateral after ratification. Treaties so laden would sink under their own weight.

In joint hearings before the Senate Foreign Relations and Judiciary Committees, a wide array of constitutional scholars firmly rejected the Sofaer doctrine. In the words of Louis Henkin, perhaps the nation's leading expert on the Constitution and U.S. foreign relations law, and principle author of the authoritative American Law Institute's *Foreign Relations Law of the United States*:

Kinetic-Energy Weapons And the ABM Treaty

One of the great ironies of the ABM interpretation debate is that although the "broad" interpretation was intended to gain greater leeway for near-term testing and deployment of SDI, there is a broad legal consensus that testing of the rockets intended for such near-term deployment would be prohibited even under the broad view.

Space-based rockets designed to home in on Soviet missiles and destroy them by direct collision are fundamental to the near-term deployment plan the SDI Organization (SDIO) is now focusing on. (See "The Technology of Near-Term Deployment," p.28.) Supporters of "early deployment" have tried to argue that since such missiles would use infrared guidance rather than radar, and would not be armed with nuclear warheads, they are based not on 1972-era technology but on "other physical principles," allowing them to be tested if the broad interpretation is implemented.

But the ABM Treaty *explicitly* prohibits development and testing of all space-based "ABM interceptor missiles." The technologies referred to in Agreed Statement D as "based on other physical principles" are those *"capable of substituting for"* ABM interceptors, launchers, and radars, not variations on ABM interceptors, launchers and radars themselves. There can be no doubt that whatever their guidance or armament, the rockets planned for near-term deployment remain "interceptor missiles."

Moreover, it strains all logic to argue that destroying a target by hitting it with a solid object—the means David used to slay Goliath—amounts to a new "physical principle." Weapons relying on such infrared-guided homing systems were not a futuristic concept at the time the ABM Treaty was negotiated. Rather, they had already been widely deployed for a variety of military roles, including air defense (which was a subject discussed at length during the ABM Treaty negotiations). More than a decade before the ABM Treaty was signed, the United States was exploring such space-based interceptors for an ABM role in a program known as BAMBI (for ballistic missile boost-phase intercept). In addition, the Advanced Research Projects Agency (ARPA) conducted tests of infrared sensors for terminal ABM interceptors at the White Sands missile range in the early 1960s, in a program known as ARPA-Terminal. The Homing Intercept Technology (HIT) program, a research effort exploring infrared-guided kinetic-kill interceptors, was underway during the ABM Treaty negotiations, with sensors for small ABM homing vehicles being tested in hangars. The U.S. negotiators' awareness of the HIT program, which envisioned multiple-warhead ABM interceptors, reportedly contributed to the U.S. proposal to ban such MIRVed interceptors, which was eventually incorporated in the treaty. After the treaty was signed, the HIT program's manager told Congress that the portion of the HIT program involving multiple warheads was prohibited by the ABM Treaty and had been canceled.

This sequence of events makes clear that U.S. research and development on non-nuclear, infrared-guided ABMs was well underway when the ABM Treaty was signed, that the U.S.

> The president can only make a treaty that means what the Senate understood the treaty to mean when the Senate gave its consent . . . The Senate's understanding of the treaty to which it consents is binding on the president Where several statements are made and there is general acceptance of their tenor, that is the Senate understanding.

In the case of the ABM Treaty, it is indisputable that several statements were made and that there was general acceptance of them, making the traditional interpretation constitutionally binding on the president.

Nevertheless, the Reagan administration continued to maintain the Sofaer doctrine, making it necessary for the Senate to reassert its constitutional power. The issue came to the fore as the Senate prepared to consider the Intermediate-range Nuclear Forces (INF) Treaty, for the Senate had to assure itself that the interpretations of the treaty provided by the Reagan administration would not later be reversed. After a prolonged debate, the Senate approved a condition to its resolution of ratification requiring that the treaty be interpreted "in accordance with the common understanding of the treaty shared by the President and the Senate at the time the Senate gave its advice and consent to ratification . [and] the United States shall not agree to or adopt an interpretation different from that common understanding except pursuant to Senate advice and consent

negotiators were aware of that work and considered such interceptors "ABM interceptor missiles" covered by the ABM Treaty, and that U.S. ABM program managers were also aware that such interceptors were covered by the accord.

In addition, the subsequent practice of the parties makes clear that missiles need not be guided by radars to be considered "ABM interceptor missiles" restrained by the treaty's limits. In 1978, the two parties completed an agreed statement regulating testing "in an ABM mode," which the Reagan administration described as referring explicitly to rockets with "the capability to carry out an interception without being guided by an ABM radar" as "ABM interceptor[s]." Senator Nunn has reported that the classified records of the negotiation of this statement further strengthen the case that such rockets constitute ABM interceptor missiles.

Even Paul Nitze, the only advocate of the broad interpretation among the U.S. ABM Treaty negotiators, has strongly criticized the view that the interpretation would apply to SDIO's space-based interceptor concept, arguing that "the application of its physical principles was understood in 1972 and thus is not based on OPP (other physical principles). Moreover, the negotiating record does not support the notion that the absence of a nuclear warhead or the use of a guidance system not based on ABM radars exempts a missile from the constraints of the treaty." Nitze has also argued that even if a case could somehow be made that such a missile was not an ABM interceptor, it would then be a non-ABM interceptor, whose testing in an ABM mode is prohibited by Article VI.

If interceptors using infrared guidance and non-nuclear kill are "based on other physical principles," then SDI's ground-based Exoatmospheric Reentry-Vehicle Interceptor Systems (ERIS) rocket must be considered a futuristic system as well, and its deployment even at the permitted Grand Forks ABM site would be prohibited. Yet Defense Department witnesses have repeatedly referred to ERIS as an ABM interceptor missile, and testified that deployment of 100 ERIS interceptors at Grand Forks is permitted, further undermining the case that such homing rockets can be considered "other physical principles."

Faced with these difficulties, the Reagan Defense Department put forward a broader-than-broad interpretation, arguing that if an ABM system contained any exotic-technology components, then the entire system should be considered "based on other physical principles," allowing mobile components associated with it to be tested. This view of the treaty is absurd on its face, and directly contrary to the treaty's object and purpose, for it would allow unlimited testing of mobile traditional-technology components as long as a single exotic-technology component could be mustered to test along with them. Nitze has strongly rejected this view as well, pointing out that if it were accepted, "circumvention . would be easily accomplished, and the main purpose of the treaty would be undermined."

In short, rockets designed to intercept strategic missiles are "ABM interceptor missiles" regardless of their guidance systems or warheads, and testing of such ABM interceptors is expressly prohibited, under either the traditional or the broad interpretation of the ABM Treaty.

to a subsequent treaty or protocol, or the enactment of a statute." The condition held that the "common understanding" of the treaty's meaning was to be found first in the text of the treaty and the resolution of ratification, and second, in the descriptions of the treaty provided by the executive branch during the ratification hearings. The following day, when Senator Arlen Specter (R-PA) introduced an amendment which would have specifically reaffirmed the Reagan administration's criteria for judging when the ratification record is binding on the president, it was defeated by a vote of 67-30.

> ***"Adhering to the ABM Treaty in its traditional form would not seriously hamper a sensible research and development program for another decade . . . We would forfeit very little in technical terms by remaining in compliance with the treaty and thereby continuing to reap its contributions to our security."***
>
> *—Brent Scowcroft, 1988*
> *President Bush's National Security Adviser*

These votes directly repudiated the Sofaer doctrine. Basing itself on "the treaty clauses of the Constitution," the condition to the INF Treaty reaffirmed constitutional principles that apply to all treaties—including the ABM Treaty—as both supporters and opponents pointed out during the Senate debate. Combined with the clear evidence contradicting Sofaer's factual claim that there was no general understanding of the ABM Treaty at the time of ratification, these basic constitutional principles make clear that the broad interpretation is illegal; the traditional interpretation of the ABM Treaty is the law of the land, under the Constitution of the United States.

THE SECURITY IMPACT OF THE REINTERPRETATION

Supporters of the reinterpretation—perhaps recognizing the weakness of their legal case—have argued that the interpretation debate has focused too narrowly on legal issues, ignoring broader security concerns. But a weighing of the risks and benefits for U.S. security of implementing the broad interpretation also strongly supports maintaining the traditional view. It was, after all, the Nixon administration's judgment of U.S. security interests that led it to propose the ban on development and testing of mobile exotic-technology ABMs in 1971. In 1987, six former secretaries of defense agreed that the ABM Treaty in its traditional interpretation continued to serve U.S. security interests, and recommended that "the United States and the Soviet Union should continue to adhere to the traditional interpretation."

Advocates of the broad interpretation argue that the Soviet Union never accepted the restraints of the traditional view, and that therefore limiting SDI testing to the traditional interpretation amounts to "tying our hands while our adversary's hands are not tied at all," as then-Secretary of State George Shultz put it in 1987. But the basic premise of this argument is simply incorrect, since the Soviet Union has committed itself to the traditional interpretation repeatedly, both before and after the broader view was made public. Had "unilateral restraint" ever been a serious issue rather than a debating point, U.S. negotiators could have sat down with their Soviet counterparts and translated the repeated Soviet public commitments into an explicit agreed statement confirming the traditional view. That option was never taken, because the Reagan administration simply did not wish to be bound by the view of the treaty the Soviet Union had long accepted.

Supporters of the broad interpretation have also argued that adhering to the traditional view would severely damage the SDI program and make the research far more expensive. In fact, however, a substantial research and development program can be carried out under the traditional interpretation. Harvard physicist Ashton Carter, after conducting an extensive classified study of the planned SDI testing program under contract to the Reagan administration, concluded that "all of the outstanding scientific and technological issues identified at this time that bear upon the feasibility of SDI concepts can be addressed within the ABM Treaty as traditionally interpreted."

There are several reasons why the traditional interpretation need not prevent the United States from carrying out an effective SDI research program. First, much of any future strategic defense will be ground-based, and the ABM Treaty permits development and testing of ground-based ABMs. Even for space-based technologies, the ABM Treaty does not ban all experiments, but only the testing of full-scale ABM "components." Space experiments to collect data on many of the technological issues facing the program are already under way, many of which raise no serious questions of compliance with the treaty.

The traditional interpretation would, however, prohibit the testing of full-scale space-based ABM weapons and sensors. But testing of space-based rocket interceptors, the primary near-term SDI space weapon, would also be banned under the broad interpretation. (See "Kinetic-Energy Weapons and the ABM Treaty," p.70.) Full-scale testing of longer-term ABM weapons such as space-based lasers and particle beams would be prohibited by the traditional interpretation, but the most important issues facing such weapons are those of cost and vulnerability, issues which do not require full-scale space testing in the near or medium term. Possibly more promising ground-based free-electron lasers remain in the infancy of research, with no tests that would raise substantial ABM Treaty questions likely until the twenty-first century. (See Chapter IV, "The Strategic Defense Initiative.")

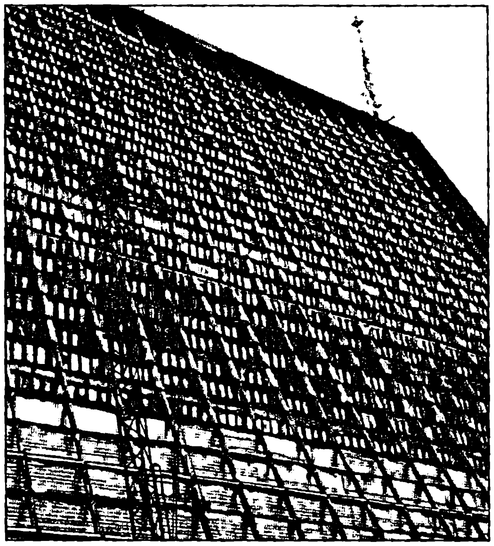
In short, there would be few near-term benefits of a shift to the broad interpretation. But the dangers posed by such a move would be substantial. As described above, implementing the broader view would eviscerate the ABM Treaty, eliminating many of the treaty's protections against rapid breakout from the accord and thereby increasing the risks to U.S. security that might be posed by future Soviet ABM programs. In such an environment, the complete collapse of the ABM Treaty would be likely, potentially leading to an expensive and dangerous race between missile defenses and increased offensive forces. At the same time, the Soviet Union has made clear that it would consider U.S. pursuit of SDI testing in violation of the traditional view as grounds for withdrawal from START, destroying that agreement and likely eliminating any chance of the more sweeping START II pact that now seems possible. Such a breakdown in the strategic arms control process could have a disastrous impact on the current warming trend in U.S.-Soviet relations, potentially setting back other negotiations as well. (See Chapter X, "Nationwide Missile Defenses or the ABM Treaty?")

In addition, implementation of the broader view could touch off a major political crisis within the NATO alliance. Even the most staunchly conservative U.S. allies, such as Britain's Prime Minister Margaret Thatcher and West Germany's Chancellor Helmut Kohl, have been strongly critical of the broad interpretation. Rejecting their views would exacerbate fears of U.S. "unilateralism" at a particularly sensitive time for the future of NATO.

Implementing the broad interpretation would also provoke a major confrontation between the president and Congress. Strong majorities in both houses of Congress have rejected the broad interpretation, and any effort to override those congressional views would mire the national security process in divisive debate.

Finally, the United States has a substantial security interest in the rule of law in international relations. As the Reagan administration's compliance reports pointed out, the continued functioning of international law requires that "states must honor obligations they have solemnly undertaken." Implementing a radical reinterpretation of the ABM Treaty with virtually no legal basis would cast doubt on the credibility of all U.S. treaty obligations, and virtually sanction similar Soviet "reinterpretations" of key treaties to suit their interests. As Senator Nunn has said, "If we are going to have a safer and saner world, the United States must stand for the rule of law. It is not out-moded for America to keep our word of honor—even in dealing with the Soviet Union."

By reaffirming the ABM Treaty in its traditional interpretation, President Bush could avoid all of these security risks, and do much to moderate the long-running controversy over SDI. In doing so, he would be following the recommendation of Brent Scowcroft, his national security adviser; of six former secretaries of defense; of a strong majority of U.S. allies; and of majorities of both houses of Congress. And he would keep the door open for historic agreements mandating deep reductions in the offensive strategic forces of both the United States and the Soviet Union.



A close-up of the face of the Soviet Krasnoyarsk radar.

VII. Soviet Compliance With the ABM Treaty

Disagreements over implementation and compliance are an inevitable part of complex arms control agreements. Until the Reagan administration came to power, such disagreements were constructively discussed and resolved in the U.S.-Soviet Standing Consultative Commission (SCC), the organization created for that purpose by the ABM Treaty. During that time, no U.S. administration, Republican or Democratic, ever charged the Soviet Union with outright violations of the ABM Treaty. As recently as 1982, the U.S. government reported that "in each case raised by the United States [in the SCC], the Soviet activity in question has either ceased or additional information has allayed U.S. concern."

But beginning in 1984, the Reagan administration charged the Soviet Union with a "continuing pattern" of violations of arms control agreements, including the ABM Treaty. The Soviet Krasnoyarsk radar, discovered in 1983, and the 1987 movement of parts of dismantled radars to the city of Gomel were identified as outright violations of the treaty, while several other Soviet ABM-related activities were described as "probable" or "potential" violations of the accord. With the exception of the Krasnoyarsk radar, however, these charges were not supported by the evidence, resting on contentious interpretations of the available data and the treaty language. The Reagan administration's charges seriously distorted the overall compliance picture, exaggerating problem areas of relatively minor military significance while ignoring the undisputed positive record of Soviet compliance with most treaty provisions.

In recent years, Soviet compliance behavior has greatly improved. In response to U.S. concerns over the location of dismantled radar pieces at Gomel, for example, the Soviet Union invited a U.S. inspection which was not required by the ABM Treaty, and when U.S. officials remained unsatisfied, destroyed the offending radar pieces. In September 1989, the Soviet Union agreed to completely dismantle the Krasnoyarsk radar without preconditions, and in a stunning speech to the Supreme Soviet the following month, Soviet Foreign Minister Eduard Shevardnadze admitted that the radar violated the ABM Treaty. The available evidence suggests a pattern of greater civilian oversight of military programs to ensure their compliance with international agreements. Even former Arms Control and Disarmament Agency Director Kenneth Adelman, one of the Reagan administration's harshest critics of alleged Soviet "cheating," recently acknowledged: "With glasnost comes compliance."

In its first public report on Soviet compliance, issued in February 1990, the Bush administration acknowledged some of these positive changes, expressing the hope that "through the institutionalization of a more accountable Soviet government... a lasting foundation will be laid for constructive Soviet behavior." Unfortunately, however, while the 1990 report abandoned or toned down some of the Reagan administration's most insupportable charges, others were repeated, and the report continued to distort the compliance picture by ignoring the ABM Treaty's overall record of success. Most seriously, the Bush administration report repeated the charge that the "totality of Soviet ABM and ABM-related activities . . . suggest that the USSR may be preparing a defense of its national territory," in violation of the ABM Treaty's fundamental ban on nationwide missile defenses. This charge is contradicted by overwhelming contrary evidence: There is little doubt that the Soviet Union intends to remain within the ABM Treaty's terms as long as the United States does likewise. Soviet leaders have clearly recognized that the ABM Treaty continues to provide substantial security benefits to both the United States and the Soviet Union.

THE KRASNOYARSK RADAR

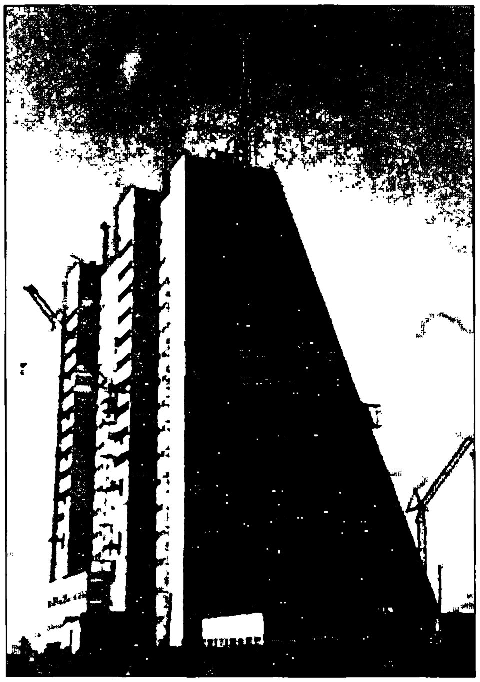
Since its discovery in 1983, the partially constructed Soviet radar near Krasnoyarsk has been the centerpiece of charges of Soviet noncompliance with the ABM Treaty. The Bush administration's February 1990 report called the radar "a significant violation of a central element" of the treaty.

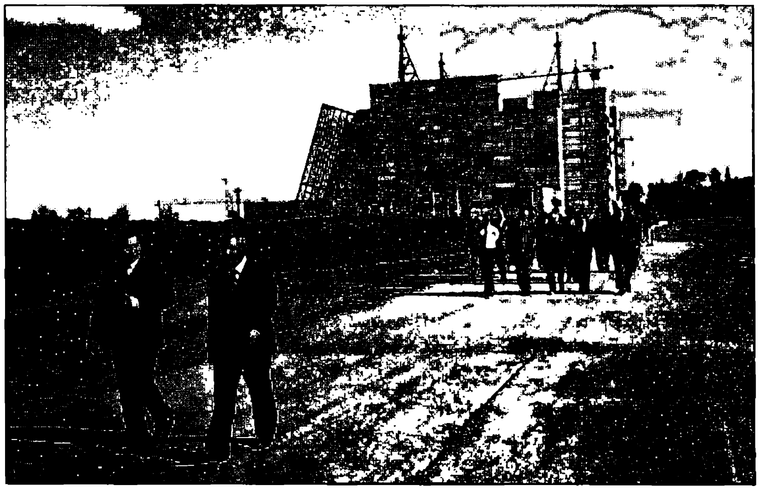
Background

In mid-1983, U.S. intelligence discovered a new large phased-array radar (LPAR) under construction in central Siberia at Abalakovo, north of the city of Krasnoyarsk, about 740 kilometers from the nearest Soviet border. The radar is oriented toward the northeast, away from the border. Separate buildings have been constructed for the radar transmitter and receiver, both at an angle appropriate to tracking targets coming over the horizon, as is generally the case with early warning radars. The radar is similar in design to eight other new early warning radars operational or under construction. These radars, dubbed the "Pechora" class, cover almost all approaches to the Soviet Union.

The ABM Treaty permits new early warning radars only on the periphery of the country and oriented outward, but radars for space tracking are not limited. In the fall of 1983, the United States questioned Krasnoyarsk in the SCC, arguing that it was clearly designed for "ballistic missile detection and tracking," as U.S. compliance reports have put it, and was therefore illegal at its inland location. Then and for years thereafter, the Soviet Union claimed that Krasnoyarsk was designed as a permitted space-tracking radar. The United States rejected this claim, pointing out the radar's similarity to other Soviet early warning radars, its location filling a major gap in Soviet early warning coverage, and the lack of any convincing rationale for a space-tracking radar of that design and orientation at that site.

During several years of negotiations over the Krasnoyarsk issue, the Soviet position gradually evolved, while the United States maintained the view that the radar was a violation and should be completely dismantled without preconditions. In October 1985, the Soviet Union offered to halt construction at Krasnoyarsk in return for U.S. abandonment of early warn-





Illegal Radar: *The Soviet Union has now acknowledged that the Krasnoyarsk radar violates the ABM Treaty, and has pledged to dismantle it. Never completed, the radar was to be part of a new Soviet early warning network. Its design indicates it would have had no significant ABM battle-management capability. In 1987, the Soviet Union permitted a U.S. group to inspect the facility, including both the transmitter (above) and the receiver (left), and unilaterally ceased construction.*

ing radars at Thule, Greenland, and Fylingdales Moor, United Kingdom. In September 1987, the Soviet Union permitted a U.S. congressional team to inspect the facility. A month later, Soviet leader Mikhail Gorbachev announced a unilateral moratorium on construction at Krasnoyarsk. Then, in July 1988, Soviet negotiators offered to dismantle the radar's "equipment," while leaving the structure, if the United States agreed to abide by the traditional interpretation of the ABM Treaty. In September of that year, after the third ABM Treaty Review Conference had ended in discord over the Krasnoyarsk issue, Gorbachev announced a plan to turn Krasnoyarsk over to an international space organization, to be operated as a space research center, and a month later it was announced that administrative control of the facility would be shifted from the military to the Academy of Sciences. In May 1989, the Soviet Union reportedly offered to dismantle the radar completely, but again tied the issue to U.S. compliance with the traditional interpretation, a link unacceptable to both the Reagan and Bush administrations.

> ***"The Krasnoyarsk radar installation. . . . [is] to put it bluntly, a violation of the ABM Treaty. At last we resolved this issue and announced we would dismantle the station."***
> *—Eduard Shevardnadze, 1989*
> *Soviet Foreign Minister*

Then in September 1989, at the Wyoming ministerial meeting between U.S. Secretary of State James Baker and Soviet Foreign Minister Eduard Shevardnadze, the Soviet Union finally agreed to dismantle the radar in its entirety, without preconditions or links to other issues. A month later, in a remarkable speech to the Supreme Soviet, Shevardnadze acknowledged that the radar is "a violation of the ABM Treaty."

As of February 1990, the Bush administration reported that "the Soviets have not yet begun dismantlement of this radar," although "preparations for dismantlement may have begun." Reportedly, a large crane has been moved to the site. The Bush administration argues that to be "satisfactory," elimination of the radar must be sufficiently complete to "reestablish the lead time [for radar construction] that was the purpose of the LPAR provisions of the ABM Treaty."

Analysis

As the Soviet Union has now admitted, the Krasnoyarsk radar is a clear violation of the ABM Treaty. Its location and all of its characteristics identify it as an early warning radar, not a space-tracking facility. The recent Soviet decision to dismantle Krasnoyarsk in its entirety will eliminate this violation. The Soviet acknowledgement that the radar violates the ABM Treaty and the pledge to dismantle it completely without accompanying concessions from the United States are perhaps the most striking examples of the Soviet Union's new approach to compliance policy, which bodes well for maintaining the effectiveness of the ABM Treaty and other arms control agreements in the future.

While any large-scale violation of an arms control agreement is unacceptable, the Krasnoyarsk radar never posed a major threat to U.S. security. First, of course, it was never completed: the radar buildings were never more than empty shells, years from operation. More fundamentally, overwhelming evidence indicates that Krasnoyarsk is an early warning radar in the wrong place, not an ABM radar. The radar is an undefended, soft target which would be extremely vulnerable to attack. The congressional inspection team found that the radar is shoddily constructed and totally unhardened against nuclear blast and electromagnetic pulse (EMP). It is difficult to imagine that Soviet military planners would have installed fragile windows on most floors of the radar buildings and relied on outside power supplies, as the congressional inspection team found, if they intended the Krasnoyarsk radar to manage a nuclear battle.

Just as important, Krasnoyarsk and the other Pechora-class radars are reportedly designed to operate at a frequency of roughly 150 megahertz, more than 10 times lower than the frequencies used by modern ABM battle-management radars. This frequency is well-suited for the long-range detection required for early warning, but provides less accurate tracking data for antimissile defense than higher-frequency radars do, and is extremely susceptible to blinding by "blackout" from nuclear blasts—a vulnerability the CIA has emphasized in public testimony.

For these reasons, the CIA has reportedly concluded that Krasnoyarsk is "not well designed" as an ABM radar. Anthony Battista, a technical expert who accompanied the congressional inspection team, summed up the situation by saying: "this radar, if it were turned on today, would be an early warning radar—not a very good one, either." Krasnoyarsk appears to have been placed at its illegal inland location to provide cost-efficient early warning, filling an early warning gap which could only otherwise be filled at much higher cost by deploying one or even two radars in northeastern Siberia, far from major transportation networks. Because Krasnoyarsk, even if completed, would have had little capability to manage an ABM battle, this violation never fundamentally undercut the ABM Treaty's objectives in constraining such LPARs.

The Standing Consultative Commission

Article XIII of the ABM Treaty provides for the establishment of a U.S.-Soviet Standing Consultative Commission (SCC), intended for discussions of the treaty's implementation, ambiguities, compliance issues, and consideration of further steps to strengthen the treaty or additional limitations on strategic arms. In practice, the subjects considered in the SCC have largely been limited to the first three of these topics, with additional arms limitations considered in the ongoing strategic arms talks. The SALT I Interim Agreement, SALT II, and the Accidents Measures accord assigned similar responsibilities to the SCC.

Although much of its work focuses on compliance with arms agreements, the SCC is not a judicial body reaching judgments of "guilt" or "innocence," but simply a private forum for discussion between the two sides. Its success is therefore dependent on both sides' willingness to work to reach mutually acceptable resolutions of the issues before it. The United States and the Soviet Union are each represented in the SCC by a commissioner, a deputy commissioner, and a variety of supporting negotiators. Both sides have generally chosen high-level experts as their SCC commissioners. The SCC meets every spring and fall, and at any other time the commissioners agree. All proceedings are confidential, to encourage candid discussions of the sensitive issues the SCC addresses.

The SCC has been remarkably successful in reaching agreements on treaty implementation (such as procedures for observably dismantling weapons eliminated under treaty provisions), and in clarifying ambiguities that have raised questions of compliance. (For a summary of SCC agreements related to the ABM Treaty, see Appendix B.) On one occasion, for example, it appeared that the Soviet Union was beginning new missile silo construction, forbidden by SALT I. In SCC discussions, the Soviets indicated that the new facilities were command centers, not missile silos, and eventually the pieces of the new facilities were laid out for observation by U.S. intelligence satellites, resolving the issue. On another occasion, as described in the chapter, Soviet use of air-defense radars at the Sary Shagan test range led to U.S. concerns over the possibility that the radars were being tested in an ABM mode. The Soviet Union ceased the activity in question soon after U.S. representatives raised it in the SCC, and the two sides reached an agreed definition of the term "tested in an ABM mode" in 1978—of which, as the Bush administration acknowledges, there have been "no known violations." While the hostile atmosphere of U.S.-Soviet relations during much of the Reagan administration—particularly on the issue of alleged "cheating" on arms agreements—impeded progress in the SCC, the resolution of the Gomel issue toward the end of the Reagan administration's second term provides another example of SCC success. When U.S. negotiators questioned the presence of pieces of dismantled radars at Gomel, the Soviet Union permitted a U.S. team to inspect the radar parts, and when the United States remained concerned, destroyed them, allowing another inspection to confirm that the destruction had taken place.

> ***"The SCC has proven to be an effective forum for raising, discussing, and resolving questions concerning compliance."***
>
> *—Sidney Graybeal, 1979*
> *Former U.S. Commissioner to the SCC*

The harsh criticisms of the SCC by some Reagan administration officials, such as then-Secretary of Defense Caspar Weinberger's 1985 claim that the SCC "has failed to resolve any significant compliance issue," rendering it "an Orwellian memory-hole into which our concerns have been dumped like yesterday's trash," are simply wrong. The SCC has been an effective, even essential, forum for the implementation and maintenance of arms control agreements. Indeed, despite its virulently negative attitude toward the SCC, the Reagan administration found itself forced to create a very similar forum, the Special Verification Commission (SVC), to implement the INF Treaty. Any complex agreement will require discussion between the parties after it is reached; the initial agreement is only the first step in a continuing process. Hence, forums such as the SCC will be indispensable tools for implementing the arms control agreements of the future.

Beyond the clear demonstration of the changed Soviet approach to compliance, there are two lessons to be learned from the Krasnoyarsk episode. First, contrary to the charges of arms control critics, the U.S. government and the arms control community do not respond to cases of clear and continuing violations by sweeping them under the rug, but by pressing the case to correct the violation until the issue is resolved. Both houses of Congress, for example, voted virtually unanimously to call Krasnoyarsk a violation and to demand its removal, a step which the Bush administration's report indicates was "of immeasurable value in convincing the Soviet Union that this violation must be corrected." Second, the United States should never throw the baby out with the bathwater by repudiating a violated agreement (or undertaking its own violations in "response") until all possible avenues of resolution have been pursued and all the security consequences explored. Had the United States repudiated the ABM Treaty in response to Krasnoyarsk, as many in the Reagan administration recommended, the Soviet Union would have had no incentive to ultimately dismantle the radar—and the current prospects for substantial offensive arms reductions would not exist.

> ***"Krasnoyarsk is an early warning radar that is located in the wrong place. I do not think it is a great threat to U.S. security because I do not think it has that much capability."***
>
> *—Harold Brown, 1985*
> *Former Secretary of Defense*

'DEPLOYMENT' OF ABM RADARS AT GOMEL

President Bush's February 1990 compliance report repeats the Reagan administration's charge that the Soviet Union "violated the ABM Treaty" by "deployment" of parts of Flat Twin and Pawn Shop ABM radars at Gomel, which is neither a permitted ABM deployment area nor an ABM test range. However, the report acknowledges that the Soviet Union has destroyed the radar parts in question, and concludes that they "are no longer deployed in violation of the ABM Treaty."

Background

Articles III and IV of the ABM Treaty prohibit all deployment of ABM systems and components outside of permitted ABM deployment areas or test ranges. "Deployment" is not specifically defined. The Flat Twin and Pawn Shop ABM radars in question had been legally stationed at the Soviet ABM test range at Sary Shagan, and were dismantled in early 1987. Later that year, disassembled parts of one Flat Twin and an empty Pawn Shop container reappeared near an electronics plant in Gomel, north of the city of Kiev. An additional Pawn Shop container was moved to Vnukovo, near Moscow. The Soviet Union indicated that the radar parts would be used in the civil economy.

The Reagan administration argued that the movement of radar parts to Gomel constituted "initiating deployment," in violation of the ABM Treaty. The Soviet Union denied the charge, arguing that the Flat Twin was not reassembled, and that the Pawn Shop container did not have its radar equipment installed. To allay U.S. concerns, the Soviet Union offered to allow U.S. inspectors to examine the radar parts at Gomel and Moscow. The United States accepted, but publicly charged the Soviet Union with violating the treaty before the inspection had even been carried out. In December 1987, a U.S. team led by Manfred Eimer, assistant director of the Arms Control and Disarmament Agency (ACDA) inspected the radar parts at both Gomel and Moscow. The team reportedly found the radars to be disassembled, as the Soviet Union had reported, but the Reagan administration argued that the presence of substantial parts of the radars at the site still constituted illegal "deployment," and the Bush administration has now repeated that charge.

In October 1988, while continuing to deny any violation, the Soviet Union offered to destroy the remaining radar parts, and the United States and the Soviet Union agreed on procedures for doing so in December 1988. The Pawn Shop and Flat Twin parts were destroyed that winter. The Bush administration's February 1990 compliance report acknowledges that the radar parts have been destroyed, but complains that "the Soviet Union failed to honor certain specific procedures" in their destruction.

As this problem originally arose as the result of the Soviet dismantlement of the radars at their ABM test range, Soviet negotiators at the 1988 ABM Treaty Review Conference proposed negotiating specific procedures for such dismantlement, to avoid a recurrence of similar issues.

Analysis

The charge that the Gomel radar parts once violated the ABM Treaty is totally unjustified. The available evidence indicates that the Flat Twin and Pawn Shop radars were in fact disassembled and nonfunctional, and were never intended to be "deployed" at Gomel. Even the Reagan administration compliance reports that raised the charge acknowledged that only "parts" of the radars were located at Gomel, and that "it is not likely that the actions at Gomel are to support an ABM defense at that locality." Given that acknowledgement, there is no substantial basis for a charge of violation: placing a nonfunctional portion of a radar, of a type clearly capable of being relocated over a period of time, at a particular site simply does not plausibly constitute "deployment" at that location. In the words of Sidney Graybeal, the U.S. SCC representative who led the negotiations over procedures for radar dismantlement in the 1970s: "It is no more a violation than if we take a radar from our ABM test range, take it back to a facility at Raytheon, take it apart, and have it sitting there."

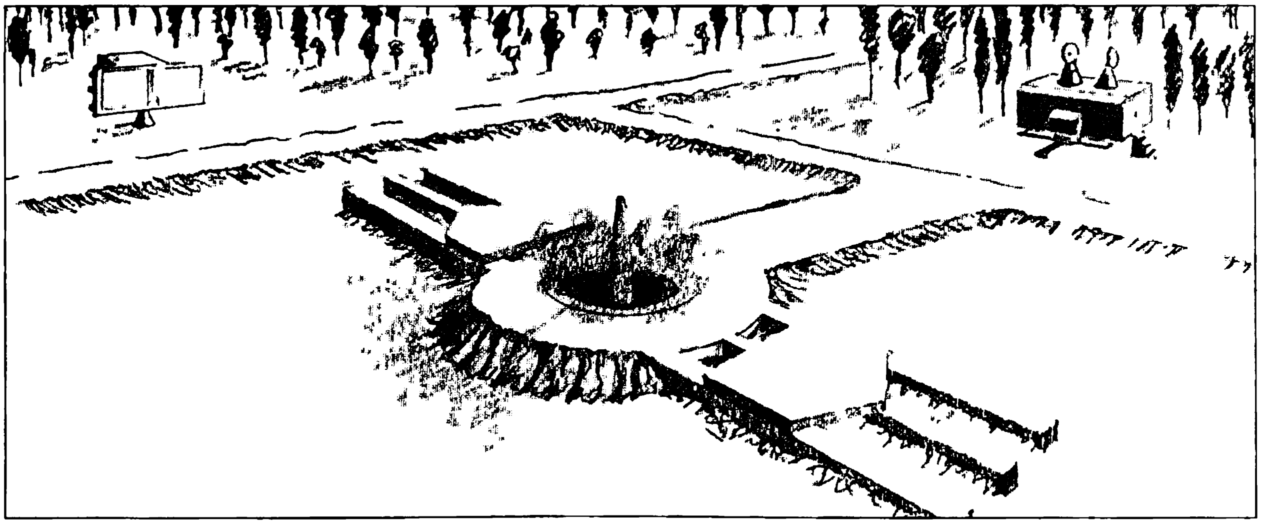
Coming before the agreed inspection had even been carried out, the original public charge of violation was clearly premature—a particularly extreme example of the Reagan administration's practice of making grave public accusations before all the evidence was available and all avenues for resolution had been explored. Indeed, Soviet behavior in resolving this issue has, by and large, been exemplary: As soon as a question was raised, the Soviet Union offered an inspection which was not required by the treaty; when the United States continued to press the charge, the Soviet Union destroyed the remaining radar parts, with no suggested linkage to any other issue; and the Soviet Union offered to negotiate new procedures to avoid such disagreements in the future. With these steps, the issue has been laid to rest, as the Bush administration's report acknowledges. The past disagreement over the specific procedures of destruction is a detail, though it would be useful to discuss and resolve the matter to avoid similar disagreements in the future.

'MOBILITY' OF ABM SYSTEM COMPONENTS

The February 1990 compliance report takes a somewhat ambiguous approach to the issue of whether the Soviet Pawn Shop and Flat Twin ABM radars should be considered "mobile" in the sense prohibited by the ABM Treaty. While the report does not repeat the Reagan administration's charge that development and testing of these radars "represents a potential violation" of the treaty, it does charge that the Pawn Shop is "road-mobile." The report acknowledges that the Soviet elimination of all existing Pawn Shop radars and the Flat Twin radar parts from Gomel "has lessened U.S. concern regarding ABM component mobility."

Background

Article V of the ABM Treaty prohibits the development, testing, and deployment of mobile land-based ABM systems and components. Mobile ABM components are defined in a Common Understanding as being those that are "not permanent fixed types." In the 1970s, the Soviet Union began testing two new ABM radars, the Flat Twin and the Pawn Shop. The Flat Twin is the larger of the two, a modular radar which was first observed in 1971. According to some estimates, the Flat Twin could be set up on a prepared site in several



Radar Controversy: *The Reagan administration charged that the Soviet Flat Twin radar, shown at left in this artist's concept, and the accompanying Pawn Shop radar (right) constituted a "potential violation" of the ABM Treaty's ban on testing of mobile ABM components. However, neither is truly mobile, and the Soviet Union has abandoned the development program of which they were a part and destroyed most of the radars involved.*

months. U.S. concern was originally aroused by the fact that a Flat Twin radar, which had initially been tested at the Sary Shagan ABM test range, was disassembled in 1975 and moved to the Kamchatka peninsula within a period of months, rather than the years required to build most previous ABM radars. (The Soviets indicated that the Kamchatka site was also an ABM test range, though they had not previously identified it as such; disagreement over the incident led to a new accord on the designation of permitted ABM test ranges.) The Pawn Shop is a radar housed in a van-size container. Prior to the dismantlement of the Pawn Shop radars at Sary Shagan and the movement of the empty radar vans to Gomel and Moscow, no movement of Pawn Shop radars had ever been reported.

Despite earlier predictions, neither the Pawn Shop nor the Flat Twin were ever deployed as part of the upgrade of the Moscow ABM system. Indeed, prior to their disassembly, neither radar had ever been located outside of ABM test areas, where only three Pawn Shop and three Flat Twin radars were ever observed. All but two Flat Twin radars (one at each of the Soviet ABM test ranges) have now been dismantled. Aside from the dismantlements, little Flat Twin or Pawn Shop activity has been observed in recent years.

Analysis

The issue in this case hinges on the interpretation of the term "mobile" as used in the ABM Treaty, and its application to the characteristics of the Pawn Shop and Flat Twin radars. When the treaty was being drafted, the United States was concerned about the mobility of the Soviet SA-2 air-defense missile system, components of which could be dismantled and quickly reassembled at a new site. U.S. negotiators reportedly held the view that if a component could be moved within a week or less, it would be considered mobile and therefore banned by the treaty. Declassified negotiating records indicate that U.S. negotiators described the word "mobile" to their Soviet counterparts as meaning systems "designed to be moved frequently during their service life," and specifically indicated that the limitation of ABM radars to those that were "permanent fixed types" would not necessarily prohibit "a system transported from a factory to a site."

By these standards, neither the Flat Twin nor the Pawn Shop would appear to be "mobile." The Bush administration's charge that the Pawn Shop is "road-mobile" does not appear to be justified. Surely the United States would not accept a judgment that a U.S. radar was "road-mobile" simply because substantial portions of it could be loaded onto a large vehicle at the production plant and shipped to a test range for assembly. In the case of the Flat Twin, the Bush administration acknowledges that it "cannot be said to be truly mobile"; while the report points out that it also cannot "be considered to be immobile," complete immobility is not the standard set in the ABM negotiations, as described above.

Indeed, although these issues date from the 1970s, no U.S. administration before President Reagan's chose to even raise the matter in the SCC, let alone issue a public charge of potential violation. As a 1978 U.S. government report on Soviet compliance concluded:

> The [new ABM system undergoing testing] and its components can be installed more rapidly than previous ABM systems, but they are clearly not mobile in the sense of being able to be moved about readily or hidden. A single operational site would take about half a year to construct. A nationwide ABM system based on this new system under development would take a matter of years to build.

Nothing that would change this conclusion has transpired since then. Indeed, except for the recent dismantlements, there has apparently been very little Pawn Shop- and Flat Twin-related activity since the 1978 report was written. Flat Twin and Pawn Shop represent Soviet technology some two decades old. Given the decision not to incorporate these systems in the Moscow ABM, the destruction of all of the Pawn Shop radars and one of the Flat Twins, and the very low level of activity reportedly associated with these radars in recent years, it appears that Flat Twin and Pawn Shop were part of a development program that has long since been abandoned, and pose little remaining cause for concern.

CONCURRENT OPERATIONS OF ABM AND AIR-DEFENSE COMPONENTS

The February 1990 compliance report charges that the Soviet Union "probably has violated" the ABM Treaty's ban on testing air-defense radars "in an ABM mode." But the report acknowledges that these alleged violations are not of the treaty itself but of a U.S. interpretation of the phrase "testing in an ABM mode," put forward in a unilateral statement in 1972, and that there have been "no known violations" of the agreed definition of the phrase, reached in the SCC in 1978.

Background

Article VI of the ABM Treaty prohibits testing non-ABM systems and components "in an ABM mode." No agreed definition of this phrase was reached during the negotiations. But in a unilateral interpretation (appended to U.S. texts of the treaty as Unilateral Statement B) U.S. negotiators stated that they would consider a radar to have been "tested in an ABM mode" if it "makes measurements on a cooperative target vehicle" having "a flight trajectory with characteristics of a strategic ballistic missile flight trajectory" during reentry, or "makes measurements in conjunction with the test of an ABM interceptor missile or an ABM radar at the same test range." The U.S. statement indicated that "radars used for purposes such as range safety or instrumentation would be exempt from application of these criteria."

During 1973 and 1974, U.S. intelligence observed that an air-defense radar associated with the SA-5 SAM system had been operating at the Sary Shagan test range during ABM tests. While it was not certain whether these concurrent operations might have been for purposes such as range safety or instrumentation, the circumstances constituted a basis for concern, and the United States raised the issue in the SCC. The activities in question stopped shortly thereafter. A classified Agreed Statement was negotiated in the SCC and signed in 1978, which defined the term "tested in an ABM mode," and regulated other operations of air defense radars at ABM test ranges. While this statement remains classified, the U.S. government has described it as providing, in part, that a radar:

> ... is considered to be 'tested in an ABM mode' if it performs certain functions such as tracking and guiding an ABM interceptor missile or tracking strategic ballistic missiles or their elements in flight trajectory in conjunction with an ABM radar which is tracking and guiding an ABM interceptor missile ... Tracking alone is insufficient for a radar to be tested in an ABM mode; the presence of an ABM interceptor being guided by an ABM radar is also required.

Further, the two sides agreed to "refrain from concurrent testing of air-defense components and ABM system components co-located at the same test range," and not to "make measurements on strategic ballistic missiles" with "air-defense radars utilized as instrumentation equipment."

While there have been "no known violations" of this agreement defining testing in an ABM mode, as the Bush administration report acknowledges, somewhat different uses of air-defense radars at Sary Shagan caused the United States to express concern again, leading to an additional Common Understanding which was initialed in 1985. This understanding reportedly prohibits launching strategic ballistic missiles to the area of a test range, or launching ABM interceptor missiles at such a range, while air defense components are operating there. An exception is reportedly made for air-defense systems tracking aircraft for air safety purposes or defending the test range in the unlikely event that potentially hostile aircraft are in the vicinity, but such incidents must be reported and a detailed explanation offered.

Analysis

It is simply inexplicable that the Bush administration would choose to maintain the Reagan administration's charge that Soviet concurrent operations represent a probable violation of the ABM Treaty, while simultaneously acknowledging that there have been "no known violations" of the agreed definition of the limit in question. The Soviet Union has never considered unilateral U.S. interpretations from the SALT I negotiations binding, and there is no evidence that the Soviet Union has violated the only definition it ever accepted. It appears, given the 1978 definition, that no Soviet air-defense radar has ever guided an ABM interceptor missile or tracked a strategic missile while an ABM radar was guiding such an interceptor: an extensive series of such tests would clearly be necessary to upgrade an air-defense system to give it a significant ABM capability.

It is particularly unfortunate that the Bush administration has chosen in this instance to repeat the Reagan administration's practice of making public charges on issues that could easily be resolved through quiet diplomacy in the SCC. The SCC's record in handling this question has been impressive: The Soviet Union ceased its initial activity soon after the question was raised, and two subsequent agreements have been negotiated. Indeed, the February 1990 report acknowledges that "the sides appear to have moved closer to resolution of this issue since the Soviet Union has stated that it is willing to take steps to cease these activities."

In any case, there is no solid evidence that the past concurrent operations of the SA-5 radar were designed as tests "in an ABM mode." Whatever their purpose, these operations by no means made the SA-5 system ABM-capable. The SA-5 radar is an antiquated mechanical-scan system, now being sold to Third World clients such as Libya. As the 1978 U.S. report on Soviet compliance pointed out, while the SA-5 operations were in a grey area, "much more testing, and testing significantly different in form, would be needed before the Soviets could achieve an ABM capability for the SA-5 ... Extensive and observable modifications to other components of the system would have been necessary, but these have not occurred."

ABM CAPABILITY OF MODERN SAM SYSTEMS

While acknowledging that "the evidence . . is insufficient," the February 1990 report repeats the Reagan administration's conclusion that some modern Soviet surface-to-air missiles (SAMs) "may have some ABM capabilities." While past Reagan administration reports identified the SA-12 as "the key Soviet SAM system of concern," the Bush administration report refers to both the SA-12 and the SA-10.

Background

Article VI of the ABM Treaty prohibits giving non-ABM systems "capabilities to counter strategic ballistic missiles or their elements in flight trajectory," as well as testing such systems "in an ABM mode." No specific definitions of these terms were reached during the negotiations. The treaty permits defenses against short-range tactical missiles (so-called antitactical ballistic missiles, or ATBMs) as long as they are not capable of intercepting strategic missiles. The February 1990 report acknowledges that "since virtually any air-defense missile system has some level of ABM capability, the treaty was not intended to preclude an incidental or insignificant ABM capability," but rather a "meaningful" capability, with "military significance." Needless to say, determining whether an ABM capability is "meaningful" is largely a matter of judgment.

Tactical Defense: *The Soviet SA-12 surface-to-air missile is designed for tactical defense against aircraft and short-range ballistic missiles. The Reagan and Bush administrations have raised fears it might also have a limited ABM capability, though there is little evidence to back up these charges.*

The SA-12 is a mobile, tactical SAM designed for theater defense against both aircraft and tactical ballistic missiles. There are two versions, the SA-12a Gladiator and the larger SA-12b Giant. In the past, the SA-12b has reportedly been tested against the SS-12, a tactical ballistic missile with a range of roughly 900 kilometers, but such tests have not been conducted since the 1987 signing of the Intermediate-range Nuclear Forces (INF) Treaty, which calls for elimination of the SS-12 missile and forbids test firings of the system. The SA-10 is a strategic air-defense system being deployed to provide bomber and cruise missile protection to key targets in the Soviet Union. It may also have some capabilities against tactical ballistic missiles. A mobile version, the SA-10b, has reportedly also been deployed.

Analysis

With no agreed criteria for judging when air defense or ATBM systems should be considered to have a prohibited ABM capability, such systems represent an inherent grey area of the ABM Treaty. Neither the Reagan administration nor the Bush administration has ever charged that the SA-12 or SA-10 have been tested "in an ABM mode," and there appears to be little evidence to support the charge that these systems may have a significant ABM capability. The SS-12, the fastest and longest-range missile against which either SAM has been tested, has a range less than one-fourth that of the slowest and shortest-range remaining U.S. strategic missile, the Poseidon, and reaches a maximum speed only one-half as great. Gaining confidence in even the most limited ABM capability against current U.S. strategic missiles would require testing against much more realistic targets. But the trend is in the opposite direction, since tests have not been conducted against tactical missiles with ranges of more than 500 kilometers since the INF Treaty was signed. Even against tactical ballistic missiles the SA-12 (described by the Reagan administration as the more worrisome of the two) has apparently had a poor record, reportedly intercepting its target only once in 20 tests.

It should be noted that the United States is also upgrading an air-defense system, the Patriot, for an ATBM role, and is developing more advanced ATBMs for the future. (See Chapter IX, "Grey-Area Systems and the ABM Treaty.")

RELOAD OF ABM LAUNCHERS

The February 1990 report largely abandons the Reagan administration's concern over Soviet reloadable ABM launchers, acknowledging that "there have been no detected instances of the activity of concern since 1983."

Background

Article V of the ABM Treaty prohibits the development, testing, and deployment of "automatic or semi-automatic or other similar systems for rapid reload of ABM launchers." This provision does not ban all systems for launcher reloading, but only those with a "rapid reload" capability. During the negotiations, the United States reportedly indicated that it would consider an ABM launcher to be rapidly reloadable if it was reloaded in a "strategically significant" period of time. The goal was to prevent either side from expanding the very limited firepower of the permitted ABM system by developing the capability to fire several interceptors from each of the allowed 100 launchers during a missile attack.

American intelligence has reportedly observed reload activities involving two Soviet ABM interceptors, the Galosh and the newer Gazelle interceptor, which is similar to the U.S. Sprint missile. The Reagan administration reported that a Galosh launcher had been reloaded and refired, and a Gazelle launcher had been reloaded but not refired, both in "much less than a day." Some press reports indicate that the reloads required roughly two hours. The Reagan administration never indicated how frequently these reload activities may have occurred, but some reports suggest that one of the launchers was only reloaded once in 1983, and as the Bush administration report points out, reloading activities have not been repeated since then.

Analysis

The issue hinges on whether the few Soviet reload activities constitute "rapid" reload. During the ABM Treaty negotiations, the United States informed the Soviet Union that the ban on rapidly reloadable launchers would not require any changes in existing Soviet systems. At the time, U.S. intelligence reportedly estimated that the Galosh launchers could be reloaded in as little as 15 minutes (this estimate was later lengthened). Since the observed reloads reportedly took well over an hour, it does not appear that the Soviet systems should be considered "rapidly reloadable." With no reloading having been observed since 1983, the Bush administration is clearly justified in largely dropping the Reagan administration's concerns over the issue.

PREPARATION OF A TERRITORIAL DEFENSE

The Bush administration's February 1990 report repeats the Reagan administration's most serious charge, that "the totality of Soviet ABM and ABM-related activities suggest that the USSR may be preparing a defense of its national territory." But the report acknowledges that the Soviet decision to dismantle the Krasnoyarsk radar, the elimination of the radar pieces at Gomel, and the Soviet offer to end concurrent operations of air-defense components at ABM test ranges could "affect our earlier judgment."

Background

Article I of the ABM Treaty states that "Each party undertakes not to deploy ABM systems for a defense of the territory of its country and not to provide a base for such a defense." This was the underlying objective of the treaty, and therefore any Soviet breach of this central prohibition would strike to the heart of the agreement.

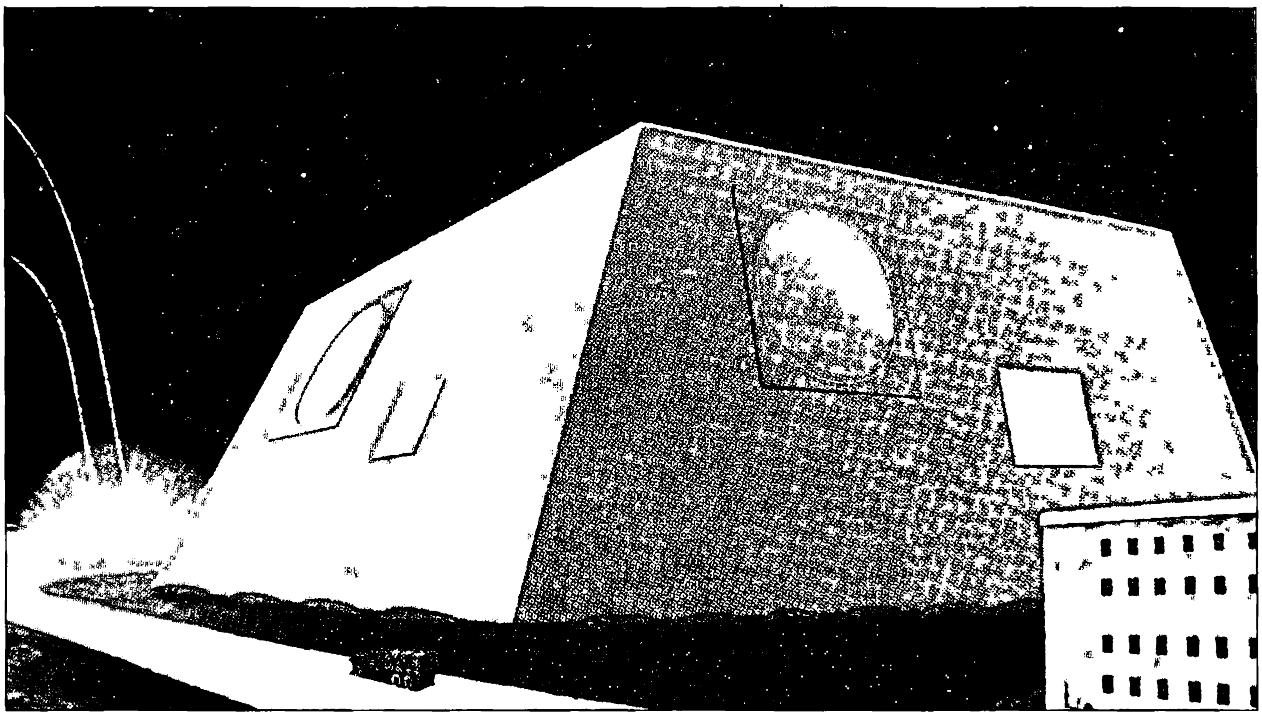
As described above, the Bush administration cites:

- the illegal Krasnoyarsk radar, now slated for dismantlement;
- the alleged "mobility" of the Flat Twin and Pawn Shop radars;
- operations of some air-defense radars during ABM tests; and
- two air-defense systems with some ATBM capability.

The Bush administration report also cites the modernization of the Moscow ABM system, and the construction of eight other early warning radars in the network of which Krasnoyarsk is a part. While acknowledging that these actions "appear to be consistent with the ABM Treaty," the administration warns that the new early warning radars "could constitute the deployment of a major long-lead-time component of a nationwide ABM system," and that the Moscow ABM system "provides the world's only active production line for ABM interceptors."

Analysis

Despite the seriousness of the charge, the Bush administration offers little substantial evidence to support it. Indeed, the available evidence from both Soviet



Breakout Potential?: *The Reagan and Bush administrations have raised fears that the Soviet Union might break out of the ABM Treaty and build a nationwide missile defense based on technology similar to that deployed in the new Moscow ABM system. But such a system, based on technology similar to that of the Safeguard ABM system the United States abandoned in the mid-1970s, would be critically vulnerable to attack, and could be overwhelmed by decoys and other antidefense penetration aids.*

actions and Soviet arms control proposals overwhelmingly indicates the opposite—that the Soviet Union sees the substantial security benefits provided by the ABM Treaty, and intends to remain within the treaty's terms as long as the United States does likewise. If the Soviet Union were in fact "preparing a defense of its national territory," it is hardly likely that it would agree to dismantle the Krasnoyarsk radar (one of the nine such radars that are alleged to be the "long-lead-time component" of the plan), effectively abandon its "rapidly deployable" radar program, and destroy all of the Pawn Shop radars built in that program. It is remarkable that after all the recent changes in Soviet military policy, from the large-scale arms reductions to the withdrawal from much of Eastern Europe, the Bush administration is still raising fears that Soviet leaders may be secretly planning to tear up the ABM Treaty and build a nationwide missile defense.

Moreover, the scenario of a rapid Soviet "breakout" from the ABM Treaty hinted at in the Bush administration's report—using the "long-lead-time" Pechora-class radars backed up by the "rapidly deployable" Flat Twin and Pawn Shop guidance and tracking radars, guiding ABM interceptors of the types used in the Moscow ABM system—is economically, strategically, and technically implausible.

Economically, it is extremely unlikely that in the midst of the economic disaster that is today's Soviet Union, with large-scale shifts from military to civilian spending already under way, Soviet leaders are seriously contemplating the diversion of tens or hundreds of billions of dollars from other tasks to build a widespread ABM system. The resources for such a program are simply not available. And Soviet leaders are fully aware that embarking on such a deployment would mean undertaking a long-term race between offensive and defensive forces, involving even greater expenses. In 1989, General Robert Herres, then vice chairman of the Joint Chiefs of Staff, emphasized this point in arguing that the Soviet Union was not likely to abandon the ABM Treaty.

Strategically, while Soviet military doctrine has long had a substantial emphasis on defense of the motherland, Soviet leaders recognize that U.S. technological advantages would negate any gains the Soviets might hope to make by deploying a nationwide missile defense. In all likelihood, that calculation provided the motivation for Soviet agreement to ABM talks in the 1960s and for the Soviet Union's consistent efforts to maintain the ABM Treaty in recent years. In particular, the United States has already developed decoys, chaff, and other antidefense "penetration aids" that would readily overwhelm a system based on the relatively primitive technologies involved in this "rapid deployment" scenario—technologies no more advanced than those the United States deployed and dismantled a decade and a half ago. (See "Hedging Against Soviet Breakout," p.86.) By abrogating the ABM Treaty to deploy a nationwide ABM system, Soviet leaders would in effect demolish all the recent years of work on U.S.-Soviet relations and arms reductions, probably sparking a renewed and increasingly dangerous arms competition, and provoking an increased U.S. offensive threat against which their extraordinarily expensive defenses could not provide effective protection—hardly a very attractive prospect.

Technically, a system based on the long-lead-time Pechora-class radars and rapidly deployable radars the Bush administration report expresses concern over would simply be ineffective. Perhaps the most fundamental problem would be the system's extreme vulnerability. With Krasnoyarsk now slated for dismantlement, there will be only eight of the Pechora-class radars, each large, expensive facilities highly vulnerable to nuclear attack. (Such large radars cannot effectively be hardened against nearby nuclear detonations.) Hence, as the CIA has pointed out, many would question "whether an ABM system is worth having which depends to a great extent on a few, potentially quite vulnerable facilities."

Moreover, the location and design parameters of these radars make it clear that they were designed as early warning radars (replacing the aging Hen House radar network), not as ABM battle-management radars. The Bush administration concedes that with the exception of Krasnoyarsk, each of these radars is located on the periphery of the Soviet Union and oriented outward, as the ABM Treaty requires. Hence, as intended by the drafters of the ABM Treaty, almost all of their coverage is *outside* Soviet territory, hobbling their ability to serve as ABM battle-management radars. In addition, as discussed in the analysis of Krasnoyarsk, these radars operate at frequencies far lower than those used by modern ABM battle-managers—frequencies that have been rejected for ABM radars because they provide less accurate tracking data than higher frequencies, and are extremely vulnerable to blinding by the "blackout" from nuclear blasts. And if the other Pechora-class radars are as identical to Krasnoyarsk as the Reagan administration often asserted, they are likely to share its lack of hardening against electromagnetic pulse, its dependence on outside power supplies, and its windows—all factors one would hardly expect in radars designed to fight a nuclear battle.

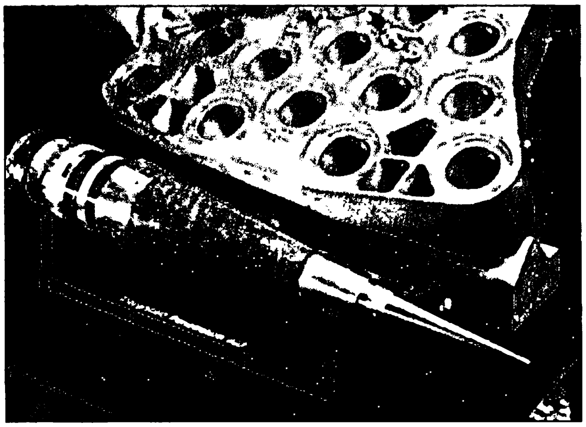
Moreover, given the apparent abandonment of the Flat Twin and Pawn Shop development program, it appears that Soviet leaders do not have a great deal of confidence in the radars that would provide the lower layer of radar coverage in this "rapid deployment" scenario. And as described above, these radars are "rapidly deployable" only in a relative sense: a nationwide system based on such radars would take years to build.

> ***"A single highly vulnerable radar installation [Krasnoyarsk] is of only marginal importance in relation to any large-scale breakout from the ABM Treaty."***
>
> *—McGeorge Bundy, George Kennan, Robert McNamara, and Gerard C. Smith, 1984*

Nor is it likely that upgraded air-defense interceptors or antitactical ballistic missiles could provide substantial backup to such an ABM system in the near term. Against the small, fast-moving reentry vehicles of modern strategic missiles, the radars of such systems are simply too small, and their interceptors too slow, to be effective over any significant range. The modifications required to give such systems a substantial ABM capability would likely be comparable in difficulty to building a new ABM system directly.

Indeed, the Defense Department itself has denied that the intelligence community believes the Soviet Union is planning to break out of the ABM Treaty, and questioned whether the Soviet Union could rapidly deploy a substantial missile defense. In 1988, General Herres told Congress that press reports suggesting a Soviet breakout already underway were "erroneous," and added that the Defense Department was "not predicting that they are going to break out." Commenting on the same reports, an official Defense Department spokesman reported that there is no evidence of mass production of either ABM radars or ABM interceptors beyond the requirements of the Moscow system, and no evidence of tests coordinating the Flat Twin or Pawn Shop radars with the Pechora-class early warning radars. The same year, the SDI Organization estimated that even if the ABM Treaty were abrogated immediately, it would take the Soviet Union until after the year 2000 to build a nationwide ABM system involving thousands of interceptors. In 1989, Undersecretary of Defense for Policy Paul Wolfowitz told Congress that the Defense Department believes that a Soviet breakout from the ABM Treaty is "unlikely" for at least a half-decade.

One useful measure of the Bush administration's genuine level of concern over the possibility of a Soviet breakout is the funding requested for penetration aids designed to counter possible Soviet defenses. During the 1988 presidential debates, penetration aids for the



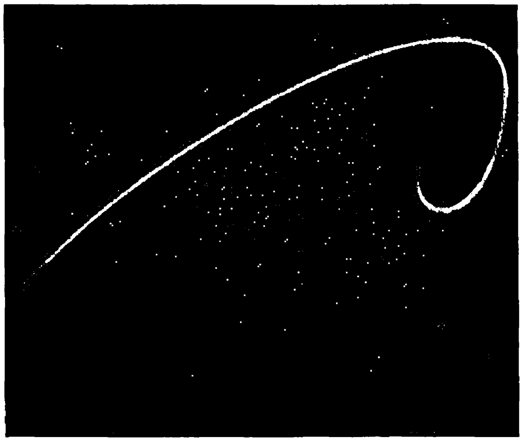
Hedging Against Soviet Breakout

For over 30 years, the United States has been developing means to overcome possible Soviet missile defenses. A bewildering array of so-called "penetration aids" have been developed to ensure that offensive missiles could get through Soviet ABMs, including many types of warhead-mimicking decoys, radar-reflecting "chaff," radar jamming devices, maneuvering reentry vehicles (MaRVs), and warheads designed to home in on and destroy ABM radars, among others. Since the 1958 report of the Reentry Body Identification Group, which concluded that a variety of such offensive countermeasures were feasible and would pose daunting problems for the Nike-Zeus ABM then in development, it has been recognized that such penetration aids pose fundamental obstacles to either superpower's pursuit of an effective ballistic missile defense.

In the early 1960s, when U.S. intelligence indicated that a major Soviet ABM development program was underway, the United States drastically increased its penetration aids research efforts, creating a program called Advanced Ballistic Reentry Systems (ABRES). Among other technologies, ABRES played a major role in the development of MIRVs. Although funding for ABRES (now known as Advanced Strategic Missile Systems, or ASMS) has declined substantially from its 1960s peak, the program continues to research and test ever-more-sophisticated means of countering potential Soviet missile defenses. Among the major types of penetration aids:

Decoys. Decoys are designed to imitate genuine reentry vehicles (RVs), confusing the defense and wasting its limited radar and computer time and interceptor supplies. Decoys are designed to be much lighter and less expensive than actual RVs, so that offensive missiles can carry enough of them to overwhelm potential ABM defenses. Crude, very lightweight decoys—so-called "traffic decoys"—have been designed with the idea of overwhelming defensive radars and computers with the huge number of objects to be tracked and identified. More sophisticated decoys designed to draw ABM interceptor fire are known as "replica decoys." Designing effective decoys for use outside the atmosphere is relatively easy, for in space heavy RVs and lightweight decoys travel the same paths. Simple aluminum-foil balloons, for example, could be inflated around each RV, accompanied by dozens of empty balloons: balloons without RVs would reflect radar just as the balloons with RVs would, making them essentially indistinguishable. This technique of designing warheads to look like decoys is known as "antisimulation." (See Chapter IV, "The Strategic Defense Initiative.")

But as the reentry vehicles begin to reenter the upper reaches of the atmosphere, many types of decoys are stripped away by atmospheric drag. To keep up with the genuine warheads as they streak through the atmosphere, decoys must be highly streamlined, but a lightweight decoy with the appropriate streamlining tends to be small and identifiable by defense radars. "Thrusted decoys," equipped with small rockets to maintain their speed in the face of atmospheric drag, are one potential approach to this problem. "Active decoys" are another, using radar signals broadcast from the decoy itself to fool defensive radars into thinking the decoy is larger than it actually is. In addition, decoys can dispense an ionizing material behind them, to mimic the glowing wake left by a full-scale reentry vehicle. ASMS has



Maneuvering Warhead: *Reentry vehicles designed to maneuver within the atmosphere, shown above in a flight test, can vastly complicate a terminal ABM defense's job. Other "penetration aids" such as decoys (shown opposite with a penetration aid deployment deck for the MX missile) would be particularly effective outside the atmosphere.*

developed and tested decoys using all of these techniques. The lower the altitude of operation of the ABM system to be countered, however, the heavier and more sophisticated credible decoys must be.

Ultimately, if the decoys become too heavy, it makes more sense for the offense to put a bomb in them and simply have more warheads—an idea that was a major part of the origin of MIRV. Even without decoys and other penetration aids, increases in U.S. MIRVs could overwhelm an ABM system based on current Soviet technology at a cost substantially lower than that of the defense itself.

Chaff and Aerosols. Chaff was one of the first penetration aids developed, consisting of thousands of tiny, hairlike wires. Such wires are highly efficient radar reflectors; if designed properly, one tiny hair of chaff would reflect as much radar energy as a whole RV. Such chaff is widely used as a radar counter in tactical battlefield applications as well. "Volume chaff" involves dispersing chaff over a large zone of space, obscuring warheads within that volume; "spot chaff" involves many small clumps of chaff, making it difficult for defense radars to tell which clumps may be hiding a warhead. Like lightweight decoys, chaff tends to be rapidly stripped away by atmospheric drag. Aerosols—mists of tiny particles—could serve a similar function against infrared sensors, reflecting infrared energy to obscure the signals from warheads.

MaRVs, Homers, Jammers. MaRVs use aerodynamic surfaces such as wings or fins to maneuver as they streak through the atmosphere, zigzagging to confuse potential defenses. To defend against MaRVs, the defense must either fire several interceptors, bracketing all the MaRV's possible paths, or develop interceptors fast and agile enough to chase down the MaRV one-on-one. The United States has been flight-testing MaRVs for over two decades, and plans to test a more sophisticated, high-acceleration version in the 1990s.

Another major weakness of traditional ABM systems is the vulnerability of their large, expensive radars. While mobile radars might potentially mitigate that problem, the United States is developing maneuvering warheads designed to home in on emissions from such radars and destroy them—a concept known as the Defense Suppression Vehicle.

In addition, radars can be jammed, by warheads or decoys equipped with broadcasting equipment of their own. Since modern warheads reflect very little radar energy, and the radar signal must travel to the target and back while the jamming signal need only go one way, even a small jammer can have a substantial advantage over a large radar, requiring expensive antijamming countermeasures.

The Defense Department is highly confident that U.S. penetration aids and other tactics could overcome Soviet missile defenses, providing an important hedge for U.S. security should the Soviet Union ever abandon the ABM Treaty and begin deploying a widespread missile defense. In 1987, for example, Lawrence Woodruff, then deputy undersecretary of defense for strategic and theater nuclear forces, testified that the Soviet Moscow ABM system could be overcome with "a small number of Minuteman missiles equipped with highly effective chaff and decoys." "And if the Soviets should deploy more advanced or proliferated defenses," Woodruff said, "we have new penetration aids as counters," citing in particular active decoys, thrusted decoys, and MaRVs.

Minuteman ICBMs were among only a handful of weapon systems then-Vice President Bush recommended cutting—a step the Pentagon had already taken. While penetration aids research continues, in the Fiscal Year 1991 budget request, funding for the main U.S. penetration aids research program was $100 million, only two percent of the request for SDI research.

"I'm guarded about the idea that they want to break out of the ABM Treaty. . . . There are a lot more signals that the Soviet economy is not ready to support a defensive technology arms race than there [were] three or four years ago, and every day there are more signs that's the case."

—General Robert Herres
Then Vice Chairman of
the Joint Chiefs of Staff, 1989

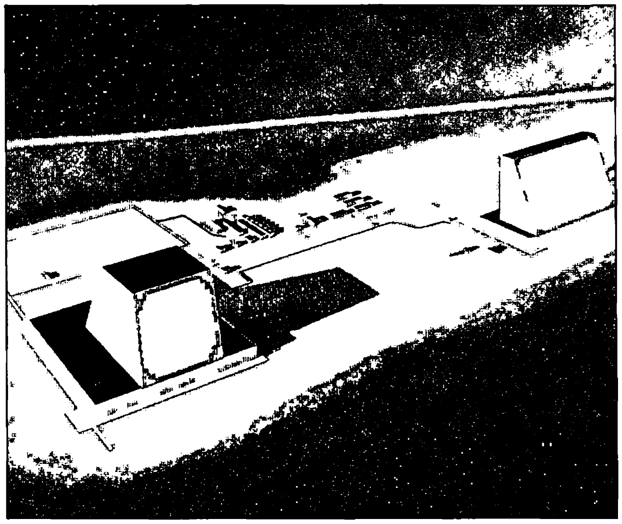
In short, there is no substantial evidence that the Soviet Union has either the capability or the intention to carry out a rapid breakout from the ABM Treaty. The Soviet Union's 12-year effort to modernize its single 100-interceptor ABM site around Moscow suggests how difficult a crash program to deploy thousands of ABMs would actually be. And the detailed charges put forward by the Reagan and Bush administrations demonstrate that even the initial stages of a genuine effort to deploy a nationwide defense would be observed long before such a system became operational, giving the United States ample time to respond.

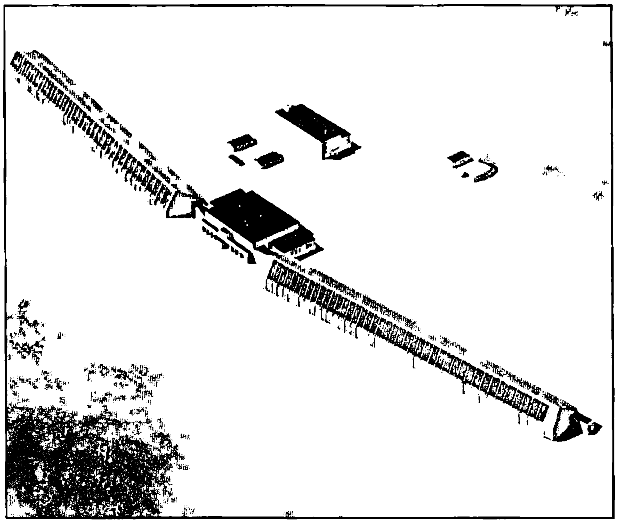
CONCLUSIONS

There has been only one genuine and significant Soviet violation of the ABM Treaty—the Krasnoyarsk radar, which the Soviet Union has now agreed to dismantle. While some other Soviet activities fall into grey areas, none of them support the grave public charges the Reagan administration initiated and the Bush administration has chosen to repeat. The ABM Treaty is unquestionably achieving its goal, preventing the deployment of a nationwide Soviet ABM defense.

The most remarkable characteristic of the issues raised in the Bush administration's report is that virtually all of them are either resolved or on the road to resolution. Krasnoyarsk is slated for dismantlement; the radar pieces at Gomel have already been destroyed; the Pawn Shop and Flat Twin development program has apparently been abandoned, and the administration acknowledges that the destruction of all of the existing Pawn Shop radars and one Flat Twin has reduced its concerns over them; and the Soviet Union has agreed to cease the concurrent operations of air-defense components that still concern the United States.

Nonetheless, the overall pattern of past Soviet behavior has indicated a legalistic approach, actively pursuing a number of activities in grey areas with little regard for the "spirit" of the accord, or to the corrosive long-term impact of such actions on the ABM Treaty's effectiveness. This conclusion is tempered somewhat by the fact that the Soviet Union has generally been willing to reach agreements in the SCC to clarify issues raised by the United States, and to abide by them once reached. But what little evidence is available suggests

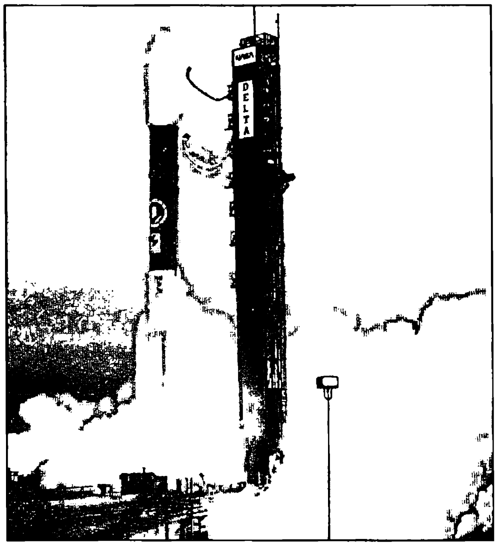




Warning Network: *The Soviet Union is now replacing the aging Hen House early warning radars (right) with a network of large phased-array radars, the first of which was built near the town of Pechora (left). These radars will provide improved early warning, but their extreme vulnerability, their location, and their design features make them poorly suited for an ABM role.*

that the Soviet Union has not had an effective process for ensuring that its planned military programs would comply with its arms control obligations; apparently, major program decisions affecting treaty compliance have generally been made with little nonmilitary input. Indeed, many Soviet officials have claimed that the construction of the Krasnoyarsk radar was a "mistake," undertaken without top officials being fully aware of the compliance implications.

Fortunately, this situation is now changing. The "new thinking" in Soviet military affairs is substantially improving Soviet compliance behavior, as the examples of Krasnoyarsk and Gomel make clear. In these cases, the Soviet Union has permitted inspections, agreed to dismantle the contentious items, and suggested SCC negotiations to resolve ambiguities and prevent similar issues from arising in the future—precisely the actions one would hope for when raising a compliance issue. In several cases, Soviet negotiators have proposed new agreements to clarify the treaty's specific application, in an important effort to avert possible compliance controversies before they arise. Moreover, Soviet defense decision-making has been broadened to include substantial inputs from nonmilitary sectors, particularly the Ministry of Foreign Affairs, which have greater institutional interests in smooth implementation of arms control agreements and less interest in the aggressive pursuit of military programs. In short, the prospects for Soviet cooperation in complying with and strengthening the ABM Treaty have never been better.



The launch of the Delta 181 SDI experiment.

VIII. U.S. Compliance With the ABM Treaty

The overall record of U.S. compliance with the ABM Treaty is good. Particularly during the treaty's first decade, the United States scrupulously avoided any effort that strayed close to the boundaries of the treaty's limits. But since its inception, the Strategic Defense Initiative has raised fundamental questions about U.S. intentions toward the treaty, as the program is explicitly directed toward development and eventual deployment of a prohibited nationwide missile defense.

The October 1985 announcement of a unilateral U.S. "reinterpretation" of the treaty, contradicting the long-standing view of the accord held by both parties, represented another grave challenge to the treaty regime. (See Chapter VI, "The Reinterpretation of the ABM Treaty.") Though the "broad" interpretation has not been implemented to date, it amounted to a sudden U.S. assertion of a right to violate the traditional interpretation of the ABM Treaty, raising basic questions as to the U.S. government's willingness to comply with its international obligations.

However, no SDI experiment yet conducted has unambiguously violated the ABM Treaty—though some have raised significant questions of compliance. Indeed, the most questionable current U.S. activity is the construction of two early warning radars outside U.S. territory, unrelated to the SDI program. (See "The Radars at Thule and Fylingdales Moor," p.100.) But ever since the SDI program began, Defense Department planners have made ever-greater efforts to exploit ambiguities in the ABM Treaty to gain the maximum possible freedom to conduct ABM-related tests. SDI planners have been torn between the desire for impressive "demonstrations" of ABM capabilities, designed to maintain political enthusiasm for the program, and the ABM Treaty's requirement that space-based tests not have genuine ABM capabilities. Decisions on compliance of planned activities are based on strictly legalistic definitions of key treaty terms, made unilaterally, in secret, with no consultation with the Soviet Union and little consideration given to verifiability or to the long-term impact of such activities on the ABM Treaty regime and on U.S. security. As a result, some past and planned SDI experiments press deep into treaty grey areas, in some cases raising compliance concerns similar to some of those the Reagan and Bush administrations have raised concerning Soviet ABM activities.

Before taking office as President Bush's national security adviser, Brent Scowcroft aptly described a better approach for judging planned SDI tests: "Would we raise objections if we saw the Soviets conducting the same test?" If the answer is yes, but the treaty limits in question appear ambiguous, the best approach would be to pursue a clarification in the Standing Consultative Commission (SCC) that would equally restrain both sides. (See Chapter XII, "Reaffirming the ABM Treaty.") If instead the United States aggressively pursues whatever loopholes it can find, it is simply opening avenues for the Soviet Union to do the same, eroding the ABM Treaty's limits and thereby undermining U.S. security.

The discussion below is intended to describe the complex technical and legal issues involved in match-ing the treaty's restraints to individual experiments in the SDI program. The focus is less on black-and-white determinations of compliance or noncompliance (which are inevitably somewhat ambiguous) than on illuminating the activities carrying the most potential for treaty erosion, and the areas where new treaty clarifications might be most useful. This analysis is merely illustrative, for in any area involving such interwoven issues of law, technology, and policy, there is room for substantial legitimate disagreement. Moreover, while U.S. ABM activities and plans are dramatically more open than their Soviet counterparts (despite the recent improvements on the Soviet side), many of the important details of SDI experiments and of U.S. compliance judgments remain classified—and constantly change as the SDI Organization's overall financial picture and program emphases shift.

PERMITTED ACTIVITIES

As described in Chapter III, the ABM Treaty permits all types of ABM research. The treaty also allows full-scale development and testing of ABM systems and components at fixed, land-based sites, but it bans all development, testing, and deployment of "sea-based, air-based, space-based, or mobile land-based" ABM systems and components. It also bans testing of any non-ABM system or component (such as an air defense missile or an antisatellite weapon) "in an ABM mode," or giving such systems an ABM capability. There is ambiguity, however, in drawing legal lines between permitted research and prohibited development; in defining precisely what constitutes an ABM component, rather than an unlimited ABM "adjunct" or a non-ABM system without ABM capability; and in defining what constitutes testing "in an ABM mode."

To clarify what is permitted, the Defense Department has divided legal ABM research and development activities into three categories. Category one is research: The United States has defined the line between unlimited research and restricted development as being the point at which a "prototype" or a "breadboard model" of an ABM component leaves the laboratory and is ready for "field testing." (See Appendix B.) Category two is development and testing, but of devices that the Defense Department believes are not genuine ABM components—defined under the traditional interpretation of the treaty as including ABM radars, launchers, and interceptors, or devices "capable of substituting for" them. During the ABM Treaty negotiations, the two sides agreed that "adjuncts," devices which assisted ABM components without substituting for them, would not be limited. Category three includes development and testing of systems and components that are clearly ABMs, but are fixed, land-based, and tested from agreed ABM test ranges.

While each of these permitted categories has fuzzy boundaries, the Defense Department's arguments have aroused the most controversy in attempting to shoehorn planned tests into category two, justifying them as "not a component," "not ABM-capable," and "not tested in an ABM mode."

SDI TESTING AND THE ABM TREATY: FOUR CASES

The SDI program has conducted or planned scores of major experiments, of which the next pages describe only a few. Four very different tests are described in considerable detail, to give a flavor for the range of issues involved. The planned Zenith Star space-based laser test is an example of an effort to "work around" the ABM Treaty's restraints by testing against spacecraft in orbit rather than strategic missiles; its legality is highly questionable. The Airborne Optical Adjunct also raises serious compliance concerns, and illustrates the difficult "grey-area" problems raised by potentially ABM-capable infrared sensors. In one respect, the series of planned "brilliant pebbles" flight experiments offer an example of legal exploitation of a significant loophole in the treaty, while in other respects these experiments may be contrary to the existing treaty and related SCC agreements. The Delta 181 SDI experiment, by contrast, demonstrates that major space tests can be conducted without raising any substantial treaty problems. Briefer discussions of other selected tests follow those four case studies, in chronological order.

> ***"There are definite risks in applying standards that say [SDI] testing may comply with the treaty if the demonstration hardware cannot meet the power or performance criteria of ABM systems or components, or if the orbital target has the attributes of a satellite, not a warhead. . . . A better criterion would be: Would we raise objections if we saw the Soviets conducting the same test?"***
>
> *—Brent Scowcroft, 1988*
> *President Bush's National Security Adviser*

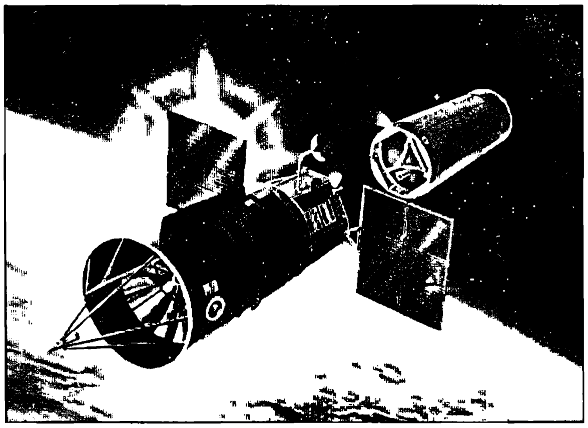
Zenith Star. The major space-based laser test code-named Zenith Star raises fundamental questions of treaty compliance.

While Zenith Star is currently planned for testing in the late 1990s, its estimated $2 billion cost could render it vulnerable to budget cutbacks. In early 1990, SDIO announced that it had decided to conduct a smaller,

$300 million test dubbed the Complementary Space Experiment in the mid-1990s, to get quicker initial data on space laser operations and to aid in designing Zenith Star. Zenith Star plans call for combining TRW's multi-megawatt Alpha laser with the four-meter Large Advanced Mirror Program (LAMP) mirror, both already undergoing ground tests. In announcing the earlier test, SDIO Director Lieutenant General George Monahan indicated that if that experiment goes well, Zenith Star may be modified to go further than previously planned, making it "higher powered, something closer to a weapons-grade prototype."

These experiments would violate the ABM Treaty if they involved space-based testing "in an ABM mode," or if the lasers or sensors involved could be considered "prototypes" or "breadboard models" of ABM components capable of substituting for ABM interceptors or ABM radars. Although few details of the new Complementary Space Experiment are available, it appears that the lasers involved—described in one report as "measured in kilowatts rather than megawatts"—will lack any substantial ABM capability, and will not be tested in an ABM mode. Any issues that might be raised by such a small-scale experiment would more likely center on whether its sensors were capable of substituting for ABM radars.

The larger-scale Zenith Star experiment raises much more serious questions. In a partly declassified 1988 memorandum approving the original plans for the test, the Defense Department argued that Zenith Star would be "fully compliant," but on all three major counts—testing in an ABM mode, and the ABM potential of the laser and the sensors to be used—the Defense Department's arguments are questionable. (The newer concepts for an even higher-power version of Zenith Star have apparently not yet been reviewed for treaty compliance.)



Zenith Star: *The planned Zenith Star space-based laser experiment would test a laser with the brightness needed to destroy a rising missile at ranges of hundreds of kilometers, raising serious questions of compliance with the ABM Treaty's ban on space-based testing of technologies capable of substituting for ABM interceptor missiles. In this artist's concept, the two separately launched parts of the Zenith Star spacecraft are docking in preparation for tests.*

"When I read the administration's report [on SDI compliance] I felt like I was reading the work of expert tax lawyers, of people trying to evade the law."

—Gerard C. Smith, 1985
Chief U.S. Negotiator of the ABM Treaty

Testing in ABM mode. The Pentagon memorandum argues that while the Zenith Star test will involve attacking rockets—referred to in the memo as "booster negation experiments"—this would not constitute testing in an ABM mode, because the target rockets would not follow flight paths similar to those of strategic ballistic missiles. Yet the memorandum acknowledges that the targets will be accelerating rockets, just as missiles in the boost or post-boost phases of flight would be—the main differences being that the targets will be closer to the Zenith Star platform than most missiles would be in a real attack, will be moving more slowly relative to it than most real missiles would be, and will be accelerating downward rather than upward. None of these three points is compelling. Testing "in an ABM mode" is defined in a 1978 Agreed Statement as any attempt to intercept targets flying on trajectories similar to those of strategic missiles; it is the speed, altitude, and acceleration of the target that counts, not its distance from the test platform. The relative motion argument is marginal for similar reasons, particularly as the relative motion between an operational ABM laser on a northward-moving orbit and northward-firing ICBMs would be relatively slow, as in the planned test. And to argue that a test is permitted if the target trajectory is simply upside down from that which would be followed by a strategic ballistic missile would make a mockery of the ABM Treaty's restraints on testing in an ABM mode.

Laser ABM capability. The Defense Department memorandum argues that the Zenith Star laser could not substitute for an ABM interceptor, because of its limited "brightness," its slow turning rate, and its lack of "sustained operational readiness." Here, too, the memorandum's arguments appear to have significant weaknesses.

A laser's brightness largely determines how rapidly it can destroy a particular target at a given range. Under the original plan considered in the 1988 memorandum,

U.S. ABM Compliance Before SDI

The Soviet Union has raised several concerns over U.S. ABM and ABM-related activities that occurred before the SDI program began, but none of these issues raises substantial questions of a U.S. violation of the accord.

ABM launcher shelters. In 1973-1974, the United States placed shelters over some ABM launchers. The Soviet Union later argued that this contradicted the treaty's ban on interference with national technical means of verification, but the United States pointed out that since the launchers in question "were acknowledged to be for ABM interceptor missiles," the presence of the shelters did not impede Soviet efforts to verify the ABM Treaty's limits on the number of ABM interceptor launchers.

Radar dismantlement. In 1974, after the required dismantling of the unfinished U.S. ABM site at Malmstrom Air Force Base, Montana, the Soviet Union questioned whether the dismantling of the radar had precisely followed agreed procedures. But after the United States explained the dismantling procedures that had been followed in the Standing Consultative Commission, the Soviets did not pursue the matter further.

Cobra Dane. In 1975, the Soviet Union suggested that this large phased-array radar then under construction on Alaska's Shemya Island (in the Aleutian Islands chain) was an ABM radar at an illegal location, in part because many of the electronic parts used in the radar had been produced for the Missile Site Radar of the Safeguard ABM system. The United States explained that Cobra Dane was a permitted verification radar, which might also be used for early warning and space tracking. The Soviet Union then let the matter drop for several years, but raised it again in a 1984 response to Reagan administration compliance charges against the Soviet Union, and several times subsequently. It is clear, however, that Cobra Dane is primarily designed for a permitted verification and intelligence collection mission, covering the latter portions of the trajectory of Soviet ballistic missile flight tests. It is on an isolated island 1,500 kilometers from the Alaskan mainland and roughly 4,200 kilometers from the rest of the United States, making it clearly unsuitable for a Safeguard-type ABM system.

Mobile ABM radar. In its 1984 statement, the Soviet Union charged that the United States was developing a mobile ABM radar, apparently referring to a transportable instrumentation radar that had been on Kwajalein Atoll for some years. The United States responded that this was not an ABM radar, that no mobile ABM radars were under development, and that the instrumentation radar in question had been dismantled.

Pave Paws. Since 1978, the Soviet Union has expressed concern that the four new U.S. Pave Paws early warning radars could provide a prohibited "base" for a nationwide defense. The Soviets have pointed to some technical similarities the Pave Paws radars share with the Safeguard ABM system's Perimeter Acquisition Radar (PAR), such as their similar size and operating frequency. In addition, the 240-degree coverage of the Pave Paws radars gives them some "over-the-shoulder" coverage over U.S. territory, creating ambiguities as to whether they comply with the treaty's requirement that early warning radars be on the periphery of the national territory and "oriented outward." The United States has responded that these radars are permitted early warning facilities, that they are indeed oriented outward, and that any similarities they may have with the PAR are little more than the inevitable similarities of any large phased-array radar designed to detect and track ballistic missile warheads at long distances—and that there are significant technical differences from the PAR as well, such as the several-fold lower power of the Pave Paws radars. Overall, it is clear that the Pave Paws radars are primarily designed for early warning, and are at legal locations. It is difficult for the Soviet Union to lodge a compelling complaint on this score while it is building a much larger number of large phased-array early warning radars, the Pechora-class. (See Chapter VII, "Soviet Compliance With the ABM Treaty.")

"We should abide by the ABM Treaty—and so should the Soviets."
—George Bush, 1988
Then Vice President

Zenith Star would have combined the four-meter LAMP mirror with the Alpha laser, estimated to have a potential power of two megawatts or more. If high beam quality were maintained, as SDIO expects, such a combination would have a brightness of some 10^{18} watts per steradian—a unit measuring the amount of power the laser can focus into a narrow cone—giving it the ability to destroy current unhardened missiles at ranges of hundreds of kilometers. The 1988 Defense Department memorandum argues that such capabilities would not be adequate "to be effective in stressing time-constrained ABM missions," in which a laser weapon "engages its targets sequentially (i.e., one after another)." That conclusion is correct, but it is not the standard set by the ABM Treaty. The treaty prohibits space-based lasers capable of substituting for an ABM interceptor missile, and such an interceptor is only designed to shoot down a single missile—a task for which even the brightness of the originally-planned Zenith Star experiment would be more than adequate. If the brightness is substantially increased, as Monahan suggested, the Defense Department's argument would be further undermined.

> ***"It is very unclear whether and how the Zenith Star experiment can be made compliant with the ABM Treaty."***
>
> *—Ashton Carter, 1988*
> *Harvard physicist, author of classified report on SDI testing and ABM Treaty limits*

It is true, however, that the reportedly very limited turning rate of the Zenith Star laser would greatly limit its ability to hold a beam on a passing missile long enough to destroy it. But it is not clear whether this is a fundamental characteristic of the Zenith Star equipment, or whether it could be quickly changed. Even with the limited turning ability, there are serious questions as to whether such a piece of equipment should still be considered a "prototype" or "breadboard model" of an ABM-capable component. In addition, this justification of the experiment's compliance is essentially unverifiable, in the absence of detailed on-site inspection.

The Pentagon's "operational readiness" argument—that the laser and sensors require a half-hour or more to prepare for testing, cannot remain aligned for more than an hour, and run on batteries that only last for half an hour before requiring a day's recharging—simply has no legal basis. Would the United States accept Soviet testing of a mobile ABM radar if the Soviet Union claimed that its batteries only lasted for half an hour?

Sensor ABM capability. Zenith Star will also conduct extensive sensor experiments, including detecting firing rockets, tracking them with both passive sensors and laser radar, and pointing and holding laser beams on them. Comparatively low-quality sensors will be used during the high-power laser experiments, which will be able to perform the essential detection and tracking only because the targets will be equipped with beacons and retro-reflectors. But at other times, the laser mirror will be used as a telescope mirror, giving the accompanying set of sensors impressive capabilities.

The Defense Department argues that neither of these sets of sensors will be capable of substituting for an ABM radar, for several reasons. They cannot turn rapidly to follow fast-moving targets; they have a limited "field of view" (meaning that they look at the world as though peeking through a knothole); and once having picked up the signal of a burning rocket, they have little ability to "hand-over" from tracking the rocket flames to tracking the missile itself, or to find and hold the laser on a missile's most vulnerable points. As applied to the less capable sensors used during the high-power laser experiments, these arguments have substantial validity.

But the case of the sensors using the LAMP mirror is more questionable—as suggested by the 1989 SDI *Report to Congress* description of them as providing "full performance sensor testing" for an ABM mission. Unclassified drawings of the system suggest that the primary reason for its limited field of view is simply the placing of "blinkers" around the mirror—hardly an approach the United States would be likely to accept from the Soviet Union. While the Defense Department memorandum argues that the system can only track "cooperative targets," with detailed prior knowledge of their trajectory, SDIO described the experiment the following year as involving "unaugmented and uncooperative targets against realistic backgrounds." Moreover, test plans do call for these sensors to "hand-over" tracking from rocket plumes to the rockets themselves, and to find and point at the target's most vulnerable points. While the Defense Department memorandum argues that these actions will be possible only because the system designers already know the targets' characteristics, the relatively small difference between serving as an ABM sensor against a known rocket or an unknown one is a rather shaky basis for a judgment of ABM compliance—and some considerable knowledge of Soviet missile designs can be gained from observation of peacetime flight tests. That leaves only the limited turning rate of the system—which again is essentially unverifiable, and leaves open the question of whether such a system, even if not fully ABM-capable, might still constitute a prohibited "prototype" or "breadboard model."

Overall, Zenith Star will involve a laser bright enough to destroy missiles at long ranges, which will be tested in a manner extremely close to testing "in an ABM mode," and will be equipped with very capable sensors. While there are some ambiguities, such a test would appear to constitute development of a "breadboard" of a laser capable of substituting for an ABM interceptor, in violation of the ABM Treaty. Zenith Star utterly fails Scowcroft's test: If the Soviet Union were to conduct a test involving a multimegawatt space-based laser, with a multimeter space mirror, firing on thrusting rockets in space, the United States would justifiably have extremely grave concerns over compliance with the ABM Treaty, and over the increased potential for rapid Soviet development and deployment of a space-based missile defense. Possible mitigating factors of the kind cited by the Defense Department would be impossible to verify. Yet having justified such an experiment ourselves, it would be difficult to complain when the Soviet Union did the same.

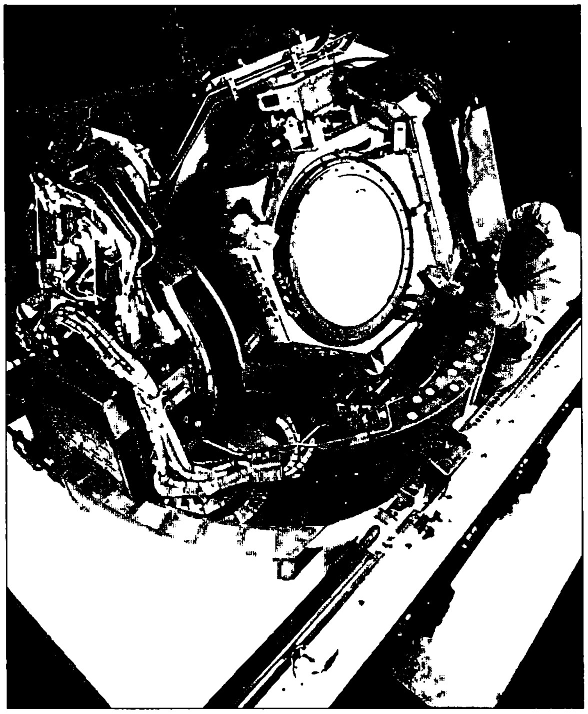
Airborne Optical Adjunct. Like Zenith Star, the ongoing experiments with the Airborne Optical Adjunct (AOA), sometimes referred to by SDIO as the Airborne Surveillance Testbed, or AST, raise serious questions of compliance with the ABM Treaty, and of the potential for activities in such grey areas to undermine the effectiveness and verifiability of the ABM Treaty's restraints.

AOA is a modified Boeing 767 equipped with a long-wavelength infrared (LWIR) telescope, signal processors, computers, and other equipment. It is designed to collect data on the use of infrared sensors in an ABM system. After completing initial shakedown tests over the continental United States, AOA will be tested at the Kwajalein ABM test range, tracking flights of strategic ballistic missile warheads and penetration aids. The program has experienced substantial delays and cost overruns (with a total cost now well over $600 million), despite cutbacks in its capability intended to reduce costs.

While the Defense Department has pledged that AOA will not be tested "in an ABM mode," AOA would still constitute a banned airborne ABM component if it were judged "capable of substituting for" an ABM radar. Otherwise, it qualifies as a permitted "adjunct." (Hence the "adjunct" in its name; a potential future operational version is generally referred to as the Airborne Optical System.)

Early SDIO descriptions of AOA strongly suggested that it would have such prohibited substitution capabilities, indicating that it would "acquire targets optically at long range, then track, discriminate, and hand over these targets to a ground-based radar"—a role essentially identical to that played by the Perimeter Acquisition Radar (PAR) in the Safeguard ABM system. SDIO then began to backtrack when the system's compliance with the ABM Treaty was called into question, indicating in a 1988 letter to House Armed Services Committee Chairman Les Aspin (D-WI) that "AOA cannot perform the basic radar functions of acquisition and closed loop tracking of an uncooperative target," making it "fully compliant with the restrictive interpretation of the 1972 ABM Treaty." Yet the following year, SDIO indicated that AOA would "validate" functions including "long-range acquisition" and "high-accuracy track," and stated in a fact sheet that the system was being upgraded to provide the previously missing "closed-loop track" capabilities.

In arguing that AOA cannot substitute for an ABM radar, the 1988 letter cites deficiencies in the sensor, the computers, and the aircraft itself. The letter describes the three-ton AOA sensor as having a "small instantaneous field of view"—an argument familiar from Zenith Star. This would prevent the system from being able to rapidly search large sections of the sky for incoming missiles, as an ABM acquisition radar would—though the field of view over a period of time is larger, since the sensor is mounted on rails within the plane to look through its viewing port from different angles.

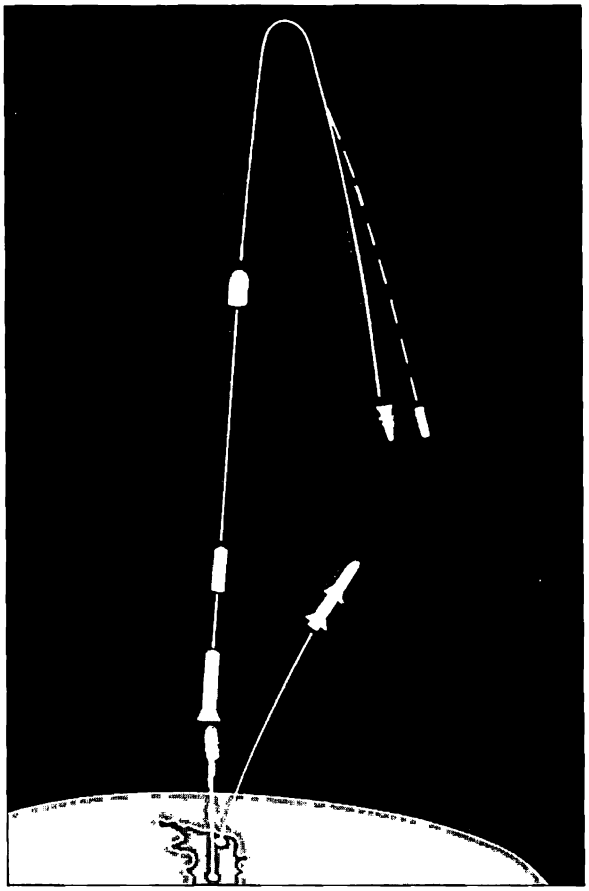


Sensor Questions: *The Defense Department argues that the sensor for the Airborne Optical Adjunct (above) cannot substitute for an ABM radar, and is therefore permitted by the ABM Treaty. But many of the arguments offered in its defense are highly questionable. The experiment highlights the difficulties of limiting and verifying such infrared sensors.*

SDIO has recently shifted its emphasis from the "space-based interceptor" (SBI) concept for such space rockets to one known as "brilliant pebbles." (See "Brilliant Pebbles: A New Miracle Weapon?" p.32.) Approximately a dozen flight experiments involving brilliant pebbles technology are scheduled in 1990-1992. The first tests will involve demonstrations of sensors and other equipment, but will not intercept ballistic missiles. By the summer of 1991, however, SDIO plans to begin conducting tests involving interceptions of strategic ballistic missiles.

The Defense Department currently plans to sidestep the ban on testing of "space-based" interceptors by lofting the brilliant pebbles into space from fixed land-based launchers at the Kwajalein ABM test range. The pebbles would then operate in the space environment while falling back toward the earth, collecting most of the information needed to demonstrate space-based ABM rockets without ever actually going into orbit. However, the Defense Department has acknowledged that even with this "lofted" approach, "field tests" of a full-scale "prototype" of an interceptor designed to be based in space would constitute prohibited "development" of a space-based ABM interceptor missile. To avoid this limitation, SDIO plans to test each brilliant pebble without its main rocket, testing only the "front end," with its sensors and maneuvering engines; the interceptor would rely on the ground-based rocket to provide nearly all its energy, and would "intercept" the target by falling on top of it, using its small maneuvering rockets to ensure a collision.

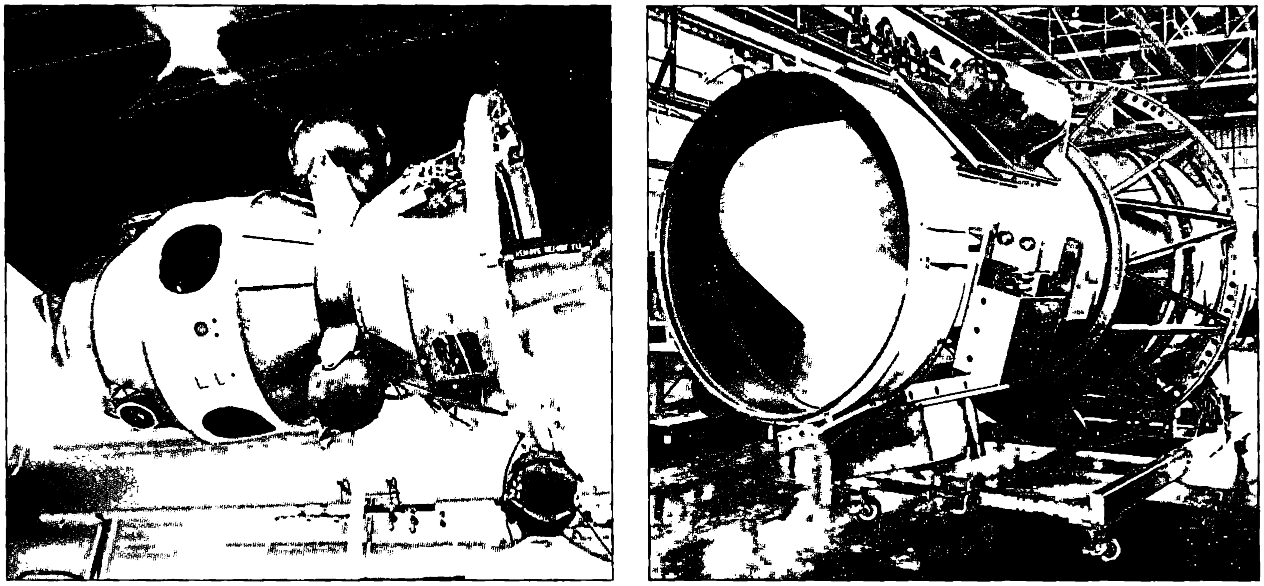
This approach of testing a system designed for space basing by "lofting" it into space from a ground-based launcher appears to be fully legal under the ABM Treaty as currently written. The interpretation of "space-based" as applying only to objects in orbit is reasonable, and was the U.S. interpretation long before the SDI program began.



Lofting Loophole: *Under current plans, brilliant pebbles interceptors would be tested by lofting them into space from ground-based launchers, as shown in this artist's conception of a now-cancelled test of the previous space-based interceptor concept. The interceptors would strike their targets as they fell back toward earth, without ever going into orbit, thereby sidestepping the ABM Treaty's ban on space-based ABM testing. But the pebbles' sensors would guide them to intercept rising missiles, effectively substituting for an ABM radar and thereby raising serious questions of compliance with both the treaty's limits on development and a 1978 Agreed Statement requiring discussions of such self-guided interceptors.*

But these tests clearly represent an effort to "work around" the treaty's restraints, running directly contrary to the object and purpose of the ban on space-based testing. U.S. pursuit of this kind of testing will open the way for the Soviet Union to do the same at some time in the future. That would increase potential Soviet "breakout" capabilities, undermining U.S. security, for having conducted extensive "lofted" tests of space interceptors, the Soviet Union could potentially conduct a few final space-based tests and deploy a system comparatively rapidly—as SDI advocates hope to do with brilliant pebbles. Rather than exploiting this loophole, it would be wiser to close it, through an agreed statement worked out in the SCC.

Even more troubling, it appears that the brilliant pebble sensors to be tested in these experiments will be sufficiently capable to allow the pebbles to intercept their targets without relying on an ABM radar, raising two serious questions of compliance. First, this would appear to constitute prohibited field testing of a prototype of a space-based ABM component; not only will the sensors be capable of substituting for an ABM radar, but they will be tested in an ABM mode, guiding an interceptor to attack a target with the flight trajectory characteristics of a strategic ballistic missile. As mentioned above, the Defense Department has acknowledged that in the case of space-based interceptor missiles, such field testing of a prototype of a space-based component would be prohibited, even in the "lofted" mode. Second, official descriptions of the still-



***Satellite Smash-Up**: The 1986 Delta 180 experiment involved two satellites launched by a Delta rocket. The interceptor satellite (left) attacked the target satellite (right) while the target's rocket was firing to simulate the motion of a rising Soviet missile, raising questions of whether the experiment constituted a prohibited test "in an ABM mode." But the interceptor satellite had little real ABM potential—it traveled too slowly, and its sensors were only able to home in on the target satellite because the target broadcast its location and carried a huge radar corner-reflector (shown in center of spacecraft).*

secret 1978 SCC Agreed Statement indicate that it requires discussions of how "testing in an ABM mode" is to be defined "if an ABM interceptor is given the capability to carry out an interception without being guided by an ABM radar," as in the case of brilliant pebbles. Yet the United States has so far refused to undertake these required discussions, raising another serious compliance concern.

Delta 181. The complex Delta 181 experiment launched on February 8, 1988, demonstrates that major space tests can be conducted that provide significant new technical information without raising any substantial questions of treaty compliance.

The Delta 181 experiment involved infrared, optical, and ultraviolet sensors as well as laser and microwave radars, all intended to help in the design of "eyes" for future strategic defense interceptors and sensor satellites. The test involved the release of 14 separate subsatellites from a Delta rocket, for observation by sensors mounted on the rocket's second stage. The 14 objects included mockups of warheads, decoys, and other possible midcourse objects, as well as four small rockets, which were ignited for close-range observation of their rocket plumes. Delta 181's sensors also tracked a sounding rocket launched from Hawaii.

This experiment collected a wealth of useful data on how various objects appear in space to a variety of different sensors—information essential for the design of potential ABM sensors. Yet with no intercept involved, there was nothing that could remotely be considered a test "in an ABM mode," and none of the on-board equipment could realistically be considered to have an ABM capability. Similar examples of substantial technical experiments in space that raise few treaty questions include the 1989 Delta Star test and the 1990 Relay Mirror Experiment and Laser Atmospheric Compensation Experiment tests, among others.

SDI TESTING AND THE ABM TREATY: OTHER ISSUES

Homing Overlay Experiment. While launched from fixed, land-based sites at an agreed ABM test range (Kwajalein Atoll), these 1983-1984 tests of a long-range kinetic-energy ABM interceptor used the first two stages of Minuteman I ICBMs as rocket boosters. The Soviet Union charged that "the Minuteman I ICBMs are being tested to give such missiles antimissile capabilities," in violation of Article VI of the ABM Treaty, which bans giving non-ABM missiles an ABM capability, or testing them in an ABM mode. The United States argued that the tests did not constitute testing Minuteman missiles in an ABM mode because the rockets were heavily modified, using only two of the three stages of the Minuteman I (which itself is no longer deployed), and were "observably different" from operational ICBMs. While this U.S. explanation is reasonably persuasive, similar Soviet testing of a modified SS-11 ICBM, for example, would surely provoke U.S. charges that the Soviet Union was developing the capability to rapidly convert the hundreds of available SS-11s to ABMs, raising the possibility of a "breakout" from the ABM Treaty.

A wide range of currently planned SDI tests will take a similar approach, and may provoke similar Soviet charges: tests of the Exoatmospheric Reentry Vehicle Interception System (ERIS) will use the second and third stages of the Minuteman I; previously planned SBI tests would also have used two Minuteman I stages, though with the shift to brilliant pebbles, different rockets may be used; and plans for tests of the Ground Surveillance and Tracking System (GSTS) rocket-borne infrared sensor include an option for launch by modified Polaris or Poseidon rockets.

Delta 180. The September 1986 Delta 180 test was a complex experiment combining a variety of different types of sensors. Two satellites were launched from a Delta rocket, and once in orbit one attacked the other, which was firing a rocket to simulate the acceleration of a Soviet missile in the boost or post-boost phase of flight. The interceptor satellite did not have a genuine ABM capability: its maximum speed was too low (though not dramatically so, three kilometers per second rather than the five to 10 planned for operational interceptors), and its sensors were capable of finding the target only because the target satellite broadcast its location and carried a large radar reflector to make itself thousands of times easier to find.

But in intercepting an accelerating satellite described by then-SDIO Director Lieutenant General James Abrahamson as "analogous to the upper stage of a Soviet ICBM while it was thrusting," the test came perilously close to a forbidden space-based test in an ABM mode—defined as a test against a target with the trajectory of a strategic ballistic missile "over the portions of the flight trajectory involved in testing." The Soviet Union reportedly complained about the Delta 180 experiment in the following session of the SCC.

Queen Match. Queen Match is a highly-classified SDI program which uses infrared sensors on rockets launched from Shemya Island in the Aleutians to track and collect data on Soviet ballistic missiles during test flights. While the ABM Treaty permits testing of such ground-launched sensors (a situation analogous to the "lofting" tests for brilliant pebbles described above), Shemya is not a permitted ABM test range; Queen Match would therefore be a violation if the sensor is capable of substituting for an ABM radar. The Defense Department has asserted that it is not capable of such substitution, though no public explanation has been offered. SDIO has indicated that the upgraded Queen Match sensors are "state of the art," but unclassified photographs of the system suggest that the sensor may be too small to effectively substitute for an ABM radar. The Soviet Union raised the issue of Queen Match during the third ABM Treaty Review Conference in August 1988, calling it a "a situation giving cause for concern," and requesting an inspection of the site.

Starlab. The Starlab flight scheduled for the fall of 1991 will test laser pointing and tracking capabilities in a week-long series of experiments aboard the space shuttle. The low-power lasers to be used clearly could not substitute for ABM interceptors, and no attempt to intercept a strategic ballistic missile will be made. However, a telescope onboard the Starlab will detect and track several specially-designed rockets and will "hand-over" from tracking the rocket plume to active laser tracking of the body of the rocket itself—one of the capabilities identified in the Defense Department's analysis of Zenith Star as critical to a sensor's ability to substitute for an ABM engagement radar in directing a laser. The sensor, however, is only capable of undertaking such experiments at ranges much less than would be needed for operational boost-phase sensors, and the active portion of the tracking requires the bright reflective coating on the target missiles. Overall, while the experiment is in a grey area, what little information is publicly available suggests that Starlab will comply with the ABM Treaty.

"The current design of the BSTS [Boost Surveillance and Tracking System]... results in the satellite being large, complex, technically risky, and raising ABM Treaty problems."

—Defense Science Board, 1989

Boost Surveillance and Tracking System. BSTS is a more advanced follow-on to current geosynchronous early warning satellites, using infrared telescopes to detect and track the fiery rocket plumes of Soviet missiles. The Bush administration has asked for $265 million to initiate full-scale development of BSTS in fiscal 1991, out of a $402 million total request for the program. But many in Congress have opposed this move from research to development, particularly as a December 1989 report from the Defense Science Board recommended that the BSTS design be drastically reconsidered, and SDIO Director Monahan has testified that because brilliant pebbles would theoretically have the ability to detect and track Soviet missiles on their own, the advanced capabilities of the current BSTS design are no longer strictly needed for the Phase I SDI system. If BSTS full-scale development is approved, initial BSTS satellites might be launched in the mid-1990s.

The Radars at Thule And Fylingdales Moor

The Soviet Union has charged that U.S. construction of phased-array early warning radars at Thule, Greenland, and Fylingdales Moor, United Kingdom, violates the ABM Treaty. The United States has rejected the Soviet charges.

Background. In 1972, when the ABM Treaty was signed, the United States had early warning radars deployed at Thule and Fylingdales Moor. These radars relied on a combination of fixed, parabolic antennas and rotating dishes. The ABM Treaty did not require dismantlement of these existing facilities, but limited early warning radars deployed in the future to the periphery of each superpower.

In July 1983, the U.S. Air Force awarded the Raytheon Corporation a contract to upgrade the Thule site with a large phased-array radar (LPAR). Built on a pre-existing but unused radar platform, the LPAR was completed and became operational in mid-1987. The facility has two radar faces, giving it 240-degree coverage. After several years of delay, Raytheon received a contract for an additional LPAR at Fylingdales in the fall of 1988, and construction began in mid-1989. That facility will be a new building near the existing radar facilities (earlier reports that the new radar would be several miles away were incorrect). That facility will have three faces, giving it all-around, 360 degree coverage.

Phased-array technology, which is used in virtually all modern ABM, early warning, and air defense radars, allows a radar beam to be steered electronically in milliseconds, rather than moving the beam by turning the radar itself. This allows phased-array radars to track many targets simultaneously, giving them much greater ABM potential than any other type of radar.

Because of this potential, the ABM Treaty puts strict limits on LPARs, not applicable to the radar technologies that had previously been deployed at Thule and Fylingdales. Agreed Statement F prohibits all LPAR deployments "except as provided for in Articles III [permitted ABM deployments], IV [ABM test ranges] and VI [early warning radars], or except for the purpose of tracking objects in outer space or for use as national technical means of verification." Since both the United States and the Soviet Union agree that Thule and Fylingdales are primarily designed for early warning, the relevant exception to this ban is Article VI, in which each party agrees "not to deploy in the future radars for early warning of strategic ballistic missile attack except at locations along the periphery of its national territory and oriented outward."

The ABM Treaty does not specifically restrain modernization of early warning or ABM radars, but any such modernization must be consistent with the treaty's other provisions. In the separate case of ABM radars, a still-secret agreement negotiated in the Standing Consultative Commission (SCC) reportedly permits "modernization by replacement"—i.e., upgrading an ABM site by building a new radar to replace an old one.

The basic dispute over Thule and Fylingdales is straightforward. The United States argues that the Thule and Fylingdales sites are permitted by the ABM Treaty, and are merely being modernized, consistent with the agreed concept of "modernization by replacement." The Soviet Union argues that both facilities are new early warning radars, deployed "in the future" at locations not on the periphery of the United States, and therefore forbidden. The Soviet Union rejects the modernization argument, pointing out that the new facilities, unlike the old radars, involve an entirely new technology, specially limited by the treaty.

The Soviet Union began raising the Thule and Fylingdales issue privately soon after the United States first raised Krasnoyarsk in the fall 1983 session of the SCC—which was also soon after the 1983 contract to Raytheon. In 1985, the Soviet Union went public with the charges over Thule and Fylingdales, and offered to halt construction at Krasnoyarsk if the United States halted construction at Thule and gave up plans for the Fylingdales facility. The United States rejected the offer. Since then, the Soviet Union has continued to focus attention on the issue, repeatedly charging that these radars violate the ABM Treaty. While both the Reagan and Bush administrations have rejected these Soviet charges, the United States agreed in February 1990 to permit Soviet experts to visit the facilities at Thule and Fylingdales Moor, as a confidence-building measure.

With the Thule radar already completed, it is unlikely that the United States will be willing to compromise on that facility, and the recent beginning of construction at Fylingdales Moor reduces the likelihood of U.S. flexibility on that LPAR as well. At the same time, it appears unlikely that the Soviet Union will link the issue to accords on START or Defense and Space, as the United States did with Krasnoyarsk. Recent statements by Soviet Foreign Minister Eduard Shevardnadze have called only for on-site inspections, which the United States has now accepted, without repeating earlier calls for dismantlement of the two radars.

Legal Status. The case of the Thule and Fylingdales radars is not as clear cut as that of the Krasnoyarsk radar, which the Soviet Union itself has now acknowledged is a violation of the ABM accord. The argument that modernization of early warning radars is not restricted—and should not be, since accurate and timely early warning serves both sides' security—has considerable plausibility. Moreover, Thule and Fylingdales, located far from U.S. territory, could contribute comparatively little to an ABM defense of the United States even if they were designed to do so.

A close reading of the treaty text, however, suggests that the treaty "does not provide a strong legal base for replacing the existing radar stations at Thule and Fylingdales with new large, phased-array radars," as the Aspen Strategy Group (co-chaired at the time by Brent Scowcroft) concluded in 1986. The phased-array radars at Thule and Fylingdales are entirely new facilities, relying on new technologies specifically constrained by the ABM Treaty: to deny that this constitutes "deployment" of new phased-array radars at those sites is contentious at best. As the Aspen group noted, permitting "modernization" does not automatically countenance a shift from a loosely limited category to one on which entirely different restrictions are placed, just as it would not permit replacement of a fixed ABM radar with a mobile one. Agreed Statement F prohibits *all* LPARs for early warning, "except as provided for" in Article VI—and Article VI bars all future deployments of such radars except on the periphery of the United States or the Soviet Union.

The record of U.S. subsequent practice (a key source of evidence for treaty interpretation under international law, as described in Chapter VI) also undermines the case for LPARs at Thule and Fylingdales. While the Reagan administration claimed that the legality of these deployments had been approved during the Carter administration, these statements appear to refer to a low-level study that was never officially sanctioned. William Perry, who as undersecretary of defense for research and engineering at that time had responsibility for ensuring U.S. treaty compliance, has indicated that he never sanctioned LPAR construction at those sites, and joined in the Aspen Strategy Group critique. Air Force congressional testimony in April 1980, the last year of the Carter administration, states that as of that time, a decision had been made not to build LPARs at Thule and Fylingdales, in part because of "the potential ABM Treaty conflicts of a phased array deployment."

"On a scale of zero to 100, with zero as absolute compliance and 100 [as] the clearest cut violation of all . . . I would put Thule in about the 60 category, and I would put Fylingdales [at] about . . . 70."

—John Rhinelander, 1987
Legal Adviser to the
U.S. ABM Treaty Negotiating Delegation

The negotiating record on this issue, unfortunately, remains classified. The U.S. negotiators are somewhat divided. Chief Negotiator Gerard Smith, delegation Legal Adviser John Rhinelander, and delegation Executive Secretary Raymond Garthoff have all concluded that the new facilities at Thule and Fylingdales are probable violations of the treaty, but Sidney Graybeal, another delegation member who went on be the first U.S. representative to the SCC, has strongly defended both LPARs.

In sum, the most straightforward reading of the treaty's terms would suggest that the new LPARs are indeed being "deployed," in violation of Article VI. But the imprecision in the treaty's language makes a black-and-white judgment as to the radars' legality impossible. However, whether legal or not, these radars would not greatly contribute to an ABM defense of the United States, and hence do not substantially undercut the ABM Treaty's basic purposes.

The ABM Treaty clearly permits infrared early warning satellites, but such satellites would run up against treaty constraints if they were "capable of substituting for" an ABM radar. The final article-by-article analysis of the treaty by John Rhinelander, legal adviser to the U.S. negotiating team, indicates that such satellites would be considered ABM components if they could provide enough information to "permit launching an ABM interceptor without relying on other ABM tracking sensors." SDIO has indicated that the first BSTS satellite will not have such ABM capabilities, primarily because its on-board computers and communications equipment will not be sufficiently capable. As with AOA however, testing a fully capable ABM sensor with slightly less advanced computers and communications than an operational component would still appear to constitute prohibited field testing of a "prototype" or "breadboard model" of the final component. And the lack of such equipment would be virtually impossible to verify.

Soviet testing of a similar system, however, would be less worrisome than Soviet analogs of many of the experiments described above, for such a system would have no ABM capabilities unless coupled with space-based boost-phase weapons, whose testing is also prohibited.

Space Surveillance and Tracking System. SSTS is also a satellite infrared-tracking system, but it will operate in lower orbits than BSTS, using more complex long-wavelength infrared sensors to track post-boost vehicles and clusters of reentry vehicles and decoys in the midcourse phase. SSTS has suffered repeated redesigns and delays for years, and could still face cancellation if SDIO decides to rely instead on ground-based and rocket-borne sensors. The 1992 Midcourse Space Experiment (about which very little is publicly known) will carry infrared and other sensors, providing design data for SSTS and other spacecraft, but a full SSTS test satellite is not slated for launch until the mid-to-late 1990s. The Defense Department has not provided detailed information on SSTS test plans or legal rationales for such testing; it is likely that the approach will be similar to that taken with BSTS, limiting the computer and communication capabilities of initial test satellites. Soviet activities similar to SSTS would raise much greater concerns, however, as such spacecraft designed to detect and track large numbers of warheads at long ranges could potentially take over essentially all the roles played by large phased-array radars in traditional-technology ABM systems. (See Chapter IX, "Grey-Area Systems and the ABM Treaty.")

Pegasus Neutral Particle Beam Experiment. A major space-based neutral particle beam (NPB) experiment called Pegasus is planned for the mid-1990s. The experiment is designed primarily to test the possibility of discriminating between warheads and decoys by observing the more intense radiation that would be emitted by the heavy warheads when struck by a particle beam. While such a system would clearly be a major ABM sensor, it would not be "capable of substituting for" either an ABM acquisition radar or an ABM engagement radar, since such a particle beam can neither search broad areas of space nor track and guide ABM interceptors. Hence, such a system could be considered a permitted "adjunct," assisting ABM radars without substituting for them. But as described in Chapter XII, an operational NPB discriminator would also have the potential to intercept strategic missiles. If the eventual space experiment involves a high-brightness beam, it could potentially be capable of substituting for an ABM interceptor, raising issues similar to those raised by Zenith Star.

Ground-Based Free-Electron Laser Technology Integration Experiment. SDIO is currently building a large free-electron laser at the White Sands ABM test range in New Mexico, for testing in the mid-to-late 1990s. The capability of the initial test system was recently decreased because of budget cutbacks; the system is now reported to include a 1.5 megawatt laser and a 1.5 meter beam director. Initial tests will demonstrate the operation of a high-power beam at the desired frequency, and the use of actively controlled mirrors to compensate for atmospheric distortions, shining the beam on an instrumented satellite. Later tests, probably after the year 2000, would involve reflecting the laser from space-based mirrors to targets. (For a description of the use of such ground-based lasers and space mirrors in an ABM system, see Chapter IV, "The Strategic Defense Initiative.")

The free-electron laser now being built is fixed, land-based, and at an agreed ABM test range. Testing of the laser is therefore permitted, even if it eventually achieves an ABM capability. But tests involving an ABM-capable laser directed by large space-based mirrors would be prohibited, since the laser-mirror combination would be an ABM component, of which part would be space-based. To argue in such a case that the mirrors were merely "adjuncts" to a permitted ground-based component would make the ABM Treaty's limits on space-based testing meaningless, as applied to such free-electron lasers.

CONCLUSIONS

While the overall record of U.S. compliance with the ABM Treaty has so far been good, the trend is toward activities raising ever greater questions under the ABM Treaty. Current AOA experiments and the planned Zenith Star and brilliant pebbles tests each raise fundamental questions of U.S. compliance with the ABM Treaty. In addition, it is important to remember that if a decision is taken to proceed with development and deployment of a Phase I missile defense, a large number of additional tests will be necessary throughout the mid-to-late 1990s, some of which would certainly violate the ABM Treaty. To provide realistic testing of space-based interceptors and sensors, the treaty would have to be irreparably breached long before the United States could have confidence that the systems under development could provide a cost-effective and survivable defense.

While the Defense Department has repeatedly argued that there must be no "double standard of compliance," judging Soviet activities and U.S. activities by different criteria, that is in effect what has developed. In virtually every case where ambiguities have arisen, the Reagan and Bush administrations have chosen to charge that Soviet activities are actual or "potential" violations, while maintaining that all U.S. activities—some of which appear harder to justify than some of the questioned Soviet activities, such as the movement of disassembled radar pieces to Gomel—are fully compliant. Judgments on the compliance of U.S. programs are based on unilateral (indeed secret) interpretations of key treaty terms, and on questionable or unverifiable means of complying with those unilateral interpretations. No consultation with the Soviet Union in reaching these interpretations has been undertaken. Pursuing this approach to compliance will open the way for the Soviet Union to pursue analogous activities, an outcome which could significantly erode the effectiveness of the ABM Treaty's limitations, undermining its substantial contribution to U.S. security.

U.S. security would be better served by judging planned activities by Scowcroft's test, eschewing activities the United States would object to if the Soviet Union were to undertake them. Where there are genuine ambiguities as to what is permitted, or loopholes in the current treaty text, clarifications should be pursued in the SCC.

The process of ensuring U.S. compliance with its international agreements would be strengthened if it were broadened and made more open. Currently, the Defense Department is assigned the task of ensuring that its programs do not violate arms control agreements. While the Defense Department does consult other agencies, this institutional framework raises the inevitable problems of self-regulation. To moderate these problems, greater formal responsibility for compliance should be assigned to the State Department, the Arms Control and Disarmament Agency, the National Security Council, and other relevant executive branch agencies. Consultation with Congress should be more regular and detailed. In addition, more compliance-related information should be made publicly available. While some technical details of planned test activities are legitimately classified, there is no reason why far more information on planned experiments could not be made available for discussion; indeed, in the Defense and Space Talks, the Reagan and Bush administrations have proposed that the United States and the Soviet Union directly exchange such testing plans. Even more important, in a democratic society, the key definitions and interpretations of ABM Treaty terms on which U.S. compliance judgments are based should be publicly available, including both the unilateral interpretations used in making U.S. compliance judgments and particularly the 1978 and 1985 understandings negotiated in the SCC, which are now integral parts of the agreement.

> ***"Near-term testing of large-scale mock-ups of SDI hardware is not advisable and should be avoided. First, such testing may 'freeze' technologies prematurely. Second, it would further erode confidence in the ABM Treaty, which is not in our interest."***
>
> *—Brent Scowcroft, 1988*
> *President Bush's National Security Adviser*

Strengthening the ABM Treaty through such clarifications and increased openness would by no means stymie an effective SDI research program. Delta 181 and many other SDI tests have demonstrated that it is possible to conduct major ABM-related space experiments without raising any substantial ABM Treaty issues. Indeed, as Scowcroft and the rest of the Aspen Strategy Group concluded in 1988, "Adhering to the ABM Treaty in its traditional form would not seriously hamper a sensible research and development program for another decade."

The Soviet ASAT uses shrapnel to destroy its target.

IX. Grey-Area Systems and the ABM Treaty

The ABM Treaty strictly limits defenses against strategic ballistic missiles, and prohibits giving other types of systems an ABM capability. But the technological capabilities needed for some other military missions—including defense against aircraft and tactical missiles, tracking and interception of satellites, and early warning, to name a few—overlap somewhat with the technologies of strategic missile defense, creating "grey areas" where the ABM Treaty's application is ambiguous. Over the long term, unrestrained pursuit of such grey-area technologies could significantly undermine the ABM Treaty's restraints. Ultimately, it may be desirable to reach clarifying accords to strengthen the treaty's terms by reducing the areas of ambiguity.

AIR DEFENSE, TACTICAL MISSILE DEFENSE, AND THE ABM TREATY

One of the most important and long-standing grey areas is that between strategic missile defenses and defenses against aircraft or tactical ballistic missiles. Both traditional air defenses and traditional ABM systems rely on rocket interceptors guided by radars. But aircraft are large, relatively slow, and fly at altitudes below 30 kilometers, while strategic missile warheads are small and travel at thousands of kilometers per second on flight-paths reaching hundreds of kilometers into space. Because of these differences, a system expressly designed for ABM defense would require a faster reaction time, faster, higher-acceleration interceptors, and larger, more capable radars (or other sensors) than would a system designed for air defense—though the advent of stealth aircraft may minimize the latter distinction, requiring more capable sensors for air defense as well.

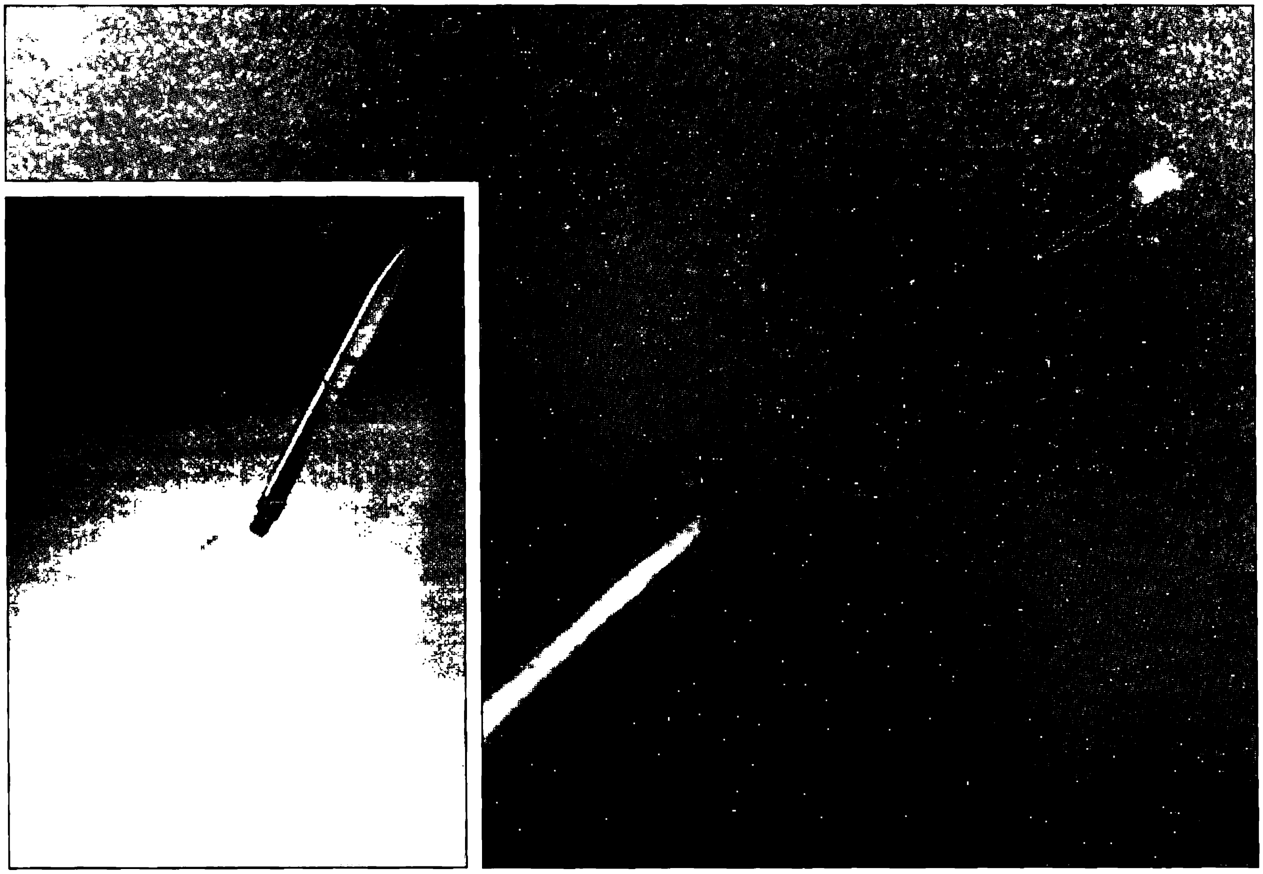
But because the basic technologies are similar, a system ostensibly designed for air defense might have some limited missile-defense capability—particularly if upgraded with improved radars or interceptors. Defenses against tactical missiles—antitactical ballistic missiles or ATBMs—pose even more difficult questions, as tactical missiles generally fall between aircraft and strategic ballistic missiles in size, speed, and altitude.

This technological overlap was a central issue from the outset of the ABM Treaty negotiations, as the United States was concerned that some surface-to-air missiles (SAMs) in the extensive Soviet air-defense system could potentially be upgraded for a limited ABM role. Of particular concern was the Soviet SA-5 air-defense system, which some U.S. intelligence analysts originally believed was designed to have at least some ABM potential. But to preserve the option of deploying a European defense against Soviet tactical missiles, the United States insisted that ATBMs be permitted by the accord. As a result, the ABM Treaty permits both air defenses and ATBMs, but prohibits giving such non-ABM systems "capabilities to counter strategic ballistic missiles" or testing them "in an ABM mode."

Both the United States and the Soviet Union are developing increasingly sophisticated air-defense and ATBM systems. Both of the new Soviet air-defense systems now being deployed, the SA-10 and the SA-12, are believed to have some ATBM capability. The SA-12 system comes in two versions, the SA-12a and the larger SA-12b. In the past, the SA-12b has reportedly been tested repeatedly against tactical ballistic missile targets, including the 900-kilometer range SS-12, though tests against such medium-range targets have not been repeated since the Intermediate-range Nuclear Forces (INF) Treaty was signed. (All SS-12s have now been dismantled under the terms of that treaty.) The Reagan and Bush administrations have both expressed concern that these systems could have a limited ABM potential, but other experts have questioned these charges. (See Chapter VII, "Soviet Compliance With the ABM Treaty.")

The United States has also undertaken a number of ATBM development programs. For the near term, the United States is upgrading the existing Patriot air-defense system to give it an ATBM capability. First tested against a tactical missile in September 1986, the Patriot will offer only a very limited point defense even against short-range tactical missiles, and would have no significant ABM capability. For the longer term, a variety of other ATBM programs are under way, including the Extended-Range Interceptor (ERINT) being developed in the SDI program, the SDI-sponsored Arrow ATBM being developed by Israel, the U.S. Army's new Theater High-Altitude Air Defense System (THAADS) concept, and a variety of SDI programs intended to encourage European and Asian companies to develop designs for defenses of the European and Pacific theaters. Several SDI studies have suggested that traditional interceptor-plus-radar systems may ultimately be replaced or augmented by more exotic technologies such as lasers, electromagnetic guns, and infrared sensors. The Soviet Union has expressed concern over the ABM potential of these future ATBMs, mirroring U.S. concerns over Soviet ATBMs.

The tactical missile threat that these U.S. and Soviet programs respond to has been greatly reduced by the INF Treaty, which requires the elimination of all Soviet ground-based missiles with ranges between 500 and 5,500 kilometers. Some Third World nations now possess or are developing ballistic missiles with these



Grey-Area Missile: *Interceptors designed to defend against short-range ballistic missiles, such as the U.S. Flexible Lightweight Agile Guided Experiment (FLAGE), shown here intercepting a Lance missile, are permitted by the ABM Treaty, but the point at which such systems gain a prohibited ability to defend against longer-range strategic missiles is ambiguous.*

ranges which could pose a threat, particularly to the Soviet Union. But it is unlikely that such Third World threats will justify the enormous expense of widespread deployment of an ATBM. Systems legitimately designed to defend against aircraft and remaining tactical ballistic missile threats with ranges below 500 kilometers are likely to have little ABM potential.

> ***"Without any agreement limiting ASATs, 'Star Wars' proponents will argue that many of the requisite missile defense technologies . . . can be tested and even deployed under the guise of ASAT systems. The intention is to use the absence of an ASAT accord to circumvent the provisions of the ABM Treaty—effectively destroying it."***
>
> *—Gerard C. Smith, 1984*
> *Chief U.S. Negotiator of the ABM Treaty*

Nevertheless, the ABM Treaty's limits on air defense and ATBM systems are somewhat ambiguous, leaving open some possibilities for future compliance disputes. A 1978 Agreed Statement defined testing "in an ABM mode" as including tests against targets "with the flight trajectory characteristics of strategic ballistic missiles over the portions of the flight trajectory involved in testing." But the two sides have never agreed on the dividing line between the flight trajectories of tactical ballistic missiles, whose use as targets is permitted, and those of strategic missiles. Similarly, while giving a non-ABM system the ability to intercept strategic ballistic missiles is prohibited, the lack of an agreed definition of the line between tactical and strategic missiles creates some ambiguity, as does the lack of any agreed specification as to how effective a system must be in an ABM role to run up against this limit, or how such effectiveness should be judged.

While the mission of intermediate-range missiles such as the Soviet SS-20 is not "strategic," their flight trajectories clearly are, travelling farther and faster than some strategic submarine-launched missiles. As a result, testing against SS-20s would clearly constitute testing "in an ABM mode," and air-defense or ATBM systems capable of intercepting such missiles would have a prohibited ABM capability. But for slower, shorter-range missiles, the situation is more uncertain.

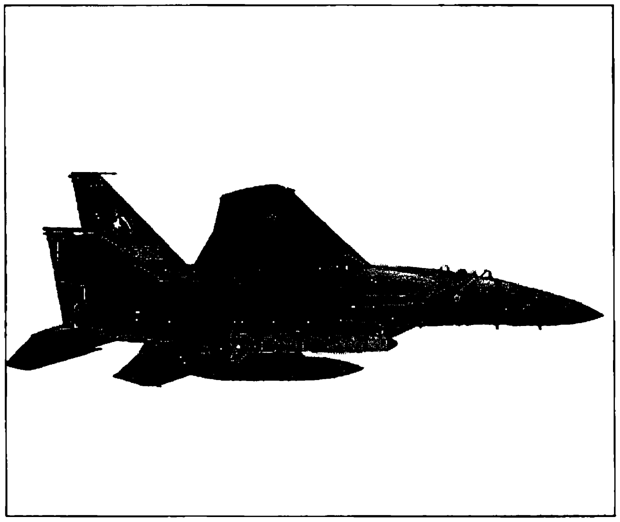
After the ABM Treaty was signed, then-Director of Defense Research and Engineering John Foster offered a rough boundary for the concept of testing "in an ABM mode," directing U.S. military contractors not to plan tests against target missiles which reached a speed greater than two to four kilometers per second and an altitude greater than 40 kilometers without consulting Defense Department compliance review officials. This rough definition was never an official U.S. government position, however, and was never agreed to by the Soviet Union. Foster's altitude limit, in particular, is too sweeping a reading of the current agreement, as defining all testing against targets above 40 kilometers as testing "in an ABM mode" would effectively count all antisatellite weapons as ABMs (see below). While a 1972 U.S. unilateral statement took a similar approach, indicating that the United States would consider all testing of air-defense interceptors at altitudes above those at which aircraft fly as testing "in an ABM mode," the agreed 1978 definition of testing "in an ABM mode" makes no reference to altitude.

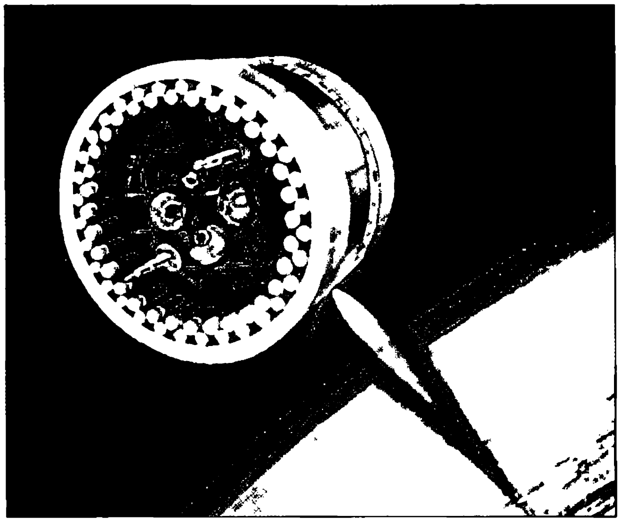
The position of several U.S. government agencies is that the shortest-range ballistic missile covered by the SALT agreements, the Soviet SS-N-5 with its 1,400-kilometer range, defines the minimum characteristics of a strategic ballistic missile. (A target with a range comparable to that of the SS-N-5 would have a maximum velocity of approximately 3.5 kilometers per second, but atmospheric drag would slow the reentry vehicle substantially during reentry.) This definition has also not been agreed to by the Soviet Union.

Fortunately, however, the recent changes in Soviet arms policies and the reduction in the tactical missile threat resulting from the INF Treaty have considerably improved the prospects for reaching accord in the SCC to clarify these issues, and a variety of possibilities for doing so are available. (See Chapter XII, "Reaffirming the ABM Treaty.")

ANTISATELLITE WEAPONS AND THE ABM TREATY

Because low-orbit satellites follow trajectories nearly identical to those of ballistic missiles in mid-flight, the technological overlap between antisatellite (ASAT) weapons and ABMs is perhaps even greater than that between ABMs and air defense or ATBMs. Initial development and testing of prohibited types of ABMs—such as space-based weapons and sensors—could be disguised as ASAT testing, while still demonstrating the basic capabilities required for an ABM mission. The reverse is also true: ABM systems designed to intercept missiles in space would pose devastating threats to low-orbit satellites—including defense satellites on the other side, if space-based defenses are deployed. (See Chapter IV, "The Strategic Defense Initiative.") Moreover, since the United States relies heavily on military satellites, the threats posed by ASATs and ASAT-capable ABMs pose major security issues of their own, giving ASAT arms control a powerful rationale independent of any concern for the ABM Treaty. (See "Toward ASAT Arms Control," p.148.)





ASAT Ambiguities: *Antisatellite weapons such as the canceled U.S. Miniature Homing Vehicle (MHV), shown above under its F-15 launch platform and in an artist's concept attacking a spacecraft, are permitted by the ABM Treaty. But new antisatellite weapons now being developed and planned SDI experiments will blur the line between ASAT and ABM capabilities.*

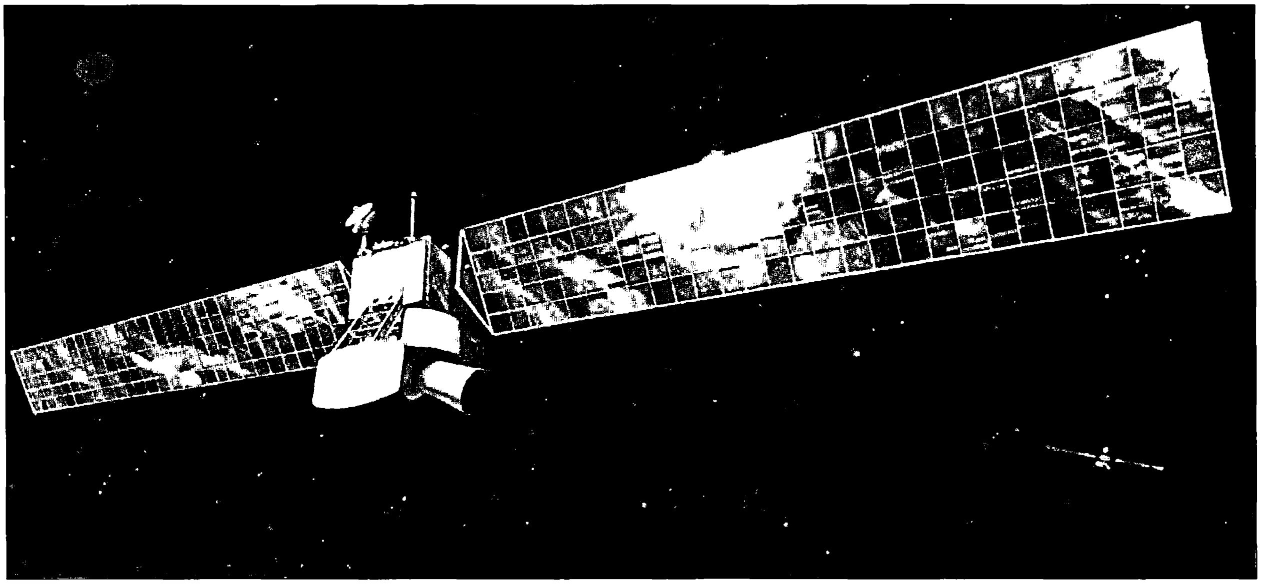
The similarities between ASATs and ABMs have been clear since the dawn of the space age. Indeed, some early U.S. ASATs were simply reconfigured Nike-Zeus ABM interceptors, and Soviet statements have explicitly indicated that the Soviet nuclear-armed Galosh ABM could also play an ASAT role, if Soviet leaders were willing to initiate the use of nuclear weapons in space.

But there are major differences between the ASAT and ABM missions as well. A large-scale ABM system could be forced to deal with thousands of missiles over the course of a few minutes, at a time and place chosen by the opponent. An ASAT system, by contrast, need only attack a few dozen satellites over a period of hours or days, and the attacker can choose the time and place, planning for weeks if necessary as the satellites' predictable orbits are tracked. Indeed, many of the best means of countering satellites—including jamming or deception of the satellite's sensors, space mines, and attacks on satellite ground stations—are simply inapplicable to ABM.

ASATs were not a major issue in the ABM Treaty negotiations, as there was no potentially upgradable infrastructure of thousands of interceptors, as was the case with air defense. Like air defense and ATBMs, ASATs are permitted, but restrained by the prohibition on giving non-ABM systems "capabilities to counter strategic ballistic missiles" or testing such systems "in an ABM mode."

While both the United States and the Soviet Union have tested dedicated ASAT systems, none of the technologies tested to date has had any significant ABM capability. The Soviet ASAT is a co-orbital system, which must be maneuvered into the orbit of the satellite to be intercepted; its relatively slow approach is totally inapplicable to the ABM mission. Similarly, while the technology of the U.S. Miniature Homing Vehicle (MHV) ASAT tested in the early 1980s was derived from the Homing Interceptor Technology (HIT) ABM research program, the final air-launched MHV system with its requirement for prolonged prior tracking information and intercept planning would have had no substantial ABM capability. The Soviet Union unilaterally ceased testing its ASAT in 1982, and has offered to dismantle the system in an ASAT agreement. The MHV program was cancelled in the Fiscal Year 1989 defense budget. Neither side has raised tests of these systems as an ABM compliance issue; there is tacit agreement that tests against objects in orbit should not necessarily be considered tests "in an ABM mode."

The urgency of the issues raised by the ASAT-ABM overlap is now increasing, however, as both ASAT-specific and SDI programs begin to come close to the boundary of ABM capabilities. The United States has initiated development of a new ASAT system using a ground-launched, direct-ascent rocket similar in many ways to the ERIS ground-based interceptor being developed for SDI, with initial tests against orbiting satellites currently scheduled for 1994. The Army, which manages the program, has pledged that this ASAT will not have an ABM capability, and will not be tested "in an ABM mode," but the distinctions between a direct-ascent warhead interceptor and a direct-ascent satellite interceptor are likely to be ambiguous and difficult to verify. While testing and deployment of an ASAT system with the capability to serve as an ABM interceptor would violate the ABM Treaty, in this par-



Sensor Spacecraft: *Sensors such as the Space Surveillance and Tracking System (SSTS) planned for SDI are creating new challenges for the ABM Treaty regime. Such sensors could potentially substitute for ABM radars, and distinctions between ABM-capable sensors and those designed for permitted purposes such as satellite tracking and early warning are likely to be difficult to verify.*

ticular case the planned fixed, land-based test program would not offer opportunities for mobile testing prohibited by the ABM accord, and hence would not seriously undermine the ABM Treaty's basic purposes. In addition, the planned deployment of 60-75 ASAT interceptors is fewer than the 100 interceptors permitted by the treaty, and would not provide a base for a nationwide missile defense (though the ASATs would not be deployed at the permitted U.S. ABM site at Grand Forks, and hence would again violate the treaty if they acquired an ABM capability).

Planned U.S. SDI experiments testing potential space-based ABM technologies against satellites rather than strategic missiles to avoid the ABM Treaty's limits on testing "in an ABM mode" raise more serious issues for the ABM Treaty regime. The U.S. case that several of these planned tests are not ABM-capable and do not involve tests "in an ABM mode" is highly questionable, and the justifications offered in several cases are unverifiable. (See Chapter VIII, "U.S. Compliance With the ABM Treaty.") If these tests proceed as planned and the Soviet Union follows suit with similar tests of its own, the ABM Treaty's restraints on development and testing of ABM systems and components could be seriously eroded over the next decade. Fortunately, as with air-defense and ATBM systems, possibilities for clarifying the ASAT-ABM overlap are available. But the United States has so far shown no willingness to pursue such clarifications, preferring to maintain the maximum possible freedom for SDI testing. (See Chapter XII, "Reaffirming the ABM Treaty.")

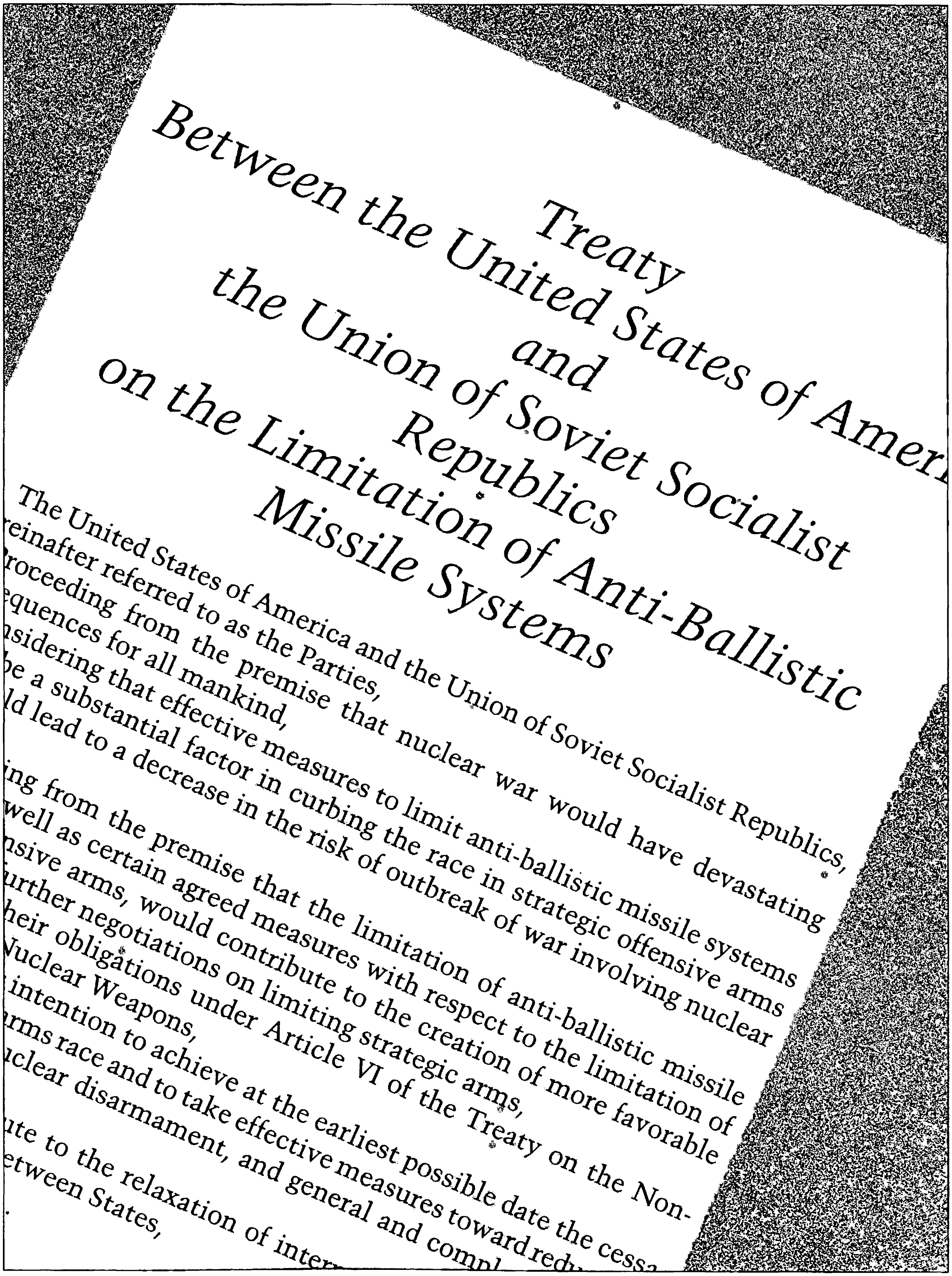
GREY-AREA SENSORS AND THE ABM TREATY

The most severe compliance problems the ABM Treaty has faced to date involve large phased-array radars (LPARs)—the Soviet radar at Krasnoyarsk, and the U.S. radars at Thule and Fylingdales Moor. (See Chapter VII, "Soviet Compliance With the ABM Treaty," and "The Radars at Thule and Fylingdales Moor," p.100.) At the time the ABM Treaty was negotiated, such radars were the critical guiding eyes of ABM systems, and the "long-lead-time item" of a nationwide defense—the single component that would take longest to build. Hence, the ABM Treaty placed strict limits on LPARs, to create a safety buffer of several years before a major nationwide defense could be put into place. But the LPAR limitations are somewhat ambiguous, as LPARs for ABM, early warning, and space tracking or verification are each constrained in different ways, with no agreed criteria for distinguishing between these various types of radars.

New types of sensors now under development pose even more daunting grey-area issues. Under the aegis of the U.S. SDI program, a variety of different infrared sensor systems are being developed, many of them designed ultimately to substitute for ABM radars. But similar sensors could have legitimate roles as well: low-orbit infrared satellites have long been under development for space surveillance (including verification of potential ASAT agreements); high-altitude infrared satellites are already deployed for early warning of missile attack, and more capable replacements were under development before SDI began; and the United States already uses airborne infrared telescopes to collect intelligence on Soviet missile flight tests and to monitor U.S. missile tests and space experiments.

Defining the differences between sensors capable only of these permitted purposes and those with an ABM capability is likely to be difficult, as the capabilities necessary for permitted and prohibited tasks are often not dramatically different. Moreover, infrared sensors can be relatively small (diameters of a few meters or less), and they do not emit energy that reveals their location and capabilities as radars do, greatly complicating the verification of agreed limits. And unlike large radars, such sensors might be built and deployed relatively rapidly once a prototype has been developed and tested, potentially reducing the lead-time for observing a breakout from the treaty.

Yet infrared sensors could potentially be just as effective as traditional radars in an ABM role: indeed, the Phase I SDI system now proposed by the Bush administration would rely almost exclusively on such infrared sensors for acquiring and tracking Soviet missiles. If current U.S. plans to develop and test airborne, space-based, and rocket-borne infrared sensors go forward, and the Soviet Union eventually follows suit, with no U.S.-Soviet agreement clarifying the ABM Treaty issues involved, the treaty's restraints on creating a "base" for a nationwide missile defense could be substantially undermined. While the technical difficulties of limiting such sensors are greater than those posed by clarifying the air defense-ABM or ASAT-ABM overlaps, here too there are some possibilities that would help strengthen the ABM Treaty regime. (See Chapter XII, "Reaffirming the ABM Treaty.")


Treaty
Between the United States of Amer
and
the Union of Soviet Socialist
Republics
on the Limitation of Anti-Ballistic
Missile Systems

The United States of America and the Union of Soviet Socialist Republics,
einafter referred to as the Parties,
roceeding from the premise that nuclear war would have devastating
quences for all mankind,
nsidering that effective measures to limit anti-ballistic missile systems
be a substantial factor in curbing the race in strategic offensive arms
ld lead to a decrease in the risk of outbreak of war involving nuclear

ing from the premise that the limitation of anti-ballistic missile
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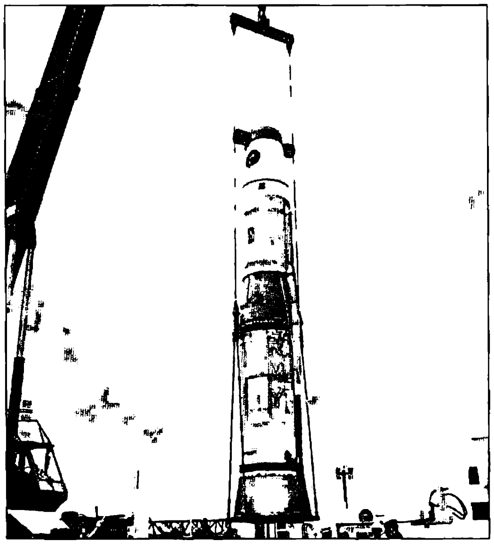
PART THREE

LOOKING TOWARD THE FUTURE



A test version of the ERIS ABM interceptor.

X. Nationwide Missile Defenses Or the ABM Treaty?

President George Bush has stated repeatedly that he intends to deploy the ABM technology being developed in the Strategic Defense Initiative program "as soon as it is ready," and has directed the SDI Organization (SDIO) to prepare for deployment of a Phase I missile defense in the 1990s. Deploying such a nationwide missile defense would require abrogating the ABM Treaty, a course Secretary of Defense Richard Cheney has said he would not hesitate to recommend. Within the next few years, the United States will therefore be faced with a fundamental choice between proceeding with the Phase I system and maintaining the ABM Treaty.

This chapter applies the logic outlined in Chapter I to the situation facing the United States in the 1990s, comparing the probable impact of deploying a Phase I missile defense to the likely results of maintaining the ABM Treaty, by a variety of criteria—the overall pace of the arms competition and the resulting budgetary implications; the magnitude of the overall nuclear threat to the United States; deterrence, crisis stability, and the survivability and effectiveness of U.S. strategic forces; the prospects for arms control and U.S.-Soviet relations; and the impact on U.S. allies and other nations. This examination clearly demonstrates that by each of these yardsticks, continuing the ABM Treaty would provide substantially greater security. Abrogating the treaty to build a Phase I missile defense would be a path of huge and uncertain costs and risks.

BUDGETS AND BUILDUPS: A RENEWED OFFENSE-DEFENSE RACE

If the United States abrogates the ABM Treaty to proceed with testing and deployment of a Phase I missile defense, the Soviet Union will surely respond. Both Soviet leaders and U.S. military officials have emphasized that the Soviet Union would increase its offensive forces to overcome U.S. defenses, and probably build a nationwide missile defense of its own. The United States would then be forced to respond in turn, touching off a new competition between ever-more-sophisticated offensive and defensive strategic forces. Such a renewed race would be enormously costly for both sides, draining essential resources from other military and civilian programs.

For the United States, the $55 billion estimated cost of the Phase I system—an estimate most non-governmental analysts believe to be far too low—would be only the beginning. The SDIO has long acknowledged that more advanced Phase II and Phase III missile defenses would soon be necessary to respond to Soviet countermeasures. Their cost is estimated in the hundreds of billions of dollars. And the nationwide ABM system the Soviet Union might deploy once the ABM Treaty's limits were abandoned "would require us to increase the number of our offensive forces and their ability to penetrate Soviet defenses to assure that our operational plans could be executed," as then-

Secretary of Defense Caspar Weinberger warned in 1985. A decision to deploy a Phase I missile defense, in short, would inevitably entail future decisions to deploy more MXs, Trident IIs, and B-2 bombers (or more advanced follow-ons to those weapons), along with offensive penetration aids such as chaff, decoys, and maneuvering reentry vehicles (MaRVs). The long-term additional cost of such improved offensive forces would also run to tens of billions of dollars.

It is essential to include these additional costs in any consideration of a Phase I deployment: the cost of Phase I, daunting even at $55 billion, would be only the first step in a long-term competition between offense and defense. At each step of such a race, expensive improvements in both offensive and defensive forces might appear essential just to maintain a balance. It would be extremely risky to initiate such a competition by abrogating the ABM Treaty without high confidence that the political consensus necessary to keep up such expenditures could be maintained over the long haul.

Given the recent dramatic declines in the Soviet and Warsaw Pact military threat, the resulting nearly inevitable cuts in future U.S. defense budgets, and the strong support for the ABM Treaty in both houses of Congress, it is extremely unlikely that a political consensus could be forged to take even the first step in such a competition. If such a step were taken, funding a dual program of missile-defense deployment and offensive force improvement to counter Soviet defenses would require either long-term increases in overall military spending, diverting both funds and technical resources from the civilian economy, or substantial cutbacks in other areas of the military budget.

Of course, the Soviet Union's disastrous economic situation would pose even more substantial restraints on its efforts to respond to U.S. missile defenses. The Soviet Union has already undertaken dramatic unilateral reductions in conventional forces and begun cutting back military spending in order to shift resources to the civilian economy, and larger military budget reductions are planned for the future. Soviet President Mikhail Gorbachev clearly hopes to avoid the substantial diversion of resources that would be required to respond effectively to a nationwide U.S. missile defense, particularly in the high-technology areas that would inevitably be the focus of such a renewed strategic competition. That has surely been one of the key motivations behind the strong Soviet opposition to SDI, and support for maintaining the ABM Treaty.

However, U.S. abrogation of the ABM Treaty and construction of a nationwide missile defense would pose a dramatic new threat to the effectiveness of Soviet strategic forces, the core of Soviet military capabilities, and Soviet leaders have repeatedly said that they would have no choice but to respond. Gorbachev himself has warned that "calculations" that the Soviet economy could not bear the cost of responding to SDI are "built on sand," saying: "The Soviet Union has the means to answer any challenge, if this should be necessary." General Colin Powell, chairman of the Joint Chiefs of Staff, has repeatedly said that Soviet military leaders consider strategic forces their "crown jewels," and are likely to maintain their capability even if substantial sacrifices are required to do so. Indeed, despite the dramatic unilateral reductions in Soviet conventional forces and the cutbacks in military spending, there have been no similar unilateral reductions in strategic forces, and the Soviet Union is still devoting substantial resources to an across-the-board modernization of its strategic arsenal. Before the recent cutbacks in conventional forces, spending on intercontinental attack forces and strategic defenses represented only a little over one-tenth of the Soviet military budget; that percentage could certainly be increased if necessary. Indeed, in 1987 Douglas MacEachin, the head of Soviet analysis for the CIA, specifically warned Congress that Soviet leaders would probably increase their overall military spending and the capabilities of their offensive forces in response to U.S. deployment of an SDI system.

> ***"While limited forms of SDI may be more plausible [than a population shield], it is unlikely that they would meet the criteria of cost-effectiveness and survivability. If they do not meet these technical criteria, premature efforts to deploy a system could stimulate a costly offensive and defensive arms race and reduce stability at a time of crisis. Both effects would reduce rather than enhance our security."***
>
> *—Brent Scowcroft, 1988*
> *President Bush's National Security Adviser*

Economic constraints, however, might lead the Soviet Union to place heavier emphasis on offensive, "offsetting" responses to a U.S. missile defense than on more costly defensive, "emulating" responses. U.S. intelligence assessments indicate that the Soviet Union is well prepared to undertake such a near-term offensive response to SDI. The Soviet Union has open production lines for at least four types of offensive strategic missiles and two types of strategic bombers, as well as a large (though aging) nuclear materials production complex. The large number of test and spare missiles currently stockpiled could be readied for operational use at relatively modest cost. In addition, the Soviet Union could rapidly increase the number of warheads on some existing missiles. For example, the

Defense Department believes that the heavy SS-18 ICBM, the only counterforce-capable weapon currently in the Soviet arsenal, could carry 14 warheads without significant modification, rather than the 10 it now carries; similarly, it is estimated that the Soviet SS-N-23 SLBM could carry 10 warheads rather than the four it is now equipped with.

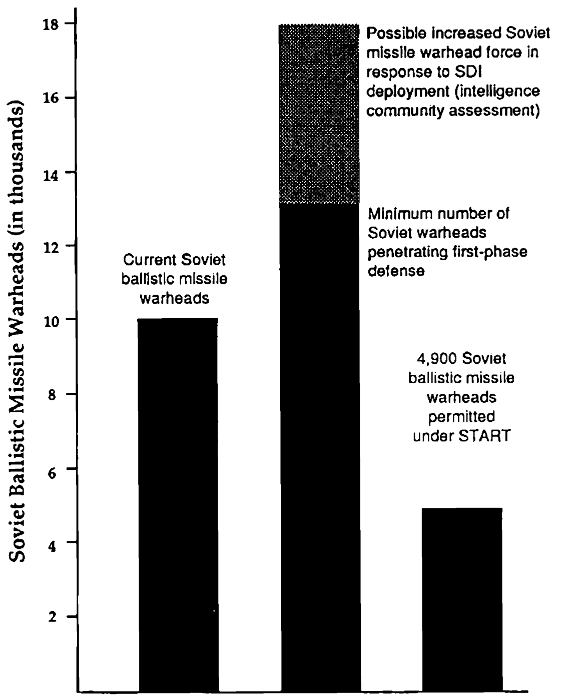
Overall, according to 1988 testimony by then-SDIO Director Lieutenant General James Abrahamson, the U.S. intelligence community estimates that in response to SDI, the Soviet Union could *more than double* its current strategic forces by the late 1990s, without having to invest in any new production lines or capital equipment. (Even Soviet advocates of deep cuts in strategic forces acknowledge that in budgetary terms, the sheer number of strategic weapons built and maintained is less important than the number of open production lines.) Such an increased Soviet force would clearly escalate the strategic threat to U.S. security.

Indeed, measured in the sheer number of warheads that could detonate over the United States in the event of a nuclear war, such an offensive response would more than compensate for the protection offered by a Phase I system. (See graph, this page.) Even if the Phase I system works exactly as planned, and the Soviet Union takes no effective countermeasures, Phase I is only designed to intercept 50 percent of the Soviet Union's SS-18s, and 30 percent of the remainder of a 4,700-warhead "leading edge" attack. Facing a larger-scale attack, the defense's effectiveness would be substantially lower, as most of the ground-based interceptors would have been expended in defending against the 4,700-warhead first wave. Thus, intercepting an average of 30 percent of the doubled Soviet strategic force Abrahamson envisioned is considerably more than the Phase I system could hope to achieve—yet even at that, thousands *more* Soviet missile warheads could reach the United States than if the Phase I defense had never been deployed. Even in the unlikely event that the Soviet Union took no response at all to U.S. deployment of a Phase I missile defense, the maximum 30 percent reduction in the number of Soviet missile warheads that could reach the United States is substantially less than the 50 percent reduction in missile warheads the Soviet Union has already agreed to in the nearly completed strategic arms reduction (START) treaty, on the condition that the ABM Treaty is maintained. In short, far from offering effective protection against a Soviet missile attack, deployment of a Phase I system would likely increase, not decrease, the Soviet missile threat; START offers a far more effective and reliable path to reducing the nuclear threat to the United States, without the enormous cost of missile defenses.

SDI supporters argue that longer-term defenses might eventually offer more protection, but the likelihood that the first round of an offense-defense competition would only take us further from the eventual goal—even if the Phase I defense worked exactly as planned—does not bode well.

Moreover, while the Soviet Union has apparently not emphasized testing of antidefense countermeasures as heavily as has the United States, intelligence projections indicate that the Soviet Union has the potential to develop a variety of effective counters to the Phase I missile defense in the near term. (See Chapter IV, "The Strategic Defense Initiative.") Studies by the nonpartisan congressional Office of Technology Assessment (OTA) and the Lawrence Livermore nuclear weapons laboratory agree that, in the Livermore study's words,

Reducing the Soviet Missile Threat: Phase I vs. START



Increased Threat: *Today the Soviet arsenal includes some 10,000 warheads on strategic ballistic missiles (left). In a best case, a Phase I missile defense might be able to intercept some 30 percent of a large-scale Soviet attack, but intelligence estimates suggest that the Soviet Union could drastically increase its missile forces by the late 1990s, in response to a U.S. missile defense—meaning that more Soviet warheads might strike the United States in the event of a nuclear war than if the defense had never been deployed (center). By contrast, a START agreement would reduce Soviet missile forces to 4,900 warheads.*

"large numbers of effective [Soviet] midcourse decoys are possible for the near term," possibly confusing the midcourse layer of U.S. defenses. In addition, after reviewing classified intelligence estimates, OTA concluded that by the time a Phase I defense could be put into place, the Soviet Union could have "numerous" nuclear-armed antisatellite weapons, which "would threaten to degrade severely the performance of a first or second-phase BMD [ballistic missile defense] system." Similarly, the Defense Intelligence Agency (DIA) has reportedly projected that the Soviet Union could build fast-burning missiles to counter U.S. space-based interceptors within seven years of a decision to do so, and then-Deputy Director of SDIO for Technology Louis Marquet made the same projection in 1987. While SDI advocates have argued that a fast-burn booster response would be too expensive, forcing the Soviet Union to replace its existing missiles, the fact is that the Soviet Union replaces its missiles with each of its regular rounds of modernization, and there is no evidence that the cost of fast-burn boosters would be enormously greater than the cost of other replacements.

In addition, while the Soviet Union would probably devote primary emphasis to an offensive response, both the Joint Chiefs of Staff and Soviet leaders themselves have warned that if the United States abrogates the ABM Treaty, the Soviet Union will expand its own missile defenses. In the near term, such expanded Soviet ABM defenses would likely be less sophisticated than U.S. defenses, relying on ground-based ABM technologies similar to those incorporated in the Moscow ABM system. (See Chapter V, "The Soviet ABM Program.") In early 1988, the Department of Defense estimated that in the absence of the ABM Treaty, the Soviet Union might deploy "a few hundred [ABM] interceptor launchers in the early to mid-1990s and perhaps a few thousand interceptor launchers after the year 2000." By then, the system might include "more than 100 ABM sites."

There is no doubt that the United States could maintain an effective deterrent in the face of such Soviet defenses, by increasing its offensive forces and deploying antidefense penetration aids. (See "Hedging Against Soviet Breakout," p.86.) Nevertheless, the problems and uncertainties facing U.S. military planners would clearly increase.

In sum, intelligence projections suggest that by the time even a limited Phase I missile defense was completed, the Soviet Union could have doubled its offensive strategic force to compensate, deployed a range of effective countermeasures to the U.S. defense, and deployed a nationwide missile defense of its own involving thousands of ABM interceptors.

Some SDI advocates argue, however, that superior U.S. technology would eventually give the United States a substantial advantage in such a race. But the history of the strategic arms competition indicates that the Soviet Union would be able to match every major innovation within a few years. And whatever the details of the technological balance, the "margin of safety" for U.S. strategic security would be significantly reduced by the uncertainties of such a long-term technological offense-defense competition. The future size and effectiveness of Soviet defenses and offenses would be unlimited by arms control and difficult to predict, making planning of U.S. forces, both offensive and defensive, increasingly complex. And as described in detail in Chapter IV, there is little likelihood that missile defenses would ever gain the upper hand over nuclear offenses. The fearsome power of nuclear weapons, the thousands of offensive nuclear weapons that already exist, and the enormous number of means of delivering those weapons and of countering potential defenses, conspire against the possibility of genuinely protecting the people of either the United States or the Soviet Union from nuclear attack. In the nuclear age, the fragile networks of civilization will unfortunately remain easier to destroy than to defend.

> ***"If the ABM Treaty were terminated, the United States will face a spiraling arms race in both defensive and offensive systems, a competition that will seriously jeopardize our national security and will require major increases in the military budget."***
>
> *—Robert McNamara, 1987*
> *Former Secretary of Defense*

By contrast, maintaining the ABM Treaty would avoid the enormous costs and uncertain risks of a renewed offense-defense competition—though such a course would not permit the United States to gain the very limited protection that might be offered by a Phase I missile defense. In addition, as described in more detail below, maintaining the ABM Treaty would allow the United States to complete and implement a START agreement, a more effective means of reducing the Soviet strategic threat.

CRISIS STABILITY, UNCERTAINTY, AND DETERRENCE

One of the most troubling risks associated with nationwide missile defenses is the possibility that the incentive for either side to launch a first nuclear strike in a moment of intense crisis could be increased, undermining deterrence and increasing the risk of nuclear war. As Secretary of Defense Cheney has acknowledged, the risk of such a conflict today is probably at its lowest point in the nuclear age; but the renewed arms competition and heightened tensions that could well result from abrogation of the ABM Treaty by either superpower would create a different environment.

Today, with no substantial protection against missile attack on either side, neither the United States nor the Soviet Union could possibly hope to destroy enough of the other's strategic forces in a first strike to prevent a devastating counterblow. But as described in Chapter I, adding substantial missile defenses to the picture might create a perception that damage from a nuclear war could be reduced by striking first, with offensive forces destroying a large portion of the adversary's forces and missile defenses intercepting much of the reduced retaliatory strike. While the victim of a first strike might use its defenses to protect a fraction of its strategic forces, virtually any missile defense would be less effective against a massive, well-coordinated surprise attack than against a reduced, disorganized retaliation that the defense commanders knew was coming, increasing the advantage of the first blow and thereby heightening the risk that an intense confrontation could escalate to all-out war. In addition, many types of missile defenses are themselves likely to be vulnerable to a well-coordinated attack, further increasing the incentive to strike first.

"The impact of the introduction of space-based capabilities . . . would be to create instability during the entire period of deployment . . . . the advantages of striking first, for either side, would be far greater than is the case for terrestrial capabilities. We must not assume the Soviets will allow us any unilateral advantage. And in the instabilities of the unavoidable superpower competition lies the potential for disaster."

—James Schlesinger, 1984
Former Secretary of Defense

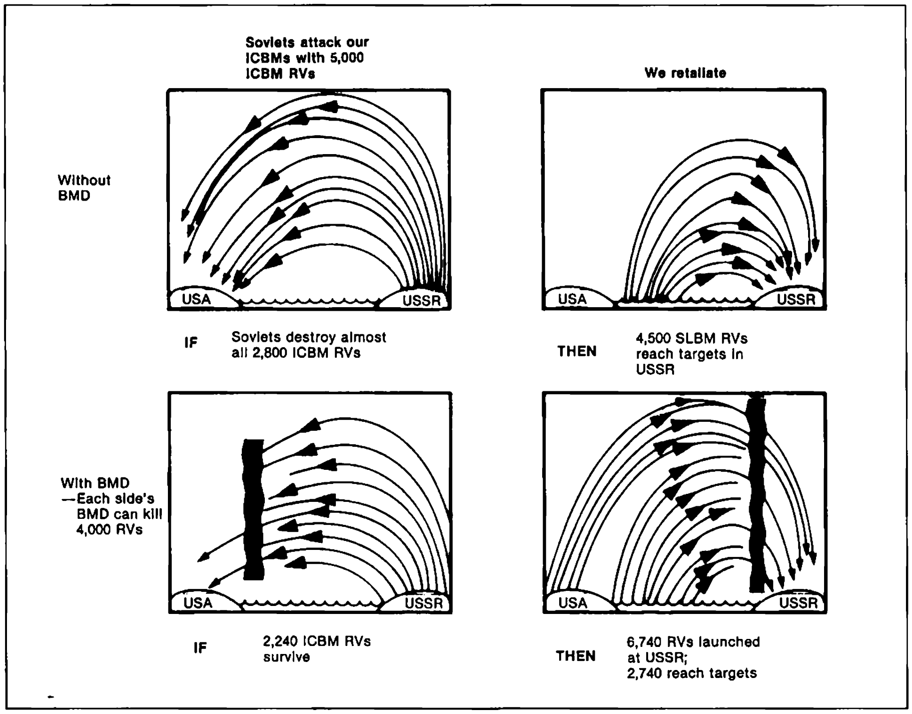
With each side now deploying over 11,000 strategic warheads, the current balance has such an enormous margin of deterrence that defenses would have to be improbably effective to make much difference in an objective calculation—but perceptions may be different from the realities, particularly in the desperation and chaos of an intense crisis. And any increase in the incentive to launch a nuclear attack, no matter how small, should be avoided.

The Office of Technology Assessment clearly identified one particular aspect of this problem in 1985, and again in 1988. If the United States deployed a missile defense to protect strategic forces roughly comparable to those it has today, and the Soviet Union then deployed similar defenses, the U.S. ABM system might defend some U.S. ICBMs from a Soviet first strike, but the Soviet defense would undermine the retaliatory effectiveness of both U.S. ICBMs and U.S. submarine-launched ballistic missiles, reducing rather than increasing the overall number of U.S. warheads that could survive a Soviet attack and get through the Soviet defense to retaliate. (See figure, p.117.) In OTA's words, "if the Soviet Union had ballistic missile defenses comparable to the United States, the net effect of trying to defend land-based missiles against a Soviet strike would be to *reduce* the U.S. ability to carry out planned retaliatory missions," which could "weaken, not strengthen, deterrence." And the better the defenses on each side became, the worse the problem would be, for equivalent Soviet defenses would intercept a larger fraction of U.S. warheads arriving in a retaliation than U.S. defenses would protect from a Soviet attack. Adding defenses to offensive forces arrayed roughly as they now are, the United States could only improve the overall effectiveness of its retaliatory forces in the face of a potential Soviet first strike if it was able to constantly maintain a roughly two-to-one superiority over the Soviet Union in missile defense effectiveness. If the history of the arms race teaches any lesson, it is that the Soviet Union is not likely to permit such a massive U.S. superiority for long.

In addition, it should be remembered that each side's incentives to strike first in a crisis are based in part on their fear of an attack by the other side—a problem certain to be exacerbated by a direct military challenge such as abrogating the ABM Treaty in order to build a nationwide missile defense. Both Soviet and U.S. leaders have already expressed the view that the other's work on missile defenses is part of a first-strike strategy. A U.S. abandonment of the ABM Treaty would surely heighten Soviet perceptions of the risk of a U.S. attack, increasing the Soviet Union's incentive to launch its missiles early in a future crisis, before the United States could seize the initiative with its own attack.

It is for these reasons that the United States and the Soviet Union agreed, in the preamble to the ABM Treaty, that the treaty's ban on nationwide missile defenses "would lead to a decrease in the risk of outbreak of war involving nuclear weapons."

Advocates of SDI take the opposite view, however, arguing that far from undermining the current balance, a Phase I system is necessary to bolster deterrence by protecting U.S. strategic forces and command and control, thereby throwing "uncertainty" into any Soviet plans for a first strike. Secretary of Defense Cheney, for example, has stated that "enhancing deterrence by con-



Reduced Retaliation:
With neither the Soviet Union nor the United States deploying widespread missile defenses, a Soviet first strike might be able to destroy most U.S. land-based missiles (top left). But the thousands of U.S. warheads on sea-based missiles (and on bombers, not shown in this figure) could carry out a devastating retaliation (top right). If both the United States and the Soviet Union deployed defenses, the U.S. defense could protect some U.S. land-based missiles from a Soviet attack (bottom left), but the Soviet defenses would undermine the effectiveness of both land-based and sea-based missiles, possibly reducing the number of U.S. warheads that could survive a Soviet attack and carry out a retaliatory strike.

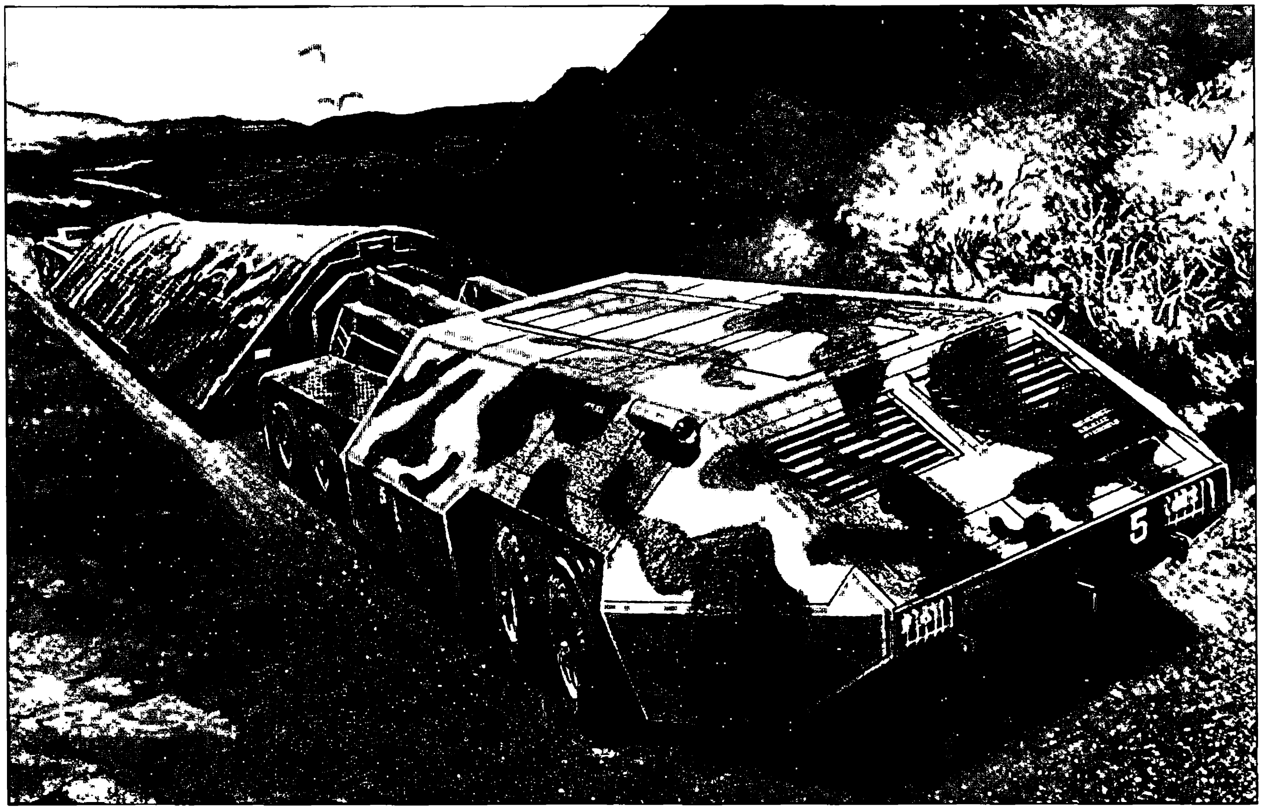
founding first strike planning is exactly the objective of the first phase of SDI," arguing that such a defense would "disrupt a coordinated attack" and thereby ensure that the Soviet Union would "face the devastation of retaliation" if Soviet leaders ever chose to attack the United States.

There are several serious problems with this argument, however. First, such survivability improvements are not urgently needed: as the Defense Department acknowledges, U.S. strategic forces are already highly survivable, posing a devastating deterrent to any Soviet nuclear attack. Thousands of survivable U.S. SLBM warheads are constantly at sea, and well over a thousand more are carried on strategic bombers on strip alert, ready to leave their bases before an attack arrived. In a crisis, the numbers of submarines at sea and bombers on alert would be substantially increased. The U.S. command and control system is sufficiently survivable to ensure that basic retaliatory commands could be executed, even after a major Soviet attack. Thus, today the Soviet Union faces no "uncertainty," but rather a *certainty* that a preemptive strike could not prevent the utter destruction of the Soviet Union in retaliation.

A substantial portion of U.S. ICBMs might be destroyed in a Soviet attack, however. The Defense Department estimates that an attack using two warheads from the "heavy" Soviet SS-18 ICBM against each of the 1,000 U.S. ICBM silos would destroy 65-80 percent of them, leaving a significant force of several hundred warheads surviving. More advanced modified SS-18s now being deployed could pose an even greater threat (though the Soviet Union has agreed to dismantle half of the SS-18s under a START agreement), as could other missiles as the accuracy of the Soviet arsenal increases. But these theoretically vulnerable ICBMs account for less than one-fifth of the warheads in the U.S. strategic force.

Moreover, an attack on U.S. ICBMs already faces enormous uncertainties and operational barriers to success. Hundreds or thousands of individuals would have to coordinate the launch of thousands of warheads over intercontinental trajectories never before flown, with precise timing and pinpoint accuracy. The accuracy, timing, and reliability of the weapons, as well as the hardness of the target, would all be imperfectly known beforehand, as would the "fratricide" effect of later warheads encountering the nuclear blasts from previous warheads in the attack. Just as important, while the United States should not rely on a policy of launching its missiles on early warning of attack, because of the horrific possibility of a false alarm, Soviet leaders could never be confident that U.S. missiles would not be launched before their attack arrived. Thus, no amount of analysis could determine beforehand whether a Soviet attack would destroy more than three-quarters of the U.S. ICBMs, or none of them, because they had already been launched—in essence, as much "uncertainty" as a Soviet planner could possibly face.

For these reasons, all three of the most recent former chairmen of the Joint Chiefs of Staff assured Congress



Mobile Missiles: *Currently, improvements in the survivability of U.S. strategic forces are not urgent, as the United States has thousands of survivable strategic warheads, and the risk of a Soviet nuclear attack is probably at its lowest point in 40 years. If changes in the threat eventually require survivability improvements, mobile ICBMs, such as the Midgetman launched from this mobile launcher, would be both "cheaper" and "more effective" than missile defenses, according to Air Force Chief of Staff General Lawrence Welch.*

in early 1990 that U.S. strategic forces were already so survivable that in the new environment of U.S.-Soviet relations, current programs to improve ICBM survivability could be safely abandoned, shifting the resources planned for these programs to more urgent priorities.

If changes in the Soviet threat eventually force the United States to take new steps to improve the survivability of its strategic forces and ensure that it remains "impossible for [the Soviets] to plan a first strike," in Cheney's words, there are alternatives available that are less costly and more effective than deployment of missile defenses.

Mobile ICBMs are one obvious possibility. While the acquisition cost of the Phase I system is estimated at $55 billion in Fiscal Year 1988 dollars, the comparable cost for the Midgetman mobile ICBM, the most expensive of the other options under consideration for improving ICBM survivability, is estimated at $23.8 billion for 500 missiles. The Defense Department estimates that putting the already purchased MX missiles on rail cars, in a so-called rail garrison basing mode, would cost $5.4 billion in 1988 dollars, less than one-tenth the cost of the Phase I system. (However, while the rail-garrison MX would provide good survivability once dispersed in time of crisis, it would not survive in the unlikely event of a "bolt-from-the-blue" first strike in peacetime.)

Comparing the cost for each additional warhead that would survive a Soviet attack—a comparison that includes both price and effectiveness—still shows either mobile ICBM system to be more cost-effective than the Phase I defense, even if optimistic assumptions are made about the performance of the defense. In the words of Air Force Chief of Staff General Lawrence Welch, it is both "cheaper" and "more effective" to achieve ICBM survivability by deploying mobile missiles than by building missile defenses. Much the same can be said of improving the survivability of U.S. command and control centers, some of which are also being made mobile to better protect them from attack.

But even these comparisons are too generous to the Phase I defense, for they do not take into account likely Soviet responses. Unlike the mobile missile options, attempting to protect U.S. ICBMs by deploying a Phase I missile defense would require abrogating the

ABM Treaty, incurring all the costs and dangers of the ensuing offense-defense competition. In such a race, Soviet countermeasures could soon drastically undermine the effectiveness of the Phase I system. (By contrast, the Defense Department has repeatedly testified that no near- or medium-term Soviet threats would seriously threaten the survivability of mobile missiles.) Indeed, since SDIO officials acknowledge that Soviet countermeasures would require that Phase I be complemented by a far more expensive Phase II system well within the standard 15-year weapon life-cycle, the costs of Phase II, as well as the costs of improvements in offensive forces that might be needed to ensure their continued effectiveness in the face of Soviet defenses, must be reckoned in the overall price of the "defense" approach, multiplying its cost severalfold.

In addition, abrogating the ABM Treaty to deploy a nationwide missile defense would eliminate any prospects for stabilizing agreements to reduce offensive strategic forces—a point described in more detail below. Deployment of mobile missiles, by contrast, could be entirely compatible with such agreements—and the reduction in the Soviet strategic threat brought about by negotiated cuts could reduce the cost and improve the survivability of such mobile deployments.

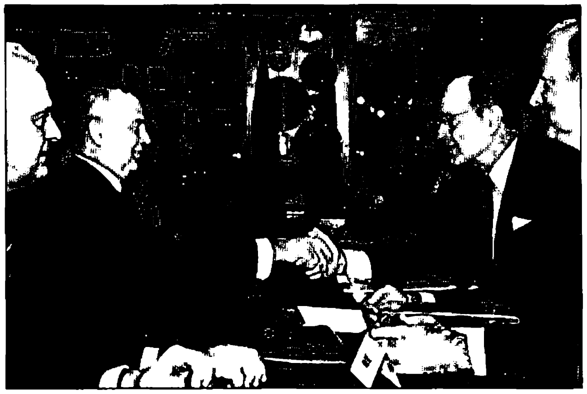
Finally, there is the problem of Soviet missile defenses that might be deployed if the United States abrogates the ABM Treaty. As described above, even if a Phase I defense could protect some U.S. ICBMs from a Soviet first strike, both those ICBMs and already-survivable U.S. submarine-launched ballistic missiles would then face Soviet missile defenses in attempting to execute a retaliation, potentially undermining rather than reinforcing the overall survivability and effectiveness of U.S. retaliatory forces. Soviet offensive and defensive forces would work together to limit the effectiveness of the U.S. deterrent; the new "uncertainty" would be as much about the effectiveness of U.S. retaliation (an uncertainty that would not exist without missile defenses in place) as about the likely degree of success of a Soviet first blow.

Overall, then, the argument that an SDI system must be deployed to protect the U.S. deterrent suffers from three critical flaws: it is not necessary, there are better ways to accomplish the task if it were, and it might well have the opposite effect.

The contrast between the two available paths is stark. Abrogating the ABM Treaty to deploy a Phase I missile defense would ultimately lead to limited missile defenses on both sides, potentially increasing the incentives to strike first by offering an attacker the possibility of intercepting much of the reduced and ragged retaliation. The substantial costs of the Phase I system and necessary follow-ons would likely eliminate any chance of gaining approval for simultaneous deployment of mobile missiles, the more effective survivability option. On the other path, if the ABM Treaty were maintained, U.S. strategic forces would continue to pose an overwhelming and survivable deterrent to nuclear attack, and there would be no substantial Soviet missile defenses to cast doubt on their effectiveness. If changes in the Soviet missile threat necessitated improvements in the survivability of land-based missiles, the United States could deploy mobile ICBMs.

PROSPECTS FOR ARMS CONTROL

Because increases in strategic force levels would be necessary to counter an adversary's missile defenses, the Soviet Union has made it clear that U.S. violation or abrogation of the ABM Treaty would force the Soviet Union to withdraw from the START agreement and begin building up its offensive forces. A variety of U.S. officials have expressed similar doubts over the wisdom of reducing U.S. offensive forces if the Soviet Union were to build a nationwide missile defense of its own. Thus, while Secretary of Defense Cheney has claimed that a Phase I missile defense would "complement" the Bush administration's arms control policy, the two in fact are in fundamental conflict. A decision to abandon the ABM Treaty in order to deploy a Phase I missile defense would sound the death knell for START, and probably for all negotiated limits on strategic arms, leaving an arms competition constrained only by available economic and technological resources.



Improved Relations: *Relations between the United States and the Soviet Union have improved dramatically in recent years, leading to progress in arms control negotiations and other issues—as symbolized by President Bush's meeting with Soviet President Gorbachev at the Malta summit in 1989. But abrogation of the ABM Treaty by either superpower could result in a decisive downturn in relations, touching off a renewed competition in offensive and defensive strategic arms.*

The Defense and Space Talks

Since the opening of the Nuclear and Space Talks in 1985, one portion of those negotiations, the Defense and Space Talks (DST), has focused on space weapons and the future of the ABM Treaty. While both sides' DST positions have shifted somewhat over the years of negotiations, the talks remain fundamentally deadlocked. As former U.S. DST Negotiator Henry Cooper has candidly described the situation: "The U.S. side wishes to move toward deployment of effective defenses as soon as possible; the Soviet side seeks to stop such deployment."

President Reagan announced the SDI program in 1983 with a pledge that it would be carried out "consistent with our obligations of the ABM Treaty." When the two sides agreed to begin DST, both agreed that the talks would be "aimed at preventing an arms race in space," and Reagan announced that he hoped the talks would "reverse the erosion of the ABM Treaty." Yet from the outset, the United States has proposed fundamentally altering the ABM Treaty to facilitate a transition to deployment of strategic missile defenses—a clear rejection of the treaty's basic premises.

The two sides' positions moved even farther apart in October 1985, when the United States announced a new "broad" interpretation of the ABM Treaty which would permit rather than prohibit development and testing of space-based and other mobile "exotic" ABM components, such as lasers and particle beams, exempting much of the SDI program from the treaty's restraints. (See Chapter VI, "The Reinterpretation of the ABM Treaty.") The Soviet Union immediately and strongly rejected the broad interpretation, and made clear, as it had from the outset of DST, that no START agreement would be possible without strict limits on ABM testing and deployment. For nearly four years, disagreement over the interpretation issue remained a major obstacle to agreement on strategic arms reductions.

The Soviet Union began the Defense and Space negotiations with what might be called a "reinterpretation" of its own, arguing the ABM Treaty prohibited even basic research related to space-based ABMs—a position clearly contradicted by then-Soviet Defense Minister Andrei Grechko's 1972 statement that the treaty "places no limitations" on research. (The traditional U.S. view of the treaty—previously largely accepted by the Soviet Union—would permit all types of research, barring only field testing of complete "prototypes" or "breadboard models" of space-based ABM components. See Appendix B.) Soviet negotiators called for a total halt to all aspects of the SDI program, in the form of an agreement to ban all research, development, and testing of "space-strike arms," which included space-based ABMs, antisatellite weapons with any basing mode, and space-based weapons designed to attack ground targets.

By late 1985, the Soviet position had shifted to permit laboratory research, while barring out-of-laboratory work. A more significant shift emerged during 1986, when the Soviet Union began focusing less on attacking the entire SDI program and more on reaffirming the ABM Treaty. The Soviet Union proposed that a Defense and Space agreement commit the sides not to withdraw from the ABM Treaty for a period of 15-20 years, and some Soviet officials began privately discussing the possibility of allowing some research in space. Nevertheless, the 1986

Reykjavik summit broke up in discord over SDI and the future of the ABM Treaty. Soviet leader Mikhail Gorbachev insisted that there could be no agreement unless SDI was limited to the laboratory, while Reagan called for virtually unrestrained SDI testing under the broad interpretation, and an explicit "right to deploy" missile defenses after a decade. Afterward, Gorbachev said: "We will never agree to helping with our own hands to wreck the ABM Treaty. For us this is a matter of principle, of our national security."

By 1987, Soviet negotiators had completed the shift from criticism of all SDI research to an emphasis on "strict observance" of the ABM Treaty "as signed and ratified in 1972"—a phrase Soviet negotiators used to refer to the traditional view of the accord—for a 10-year period. As an alternative to simple reaffirmation of the ABM Treaty "as signed and ratified," the Soviet Union proposed clarifying the traditional interpretation through agreement on a list of technologies which could not be tested in space above specific "thresholds" of capability. By the end of 1987, however, the "list" proposal had been deemphasized, perhaps regarded as too complex for agreement prior to signing of a START accord. Before the December 1987 Washington summit, Gorbachev summed up the new position: "In that degree that SDI does not run counter to the ABM Treaty... let America act, let America indulge in research."

At the Washington summit in December 1987, the two sides agreed to an ambiguous statement that each interpreted as supporting its own view. The statement referred to a commitment to abide by "the ABM Treaty as signed in 1972" (a phrase from the Soviet position, with "and ratified" removed) while allowing "testing as required" (a phrase from the U.S. position, with "in space" removed). The statement supported the idea of an agreed period of nonwithdrawal from the ABM Treaty, after which each side would have the right to "decide its course of action"—which the United States interpreted as explicit permission to deploy missile defenses, and the Soviet Union interpreted as leaving the ABM Treaty intact and allowing the Soviet Union to "decide" to withdraw from the START accord should the ABM Treaty be violated. In the end, the summit statement amounted to little more than "kicking the can down the road," in the words of then-U.S. START Negotiator Max Kampelman. While both sides incorporated the summit language into their proposed Defense and Space agreements, the fundamental disagreements resurfaced as soon as the negotiations resumed.

Indeed, in 1988 the Reagan administration introduced a position aptly described by Negotiator Cooper as "broad-plus," proposing that not only testing but deployment of any type of space-based ABM sensor be allowed, and that each side be allowed as many as 15 ABM weapons satellites in space simultaneously, for testing purposes. The Soviet Union rejected this proposal.

In September 1989, the Soviet Union agreed to complete and sign a START agreement even if disagreement continued over the interpretation of the ABM Treaty, while making it clear that any violation of the traditional view of the ABM Treaty would be considered grounds for withdrawal from START. At the same time, the two sides abandoned the idea of an agreed period of nonwithdrawal from the ABM Treaty, a concept which had previously formed the core of the Defense and Space agreement under discussion.

While neither side now expects a DST agreement to be completed before the START treaty is signed, negotiations in DST continue. The Bush administration has maintained President Reagan's "broad-plus" position without change, and proposed a new mechanism by which either side could withdraw from the ABM Treaty after initiating three years of discussions of specific measures for a "cooperative transition" to the deployment of defenses, without needing to cite any threat to its supreme national interests or violation by the other party. The Soviet Union, by contrast, proposes that the traditional interpretation of the ABM Treaty be maintained, and that the accord continue in its current form as a treaty of unlimited duration. Neither side is prepared to consider the other's position.

The only area of progress is in discussions of a "predictability protocol," involving a package of measures to improve each side's ability to predict and monitor the other's ABM activities, including pre-announcement of ABM-related tests and on-site inspection of selected sites. While the disagreement over the interpretation of the ABM Treaty has carried over into discussions of the purpose of the predictability protocol, the two sides may ultimately agree to a predictability accord apart from a Defense and Space agreement.

ABM Link: *The ABM Treaty has played a key role in the ongoing START talks, giving each side confidence that it can reduce its offensive strategic forces without fear that its remaining deterrent would be undermined by widespread missile defenses. At the Wyoming ministerial between Secretary of State James A. Baker III and Soviet Foreign Minister Eduard Shevardnadze in September 1989, the Soviet Union agreed to complete a START treaty even if no agreement on the meaning and future of the ABM Treaty could be reached. But the Soviet Union made clear that it would consider any violation of the traditional interpretation of the ABM Treaty as grounds for withdrawal from START.*

Some Strategic Defense Initiative advocates have argued that it was SDI that brought the Soviet Union back to the bargaining table and made reductions in strategic forces possible. But recent history does not support this claim. The Soviet Union was at the negotiating table and offering reductions in 1982, before the SDI program began. Soviet negotiators walked out of the negotiations only in December 1983—*after* President Reagan's SDI speech—in response to U.S. deployment of intermediate-range missiles in Europe, and returned in 1985 primarily because of the clear failure of the walk-out policy to stop the deployment of U.S. missiles in Europe. The flexibility Soviet negotiators have shown since then is surely more directly related to Mikhail Gorbachev's ascension to power than to the pressure of the SDI program. In any case, whatever impact SDI may have had clearly sprang from the strong Soviet desire to limit the program, reinforcing the point that abrogating the ABM Treaty to build an SDI defense would end any prospect for offensive arms reductions.

While the details of the Soviet position on SDI and the ABM Treaty have changed over the years (see "The Defense and Space Talks," p.120), the Soviet Union has unswervingly linked every proposal for reductions in offensive strategic forces to the maintenance of the ABM Treaty's limits on ABM testing and deployment. In September 1989, the Soviet Union agreed to proceed with the signing of a START treaty without resolving the ongoing disagreement over the interpretation and future of the ABM Treaty, but continued to make clear that any U.S. violation of the traditional interpretation or outright abandonment of the ABM Treaty would be considered grounds for Soviet withdrawal from START. In Gorbachev's words, the ABM Treaty is "the foundation for the accords," meaning that "such cuts would be impossible without preserving that treaty in full." There is no reason to expect this position to change, for it is based on the Soviet Union's enduring security interest in ensuring the effectiveness of its offensive strategic force. (See "Toward a Defense Transition?" p.8.)

Indeed, this link between offensive limits and tight restraints on missile defenses is identical to the position held by the United States from the late 1960s through the 1970s, and has an inherent logic that is impossible to deny. Reducing offensive forces in the face of an unrestricted buildup in the defenses those forces must overcome would only ease the adversary's efforts to intercept those forces, undermining their effectiveness. As then-Secretary of State George Shultz acknowledged in 1987, in supporting the idea of an agreed period of nonwithdrawal from the ABM Treaty: "Predictability and stability [is] just as important for us as it is for them . . . We don't want to reduce our offensive system unless we have some notion of stability, just as they don't." It is unlikely that either the Joint Chiefs of Staff or the Senate would support a START agreement reducing U.S. offensive forces if the ABM Treaty were abandoned and a large-scale Soviet missile-defense buildup was underway. Indeed, by formally announcing that no START agreement can be signed until the Soviet Union eliminates its violation of the ABM Treaty by dismantling the Krasnoyarsk radar, the Reagan and Bush administrations have each implicitly acknowledged the indissoluble link between the ABM Treaty's limits on missile defenses and reductions in offensive strategic arms.

Abrogating the ABM Treaty to deploy a Phase I missile defense would represent a direct challenge to the core of Soviet strategic power—a step that could reverse much of the unprecedented recent warming in U.S.-Soviet relations. Since SDI's inception, Soviet leaders have treated the program as precisely such a threat. Soviet writings have depicted SDI as one part of a broad and aggressive U.S. effort to gain technological military superiority, in a pattern including advanced nuclear forces such as the MX, Trident II, and B-2 bombers (and earlier the European deployment of Pershing II and cruise missiles), along with high-technology improvements in conventional forces. (Of course, the Soviet Union itself was conducting extensive modernization in many of these areas during the same period, and was hardly the injured innocent that Soviet statements sometimes depicted.) It is not true, as some SDI advocates claim, that Soviet opposition to SDI stems from a belief that the system would "work"—at least not if "working" means successfully protecting the people of the United States from Soviet nuclear attack. Rather, while Soviet writers have expressed great confidence that an SDI system could be overcome, the Soviets recognize that countering such a system and competing in the ensuing high-technology race would divert precious funds and technological resources from the civilian economy and other military programs; would vastly increase the complications and uncertainties facing Soviet planners of future military forces; would create unpredictable new hazards, potentially increasing the risk of war; and would largely destroy the strategic arms control process that is now beginning to achieve significant benefits for Soviet security and the Soviet economy. It appears likely that similar concerns were behind the late-1960s Soviet decision to negotiate an ABM Treaty. In addition, Soviet military analysts have expressed concern over the possibility of military "spin-offs" from the broad range of technologies being researched in the SDI program, which they fear might contribute to new technological challenges in other military fields. Even Gorbachev, who has taken a far more relaxed view of the U.S. military threat than previous Soviet leaders did, has charged that "this whole venture with Star Wars is of an exclusively militarist nature . . . aimed at gaining military superiority over the Soviet Union."

Given this perceptual backdrop, a U.S. decision to abrogate the ABM Treaty in order to proceed with an SDI defense would almost certainly herald a dramatic downturn in U.S.-Soviet relations. The ABM Treaty now stands as the central symbol of negotiated restraint on the military competition between the United States and the Soviet Union, embodying both the greatest success of the past and the foundation for progress in the future. In Soviet eyes, its abandonment by the United States could only be interpreted as an announcement of an effort to dominate the Soviet Union through high technology, a rejection of all genuine negotiated restraints on U.S. strategic capabilities. While those who advocate resolving security problems through negotiation and agreement have clearly gained the upper hand in the Soviet Union today, their position could be seriously weakened by such a turn of events. Soviet leaders could be forced to reassess the entire range of U.S.-Soviet arms negotiations, and more broadly, the very basis of their relationship with the United States. If renewed hostility and contention in U.S.-Soviet relations resulted, both sides' security would be undermined, for as communication deteriorated, the likelihood that disagreements would lead to crises and conflicts would surely rise.

By contrast, maintaining the ABM Treaty would allow the United States to take advantage of the enormous opportunities presented by the new U.S.-Soviet relationship, implementing a START treaty and accords on conventional and chemical weapons, and moving on to negotiate even more sweeping agreements. The provisions of the START agreement are clearly favorable to U.S. security. While the overall reductions in each side's strategic force levels will be substantially less than the widely advertised 50 percent (because of a variety of exclusions and "discounts" for certain types of warheads), there will be genuine 50 percent reductions in Soviet missile warheads, the most threatening part of the Soviet arsenal—a bigger cut for the Soviet Union than for the United States. The "heavy" Soviet SS-18 ICBMs in particular, long a key focus of U.S. concern as the only Soviet missiles yet capable of posing a serious threat to U.S. land-based missiles, would be reduced by half.

As described earlier, the missiles the Soviet Union would dismantle under START would carry far more warheads than the Phase I system could hope to intercept. And the Soviet Union is already proposing deeper reductions in both sides' offensive forces in a START II agreement—as long as the ABM Treaty is maintained. Ultimately, the best way to eliminate the threat posed by a ballistic missile is to dismantle it.

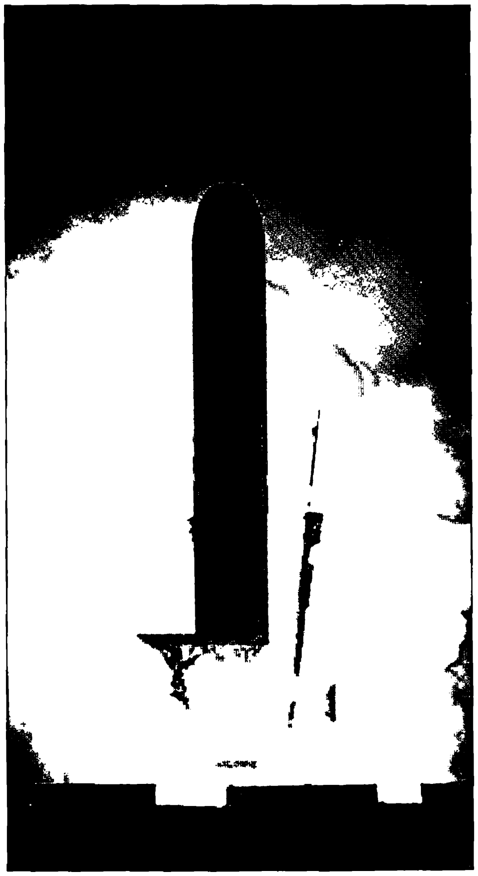
With continued progress in such arms control negotiations, U.S.-Soviet relations would stand an excellent chance of continuing to warm. Such improvements in bilateral relations would benefit both sides, fostering progress in areas ranging from other arms control negotiations to regional disputes, from trade to cooperation on global issues of development and environmental damage. As President Bush has said, "There is virtually no problem in the world ... that improvement in the U.S.-Soviet relationship will not help to ameliorate."

THE IMPACT ON NATO AND OTHER NATIONS

Abrogating the ABM Treaty to deploy a Phase I missile defense would directly contradict the often-expressed views of U.S. NATO allies, undermining alliance cohesion at the very moment when the alliance's future is already being called into question by the virtual collapse of the Warsaw Pact.

Many NATO countries have been generally supportive of SDI research, and some have sought to participate, though European companies have won less than one percent of SDI contracts to date. Several countries have also expressed interest in a European antitactical ballistic missile (ATBM) system to defend against nonstrategic missiles, though the Intermediate-range Nuclear Forces Treaty and Soviet offers to eliminate shorter-range missiles as well have greatly reduced the apparent need for such a defense. (See "Antitactical Ballistic Missiles and NATO," p.125.) But the NATO allies have strongly and consistently opposed any plan for SDI testing or deployment beyond the bounds of the ABM Treaty.

Indeed, in December 1984 British Prime Minister Margaret Thatcher, President Reagan's closest European ally, flew to Washington to discuss the SDI



NATO Support: *NATO countries strongly support the ABM Treaty, seeing it as the key to strategic arms control and improved East-West relations. The treaty's limits on Soviet missile defenses also help ensure the effectiveness of British and French nuclear forces, such as the Trident II submarine-launched ballistic missile which Britain plans to purchase (left). In 1984, British Prime Minister Margaret Thatcher (above) gained President Reagan's agreement that no SDI system would be deployed without negotiations with the Soviet Union—an accord widely interpreted in NATO as a pledge to maintain the ABM Treaty.*

Antitactical Ballistic Missiles and NATO

The SDI program and the large-scale modernization of Soviet short- and intermediate-range ballistic missiles in the 1970s and early 1980s focused attention on the possibility of limited missile defenses for NATO. More accurate Soviet theater ballistic missiles, it was feared, might be armed with conventional or chemical warheads, allowing the Soviet Union to suppress NATO air defenses and nuclear capabilities in the opening minutes of a war, creating an opening for larger-payload Soviet bombers to break through NATO defenses and follow up the ballistic missile attacks. Defenses against such nonstrategic ballistic missiles are permitted by the ABM Treaty, but the line separating them from ABM systems is not well-defined, creating a potential for deployment of such antitactical ballistic missiles (ATBMs) to erode the ABM Treaty's restraints. (See Chapter IX, "Grey-Area Systems and the ABM Treaty.")

A wide array of potential ATBM systems are now in development. Software and warhead upgrades to the Patriot air-defense system to give it a very limited ATBM capability were first tested in 1986, and are already being deployed for NATO defense; Israel is reportedly considering a major Patriot purchase for use as a near-term defense against short-range missiles deployed by Arab countries. Meanwhile, the SDI program is focusing on more capable longer-term ATBMs, including the Extended-Range Interceptor (ERINT), railguns, and the Israeli Arrow ATBM, reportedly designed to be capable of intercepting missiles with ranges up to 1,000 kilometers. At the same time, the U.S. Army is exploring a variety of other ATBM options, and several European firms are developing their own ATBM candidates.

Even in the mid-1980s, however, some NATO strategists questioned both the magnitude of the tactical ballistic missile threat and whether ATBMs are likely to be the best available response. The mobility of some NATO air defenses is likely to make them difficult to suppress with ballistic missile strikes, and while the accuracy of Soviet tactical ballistic missiles has improved, it is still limited, increasing the number of missiles needed to shut down NATO airbases. Reliance on passive defenses rather than ATBMs—such as increasing the hardening or mobility of critical weapons and command centers, increasing the number of air-base runways, and relying more heavily on aircraft capable of taking off from runways shortened by bomb damage—might be a more cost-effective response, providing protection not only against ballistic missiles but against aircraft and cruise missiles as well. In addition, some analysts argued that proposed ATBMs could be readily defeated by simple countermeasures such as decoys and radar jammers. Moreover, while some limited ATBM capabilities could be gained by upgrading existing systems such as Patriot, the cost of widespread deployment of a more capable dedicated ATBM system would probably run into the tens of billions of dollars, diverting essential resources from other urgent priorities.

Political developments since the opening rounds of the ATBM debate have drastically reduced the threat from Soviet ballistic missiles. Under the 1987 Intermediate-range Nuclear Forces (INF) Treaty, the Soviet Union is dismantling all of its ground-based missiles with ranges between 500 and 5,500 kilometers. NATO has agreed to undertake negotiations on shorter-range tactical missiles in the near term, and the Soviet Union has proposed deep cuts or even the complete elimination of such missiles on both sides. While NATO had earlier resisted the idea of deep reductions, the impending reunification of Germany and likely German opposition to such weapons is changing NATO attitudes: substantial cuts in such short-range missiles now appear a virtual certainty over the next few years. Moreover, with Germany unifying, Communist governments collapsing throughout Eastern Europe, and Soviet forces already beginning their withdrawal from Hungary and Czechoslovakia, forward-basing of Soviet tactical ballistic missiles is becoming less and less tenable. Based in the Soviet Union, missiles with ranges below the 500-kilometer limit set by the INF Treaty would not be able to reach NATO territory on the central front.

In short, the rationale for ATBMs in Europe is quickly evaporating. It now appears unlikely that NATO will deploy any ATBMs beyond the Patriot upgrade in the foreseeable future. Israel, by contrast, will continue to have an incentive to acquire an ATBM capability, though there too, cost issues may limit the scope of the ultimate ATBM program.

program, demanding and receiving Reagan's agreement that any "SDI-related deployments would, in view of treaty obligations, have to be a matter for negotiations" with the Soviet Union—a statement widely interpreted in NATO as a pledge that the SDI program would be conducted within the limits of the ABM Treaty. When the Reagan administration announced its "broad" interpretation of the treaty in 1985, so many allied complaints poured in that the administration was forced to retreat, announcing that while it considered the new interpretation "fully justified," it would not be implemented. A similar storm of NATO protest arose in early 1987, when reports leaked out that the Reagan administration was considering "early deployment" of an SDI system, and reconsidering its earlier pledge not to implement the broad interpretation. (See Chapter VI, "The Reinterpretation of the ABM Treaty.")

> ***"One of the keys to progress at Geneva could be action to strengthen the effectiveness of the ABM Treaty. Confidence as to the nature of the relationship between offense and defense might help to encourage the big cuts in offensive nuclear missiles which we all want the superpowers to make . . . The ABM Treaty is a fundamental achievement of arms control."***
>
> *—Sir Geoffrey Howe, 1986*
> *Then British Foreign Minister*

Given this history, there is little doubt that a U.S. decision to abrogate the ABM Treaty in order to build a Phase I missile defense would foster new fears of a dangerous U.S. "unilateralism," touching off an alliance dispute that could, in former Secretary of Defense James Schlesinger's words, make "the deployment of the Pershing II seem a relative political picnic."

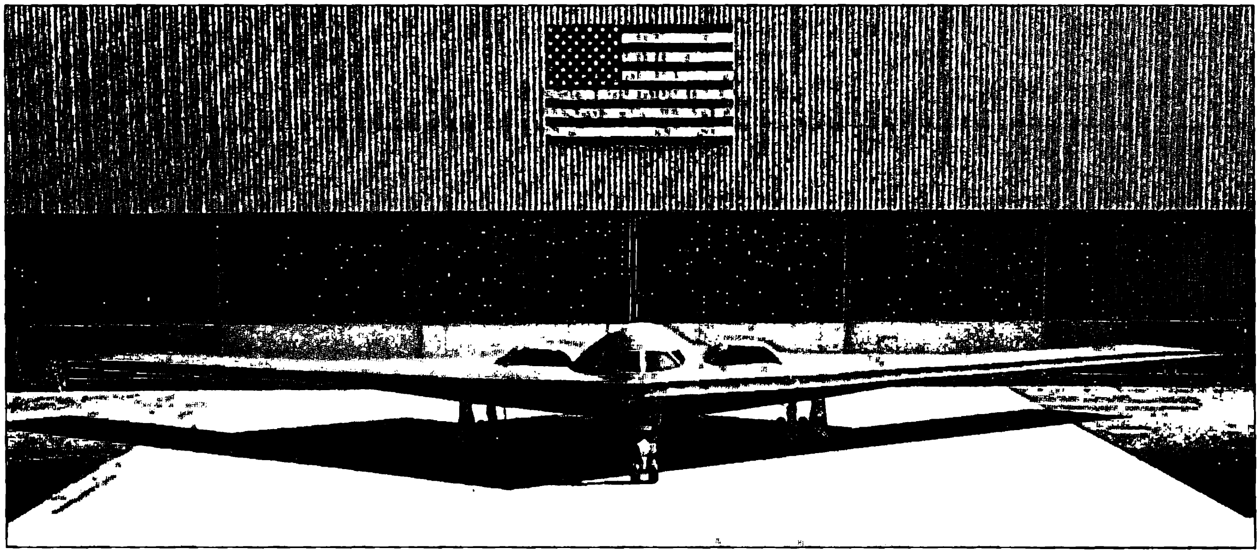
NATO support for the ABM Treaty is grounded in basic European political and security interests—though as with everything else in the European security scene, some of the arguments for and against missile defenses are shifting rapidly with the dramatic changes in Eastern Europe. Most fundamentally, European leaders understand that the possibility of protecting Europe from the devastation of a nuclear war is even more remote than the possibility of protecting the United States, since the Soviet Union is on Europe's borders and the potential means of nuclear attack are even more diverse. It is certain that a Phase I system, with its thin space-based layer and ground-based elements based entirely in the United States, would offer no significant defense.

Nor would an SDI system likely do much to bolster the U.S. security umbrella. Some SDI supporters have questioned the credibility of "extended deterrence," arguing that as long as the United States remains vulnerable to Soviet retaliation, it will always be doubtful whether the United States would use its strategic nuclear forces in the defense of Europe, in effect "risking New York to save Bonn." With the evaporation of the Warsaw Pact as an offensive-capable military alliance, the significance of this issue has been dramatically reduced. But regardless of the genuine magnitude of this problem, an SDI system could not solve it, for no plausible missile defense could protect U.S. cities from overwhelming damage from a Soviet nuclear attack. Similarly, missile defenses could not protect the key ports and air bases needed to send U.S. forces and supplies to Europe in the event of war, as suggested in the Defense Department's 1983 report, *Ballistic Missile Defense and U.S. National Security*. These targets are so small in number, and generally so close to the vulnerable coasts, that any defense of them could readily be overwhelmed. All that even the most effective defenses could hope to do is to increase the price of such an attack from a few dozen warheads to a few hundred, still a small fraction of the Soviet arsenal.

At the same time, Soviet missile defenses deployed in the absence of the ABM Treaty would pose a significant challenge to the independent nuclear forces of Britain and France. Both countries have already undertaken expensive missile modernization programs designed in part to ensure their ability to penetrate the Moscow ABM system, and to hedge against potential future ABM systems. But abandonment of the ABM Treaty would radically increase the cost and difficulty of maintaining these independent deterrent forces. The smaller nuclear powers therefore have a very direct interest in the maintenance of the ABM Treaty's restraints on Soviet missile defenses.

NATO leaders have also been concerned over the enormous costs of a renewed offense-defense race. In 1985, then-British Foreign Minister Sir Geoffrey Howe (now deputy prime minister) warned that such a competition could cost "many hundreds of billions of dollars," and pointed out that every dollar spent on missile defenses and improved offensive forces to counter Soviet defenses would be a dollar not spent on improving NATO's conventional defenses.

In addition, NATO leaders are acutely aware of the importance of the ABM Treaty to the entire fabric of arms control and U.S.-Soviet relations. From West Germany, where Foreign Minister Hans-Dietrich Genscher has called the ABM Treaty "the Magna Carta of arms control," to Britain, where Howe has termed the accord "the keystone in the still shaky arch of security," to France, where President Francois Mitterand has called



Defense Countermeasures: *While some SDI advocates argue that the Soviet Union would respond to U.S. defenses by agreeing to dismantle its offensive missiles, the United States has responded to Soviet air defenses with a stream of tactical and technical countermeasures, such as the B-2 bomber (above). Soviet air defenses also contributed to the United States' refusal to accept any limits on bombers in SALT I, and its insistence on very loose bomber limits in START.*

it the "fundamental touchstone" of existing treaties, there is a solid consensus throughout NATO behind the ABM Treaty as the starting point for further negotiations to reduce the Soviet military threat. And with their especially critical stake in East-West relations, the nations of Europe have been concerned over the possibility of a serious East-West chill should the ABM Treaty be abandoned.

The negative impact of abrogating the ABM Treaty would not be limited to NATO. Other U.S. allies from Japan to Australia have criticized the space-weapon concept as a threat to world security. Nationwide Soviet missile defenses deployed in the absence of the ABM Treaty could force China, like Britain and France, to undertake an even more extensive buildup of its offensive nuclear missiles than is already underway, a step that would be in no one's interest. Perhaps as a result of such considerations, the Chinese government has harshly criticized the SDI program, and called on the superpowers not to develop, test, or deploy space-based weapons.

Repeated votes in the United Nations have demonstrated essentially universal world opposition to space weapons, and support for agreements "to prevent an arms race in all its aspects in outer space." On occasion, the United States has cast the lone dissenting vote on such resolutions. The conference of nonaligned nations called for such a space agreement in 1986, and in 1988 the Five-Continent Peace Initiative—representing the leaders of Argentina, Greece, India, Mexico, Tanzania and Sweden—called specifically "on the parties to the Antiballistic Missile Treaty to strictly abide by that treaty."

More broadly, there is overwhelming world support for U.S.-Soviet agreements to limit and roll back the strategic arms competition, including the ABM Treaty. The Nonproliferation Treaty (NPT) of 1968 committed the United States and the Soviet Union to end the strategic arms race and pursue disarmament, in return for the non-nuclear states forgoing efforts to build the bomb. Many signatories have been critical of the superpowers' failure to take substantial steps toward disarmament; abrogation of the ABM Treaty and the likely resulting collapse of offensive arms control efforts could seriously undermine the non-proliferation regime, as OTA warned in 1985.

In short, it is clear that a U.S. abrogation of the ABM Treaty would provoke an overwhelmingly negative reaction throughout the world, potentially interfering with a number of other U.S. foreign-policy goals. Here, too, the benefits of maintaining the ABM Treaty stand in stark contrast to the risks of abandoning it. By reaffirming the ABM Treaty and continuing the remarkable progress now being made in East-West arms negotiations, the United States could substantially bolster NATO security and reassure NATO leaders of the U.S. commitment to take their views of security issues into account. Such arms control progress would receive a favorable reception from the other nations of the world as well, helping to smooth the 1990 NPT Review Conference, and preparing the way for renewal of the NPT in 1995.

Phase I vs. the ABM Treaty: Making the Choice

	Phase I	ABM Treaty
Cost	Over $55 billion for Phase I, hundreds of billions for follow-on defenses, and tens or hundreds of billions for offensive responses to Soviet ABM.	No additional costs for ABMs or offensive counters to Soviet ABMs. START agreement and potential START II accord reduce projected strategic force costs.
Overall Nuclear Threat	Potential increase to over 18,000 Soviet missile RVs in response to U.S. defense. Less than 30 percent intercepted, over 12,000 warheads threaten United States. No protection for U.S. cities.	With ABM Treaty maintained, Soviet missile RVs reduced to 4,900 by START accord, possibly further by START II.
Stability	ABMs on both sides provide some protection to strategic forces, but combine with offensive forces to increase overall effectiveness of a first strike, undermining stability.	Without ABMs, both sides maintain robust offensive forces, first strike offers no significant damage limitation. Stability maintained.
U.S. Strategic Force Effectiveness	Phase I potentially protects fraction of U.S. ICBMs, but costs probably prevent simultaneous deployment of mobile missiles, which would offer more effective protection. Soviet ABMs undermine effectiveness of U.S. deterrent.	Highly survivable submarines and bombers provide robust U.S. deterrent. No substantial Soviet ABMs to cast doubt on effectiveness. ICBM survivability can be improved through mobility if necessary.
Arms Control	U.S. forced to abrogate ABM Treaty to proceed with Phase I. Soviet Union withdraws from START, begins building up offensive forces. Prospects for limits on both offensive and defensive strategic forces virtually nil, other negotiations jeopardized.	ABM Treaty maintained, probable START accord begins reducing both sides' strategic forces, prospects good for other negotiations.
U.S.-Soviet Relations	Warming relationship severely damaged by U.S. abrogation of the ABM Treaty, reinitiation of offense-defense arms race. Progress threatened on a broad front.	Likely continued warming in superpower relationship, wide range of new agreements likely.
NATO Security	U.S. decision to abrogate ABM Treaty rocks alliance. American cities and war-reinforcement targets not substantially protected; no improvement for extended deterrence. Soviet ABMs undermine British, French strategic forces.	Maintenance of the ABM Treaty limits the Soviet ABM threat to British and French forces. Alliance unity maintained. Potential START, CFE agreements greatly improve NATO security picture.
Accidental/Unauthorized Missile Launches	Significant protection against low-probability threat.	Alternatives including more widespread PALs and in-flight destruct mechanisms may provide more reliable protection at lower cost.
Third World Missiles	Substantial protection against ballistic missile attack, but no protection against more likely means of delivery—ships, aircraft, packing crates, etc.	Increased emphasis on nuclear nonproliferation and global bans on chemical and biological weapons address all means of delivery. Broader regime controlling missile exports somewhat limits Third World missile threat.
ASAT	ABMs on both sides threaten wide array of military spacecraft. No effective ASAT limits possible.	ASAT limitations remain achievable if the United States chooses to pursue them.

OTHER ISSUES

Deployment of a Phase I missile defense also raises several other issues, each of which is addressed in more detail in Chapter XI's discussion of more limited missile defenses. First, while a Phase I system could provide some protection against long-range ballistic missiles launched from the developing world, a defense against missiles alone would not resolve the problems posed by nuclear or chemical terrorism, for such weapons could far more easily be delivered by other means, from aircraft to packing crates. Moreover, the space-based brilliant pebbles which provide the only global protection planned for the Phase I missile defense would be unable to intercept the short-range ballistic missiles that are proliferating most rapidly, for such missiles fly almost entirely within the atmosphere. Similarly, while a Phase I system might offer some protection against an accidental or unauthorized missile launch, alternatives such as improved safeguards may be able to provide greater protection at lower cost.

Finally, large-scale testing and deployment of missile defenses on both sides would create a radically increased threat to military satellites, potentially undermining U.S. security. (See "Toward ASAT Arms Control," p.148.)

CONCLUSIONS

Deploying a Phase I missile defense would inevitably touch off a profound series of changes in the strategic environment. If the United States chooses to abrogate the ABM Treaty to deploy such a nationwide missile defense, the Soviet Union will almost certainly respond, changing its offensive and defensive strategic forces in ways that are likely to have a substantial negative impact on U.S. security. To ignore these possibilities is in effect to neglect the seriousness of the Soviet military threat—the ostensible reason to deploy missile defenses in the first place.

When the responses by the Soviet Union and other nations are taken into account, the likely results of abrogating the ABM Treaty to deploy a Phase I missile defense are dramatically worse than those of maintaining the treaty. Abrogating the ABM Treaty would involve:

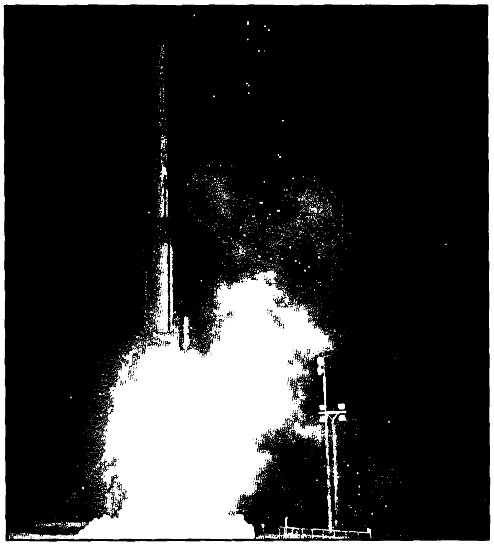
- costs in the hundreds of billions of dollars, which could otherwise be avoided;
- a renewed competition between offensive and defensive strategic forces, vastly complicating military planning;
- a potential increase, rather than a decrease, in the number of Soviet missile warheads that might reach the United States in the event of a nuclear war;
- a likely decrease in crisis stability and the overall effectiveness of U.S. strategic retaliatory forces, rather than genuine protection for those forces;
- an end to any serious prospects of reductions in offensive strategic arms, forfeiting the current arms control opportunities and severely damaging U.S.-Soviet relations;
- serious political conflict within the NATO alliance, and a substantial challenge to the independent nuclear forces of Britain and France;
- a probable sharply negative reaction from the rest of world opinion, undermining the existing non-proliferation regime, among other efforts; and
- a drastic increase in the threat to U.S. military spacecraft, ending any prospect of an ASAT agreement.

The Phase I system that could then be built would not provide any substantial protection to the U.S. population from a Soviet nuclear attack, and would be far less cost-effective in protecting U.S. strategic forces than other available options. While it could provide some protection against missile attacks from developing nations and accidental or unauthorized missile launches from the Soviet Union, weapons from the developing world are more likely to be delivered by other means, and cheaper alternatives might provide even greater protection against stray missiles.

In short, as six former secretaries of defense reaffirmed in 1987, the ABM Treaty continues to make "an important contribution to American security and to reducing the risk of nuclear war guaranteeing the effectiveness of our strategic deterrent and mak[ing] possible the negotiation of substantial reductions in strategic offensive forces."

"The plan to deploy Phase I of SDI beginning in the 1990s should be put on the shelf. . . . The price tag is breathtaking, the remaining technological and engineering challenges daunting, and the promised strategic payoff—increasing Soviet uncertainty—problematical. Indeed, plausible Soviet countermeasures and expanded BMD [ballistic missile defenses] in response to (or in anticipation of) 'interim' Phase I deployments could well lead to increased U.S. uncertainty about the credibility of its retaliatory capabilities, as well as to an offense-defense arms race that leaves both sides worse off."

—Arnold Kanter, 1988
Senior Director for Defense Policy and Arms Control, National Security Council



Launch of the Homing Overlay Experiment, a long-range SDI interceptor.

XI. Other Options for SDI

Abrogating the ABM Treaty to deploy a Phase I missile defense, or implementing the Reagan administration's broad interpretation of the pact, would be grave missteps for U.S. security, as the preceding chapters make clear. Similarly, a cooperative "transition" to deployment of widespread missile defenses is likely to be both non-negotiable and dangerous, undercutting the deterrent strategies on which both the United States and the Soviet Union base their security. For the foreseeable future, U.S. national interests will be best served by maintaining the ABM Treaty regime, and any missile defense program that would destroy or substantially undermine the treaty framework should be rejected. This fundamental conclusion, however, leaves open a variety of options for missile defense programs that could be compatible with the current ABM Treaty or with a modified accord embodying similar goals. In considering these treaty-limited or treaty-modified options, the benefits and risks posed by each must be carefully considered, as must alternative means of achieving the same ends. (See "Toward a Defense Transition?," p.8.)

AN ACCIDENTAL LAUNCH PROTECTION SYSTEM

In January 1988, Senator Sam Nunn (D-GA), chairman of the Senate Armed Services Committee, proposed that near-term research in the SDI program be directed toward exploring the feasibility of an Accidental Launch Protection System (ALPS)—a very limited ABM system designed to defend against a few missiles launched by accident or without authorization. Nunn focused on research and did not recommend deployment of such a system; indeed, when SDI supporters in the Senate proposed that some SDI funds be directed toward immediate ALPS deployment, Nunn opposed the measure. More recently, Nunn has emphasized exploring alternatives to ALPS such as improved nuclear safeguards, while keeping SDI a research program.

Nevertheless, Nunn's 1988 speech touched off a wide-ranging discussion of whether accidental or unauthorized attacks represented a significant threat, and the pros and cons of the ALPS approach to dealing with them.

Shape and Cost of an ALPS System

Two very different types of ALPS systems have been proposed. Nunn, in his original speech, argued that such a system, if it were eventually pursued, should be confined to the limits of the ABM Treaty, or "at most, a modest amendment." Others, however, have proposed multisite ALPS systems incorporating many hundreds of ABM interceptors, requiring drastic treaty modifications.

Within the ABM Treaty and its 1974 Protocol, the United States could deploy up to 100 ground-based ABM interceptors at the single permitted site at Grand Forks, North Dakota. (The site could be moved to Washington, D.C., in 1992, or at five-year intervals thereafter, after notifying the Soviet Union.) Using variants of the long-range Exoatmospheric Reentry-Vehicle Interceptor System (ERIS) missiles being developed in the SDI program, the Grand Forks ABM site might be able to protect all of the continental United States against a small number of ballistic missiles coming from the north, the likely path of approach for missiles launched from the Soviet Union. (Alaska and Hawaii would not be protected.) Current concepts call for such a system to be managed by a single large radar at Grand Forks, which would be "cued" to the approach of attacking missiles by existing early warning radars. Recent estimates of the cost of such a single-site system range from $10 billion to $16 billion.

Such a treaty-limited system, however, could not provide adequate protection against missiles arriving from other directions or against more than 100 warheads (a point described in more detail below). Because of these limitations, SDI contractors McDonnell-Douglas and Lockheed have proposed modifications to the ABM Treaty that would permit several widely spaced ABM sites, allowing more complete coverage. Such a multisite system might incorporate shorter-range endoatmospheric interceptors such as SDI's High Endoatmospheric Defense Interceptor (HEDI) system to back up the ERIS missiles, and would probably involve more than 100 interceptors at each site. Each additional site would have its own ABM radar. Cost estimates for this multisite system range from $25 billion to $37 billion. (The treaty issues raised by these proposals are discussed in more detail below.)

The significant costs of an ALPS system would have to be diverted from other military or civilian programs. Given the major cutbacks in defense spending that now seem likely, a new weapon program costing over $10 billion could only be funded through significant cutbacks in other programs. Nevertheless, there is little doubt that it is feasible to build the interceptors and radars that would be needed for either a treaty-limited or a larger ALPS system. The debate over such defenses therefore revolves primarily around whether protection against several rather remote hazards is worth the substantial cost in comparison to other defense priorities, and whether an effective system could be built without seriously undermining the ABM Treaty.

Accidental and Unauthorized Launches

A truly "accidental" launch of a single missile is extremely unlikely. Such an accident would require several separate systems to work at the same time without having been told to do so: the silo door must be opened, the engine ignited, the restraints supporting the missile pulled away, and the warhead armed. Only an extremely poor design making possible a "common mode" failure—in which a single accident such as a pair of crossed wires could command all of these actions—would make such an accident possible.

It is conceivable—though still unlikely—that an "accidental" nuclear war could arise if one side received a convincing false alarm from its warning system, and then decided to launch all or part of its missile force before the imagined attack arrived. But in that case, a decision to launch would probably involve a substantial fraction of the available land-based missiles, and a very limited defense such as ALPS could provide no significant protection.

> ***"I do not believe we are ready to make a decision to deploy this kind of system [ALPS] yet. We have to have more information. We have to have more thought. We have to have more assessment of risk. We have to look at other alternatives. We have to look at the cost and we have to look at the feasibility."***
>
> *—Sam Nunn, 1988*
> *U.S. Senator, D-GA*

An ALPS system might also defend against a small number of missiles launched without authorization by an insane submarine commander or ICBM launch officer. Fortunately, however, both superpowers have devoted considerable attention to minimizing the risks of such an unauthorized launch, placing substantial barriers in the path of any officer attempting to launch a nuclear missile without a valid order.

In the United States the methods used are somewhat different for land-based and sea-based missiles. U.S. land-based missiles are designed so that even after launch officers receive a valid command from higher authority, they are physically unable to arm the warheads until they also receive the code for the complex electronic locks known as permissive action links (PALs) installed on each missile. Once the order and the PAL codes have been received, two widely separated launch keys must be turned simultaneously to launch the missiles, requiring the participation of both the officers in the command silo. In addition, at least one other launch silo within the squadron must approve the order before a launch can take place.

On U.S. submarines, by contrast, it is physically possible for the crew of the submarine to launch its missiles and arm their warheads without receiving such codes. Even there, however, elaborate procedures are in place to prevent an unauthorized launch: a mad submarine commander could not launch U.S. submarine-launched missiles unless virtually the entire officer corps of the submarine was enlisted in the project and much of the crew successfully fooled into believing genuine launch orders had been received.

The Soviet Union has traditionally been even more concerned with assuring central control over any use of nuclear weapons. A recent visit to a Soviet missile silo by U.S. officials confirmed that Soviet land-based missiles are equipped with a multiple-key system and PALs similar to those in use in the United States. Indeed, in the 1950s and 1960s, Soviet leaders reportedly demonstrated their concern over nuclear security by storing missile warheads entirely separate from the missiles themselves, under the control of the KGB. There are some suggestions that Soviet submarine-launched missiles may also be equipped with PALs, and that the Soviet Union has recently withdrawn some forces and increased security for others in sensitive areas of the Soviet Union.

In 1988, Admiral William Crowe, then chairman of the Joint Chiefs of Staff, told Congress that because of these elaborate safeguards on both sides, the probability of such a missile launch is "very, very, low."

To the extent that accidental or unauthorized launches remain a possibility—and nothing is completely impossible, however low the risk—there are approaches to reducing the risk other than ALPS, as Senator Nunn pointed out in his original speech. High-level reviews of existing procedures should be undertaken by both the United States and the Soviet Union, with consultation between the two, to ensure that no plausible avenue for an accidental or unauthorized launch has been left open. To enhance safety, PALs should be extended to all nuclear weapons, including submarine-launched missiles. Discussions of such safety procedures with other nuclear states should be undertaken. And as Senator Nunn has advocated, serious study should be given to installation of "command destruct" systems on existing missiles, so that a missile launched by accident or without authorization could be destroyed in flight. Such systems are already used on test missiles, and with careful attention to security, could be made invulnerable to Soviet efforts to disable U.S. missiles by surreptitiously invoking the destruct mechanism. These alternative approaches could offer substantially greater confidence of stopping an accidental or unauthorized launch than an ALPS system, at considerably lower cost.

Third-World Threats: *Ballistic missiles such as the Soviet Scud-B (above) are proliferating in the developing world, and SDI advocates have argued that a limited missile defense would protect against potential nuclear or chemical attacks using such missiles. But such attacks are far more likely to be delivered by simpler means such as aircraft, boats, or crates smuggled across U.S. borders, against which a missile defense would offer no protection.*

Third World Missiles

With the continuing decline in the Soviet threat, SDI advocates now often point to the spread of ballistic missile technology in the developing world as a prime justification for SDI, and it has been suggested that an ALPS-like system might offer protection against a small missile attack fired by some future "crazy state." However, both the magnitude of this threat and the protection ALPS would offer have been greatly exaggerated.

While a substantial number of Third World nations are gaining access to ballistic missile technology, they are primarily focusing on the short and medium-range missiles needed to threaten their regional rivals, not on intercontinental missiles for attacks on the United States. Of the 15 nations in the developing world that CIA Director William Webster predicts will have ballistic missiles by the year 2000, only six are predicted to have ballistic missiles with a range of over 3,100 kilometers, and as Secretary of Defense Richard Cheney has acknowledged, few of those nations will have missiles with the range to reach the United States. While the distant future may see more nations armed with ICBM-range missiles, in the near and medium term the number of states possessing such weapons will remain small. In addition, since a ballistic missile attack, unlike most terrorist acts, could be immediately traced back to its point of origin, only leaders willing to face a devastating retaliation from the full military power of the United States could contemplate such an action. It is difficult to identify a plausible candidate for a "crazy state" that might attack the United States with a ballistic missile.

Moreover, a defense against ballistic missile attack would not solve the problem posed by such potential terrorist states, for as Senator Nunn pointed out in his initial speech highlighting the ALPS issue, there are many threats other than those posed by ballistic missiles. Terrorist weapons—whether nuclear, chemical, or biological—could far more easily be smuggled into the United States in a truck, an airplane, or a ship's cargo. Whatever the real risk of such a terrorist threat, deploying a defense that was effective only against ballistic missiles would amount to nailing the window shut while leaving the door wide open. And even against ballistic missiles alone, a treaty-limited defense would leave substantial areas of the United States unprotected, as described in more detail below.

Here, too, alternatives to limited missile defenses must be considered. Continued efforts to stem the spread of nuclear weapons are an urgent necessity, as are efforts to strengthen the existing international ban on biological weapons, and to complete the current negotiations toward a global ban on chemical weapons—an accord whose provisions regulating transfer of chemical weapons-related materials would be a major step forward in stemming the proliferation of such deadly weapons. Such nonproliferation efforts can help limit the threat from all means of delivery, not just ballistic missiles. At the same time, the existing Missile Technology Control Regime (MTCR) must be strengthened and broadened. While the MTCR has not ended the proliferation of ballistic missiles, it has had some limited successes, and a system including a larger number of countries, more effective procedures to ensure compliance with the guidelines, and constraints on a broader array of technologies—perhaps including a full-time international agency to monitor trade in such technologies—could do still more.

Treaty Limits and Security Issues

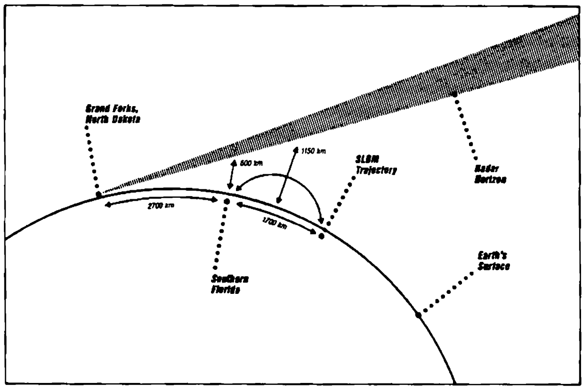
An ALPS system built within the ABM Treaty's limits would face severe limitations on its firepower and geographic coverage, limiting its ability to carry out many of the missions proponents have envisioned. But modifying the ABM Treaty to permit more widespread defenses would seriously undermine the treaty's effectiveness.

While the ABM Treaty explicitly permits deployment of one ABM site with up to 100 interceptors, a few analysts have questioned whether even a single-site ALPS system would comply with the existing treaty, arguing that the system's nationwide coverage against ICBM attack is barred by Article I, which prohibits either side from deploying "a defense of the territory of its country," or a "base" for such a defense. Most other analysts, however, point out that the treaty places no limits on interceptor range, and argue that it thereby implicitly permits interceptors of unlimited range, even if they provide nationwide coverage. The United States specifically considered and rejected such range limitations during the ABM Treaty negotiations.

A few analysts have also pointed to the proposed use of early warning radars in an ALPS system as a potential problem, arguing that reliance on these radars for "cueing" would effectively make them ABM radars at locations forbidden by the treaty. It appears, however, that the envisioned use of these radars is little more than the early warning they already provide—and it would be extremely difficult to ensure that Soviet early warning radars are not already playing a similar role in the operation of the Moscow ABM system. As long as the early warning radars do not actually guide ABM interceptors, and are not tested "in an ABM mode," their participation in an ALPS system does not appear to be prohibited.

> ***"It has been said that SDI would protect us from a fanatic or an insane Third World dictator, but that argument does not hold up under close scrutiny. . . . Terrorist or Third World delivery of a nuclear weapon is more likely to be done by an aircraft or a ship sailing into one of our harbors or other such simple ways [than with a ballistic missile]."***
>
> *—General David Jones, 1987*
> *Former Chairman of the Joint Chiefs of Staff*

In any case, the protection offered by such a single-site system would be quite limited. Because the earth is curved, a radar at Grand Forks would be unable to track submarine-launched missiles launched from most of the Atlantic and Pacific oceans and aimed at the U.S. coasts: from the radar's perspective, such missiles would be below the horizon. Existing coastal early warning radars could detect and track such missiles, but they are not sufficiently accurate to guide ERIS interceptors. If they or the ERIS interceptors themselves were upgraded to make that possible, and the combination of these coastal radars and ERIS were ever realistically tested, the current coastal radars would become ABM radars, whose location outside the single permitted ABM site would be a violation of the ABM Treaty. Even for these coastal radars, submarine-launched missiles would not come "over the horizon" until well after launch, limiting the amount of time available for the ERIS interceptors to fly the thousands of kilometers from Grand Forks to the coasts to intercept the incoming warheads. As a result, then-White House Science Adviser William Graham concluded in 1988 that a single-site system based at Grand Forks could not protect "anything west of the Sierras or east



Limited Coverage: *An ALPS system confined to the single site permitted by the ABM Treaty would leave much of the country unprotected against missiles coming from the east, west, or south, because the curvature of the Earth would keep the missiles belows the radar's "horizon." While coastal early warning radars would detect such missiles, those radars are not sufficiently accurate to guide ABM interceptors. Here, an SLBM launched from 1,700 kilometers offshore arrives on target in southern Florida without ever coming into the view of the Grand Forks radar.*

of the Appalachians" against such submarine-launched missiles. Most of the U.S. population lives in the area Graham described, and hence would not be defended against SLBMs arriving from the east, west, or south.

The same applies to missiles launched from much of the Third World, since missiles launched from many of these countries would not necessarily approach from the north where the Grand Forks radar would be well-placed to guide interceptors to stop them. As with SLBMs, existing coastal radars could track such missiles, but could not guide ABM missiles to intercept them. While some areas of the country would be protected, there would be many American cities that a potential terrorist leader armed with intercontinental ballistic missiles could still threaten.

In addition to these geographic constraints, there is a firepower problem: the 100 interceptors permitted by the ABM Treaty would be insufficient to fully protect against the most plausible unauthorized launches. The crew of a single Soviet Typhoon submarine, for example, could launch up to 200 warheads. While a 100-interceptor system could substantially reduce the destruction from such an unauthorized launch, the many warheads not intercepted could still wreak catastrophic damage. Similarly, since many types of Soviet ICBMs are thought to be commanded in groups of 10, an insane commander who somehow managed to override the electronic locks and other protections and launch a single missile could probably launch 10, carrying as many as 100 warheads. The ALPS interceptors would have to be 100 percent effective to completely stop such an attack, and nothing close to such perfection is expected. If the unauthorized launch order came from a higher level of command, a much larger number of missiles could well be involved, totally overwhelming a 100-interceptor ALPS system.

This shortage of defense firepower would become even more acute if the Soviet Union reacted to an ALPS system by placing decoys on a substantial fraction of its missiles. In that case, a small group of missiles launched by accident or without authorization might carry hundreds of decoys in addition to scores of warheads. If the ALPS system were unable to discriminate between decoys and genuine warheads—as appears likely, given the potential options for decoy technologies—it would be overwhelmed. If the Soviet Union viewed a U.S. ALPS deployment as only the first step toward a more robust nationwide defense, as many SDI supporters argue it should be, such Soviet countermeasures would be almost certain.

It is these limitations that have led SDI contractors to propose modifying the ABM Treaty to permit a larger number of ABM sites and interceptors. McDonnell-Douglas, for example, has argued that true nationwide coverage would require at least six ABM sites, adding five coastal ABM systems to the Grand Forks site, with a total of 800 ABM interceptors, eight times the number currently permitted.

Such a treaty-amendment proposal is almost certainly non-negotiable, given the Soviet Union's recent opposition to any proposal to loosen the ABM Treaty's restrictions. And even if the Soviet Union accepted the idea of a treaty modification for ALPS, its larger territory would require a larger number of ABM sites for effective protection, and Soviet negotiators might demand such an advantage in an amended accord.

With or without such a Soviet advantage, amending the ABM Treaty along these lines would substantially change the nature of the agreement. If each side were permitted to deploy the radar and command infrastructure necessary for a "thin" nationwide defense, all the long-lead-time elements would be in place for a rapid "breakout" to a more robust system. Imagine the U.S. concern if each of the Soviet Pechora-class early-warning radars were replaced with genuine ABM radars, each site was armed with over 100 interceptors, and the Soviet Union had extensive production lines in place for additional interceptors. Either side might then be able to produce and deploy thousands of ABM interceptors relatively rapidly, to be guided by the existing radars, reducing the effectiveness of the other side's strategic forces before it could easily respond. The ABM Treaty's protections against rapid breakout would be gutted, greatly reducing the treaty's contribution to U.S. security.

Moreover, such a modification of the treaty could be self-defeating, even judged strictly on the basis of defense against accidental or unauthorized launches. Faced with such nationwide ABM infrastructures, each side would be likely to equip a large fraction of its offensive missiles with decoys and other penetration aids, to hedge against a possible breakout. In that case, even the expanded defenses could be overwhelmed by an accidental or unauthorized launch of such decoy-equipped missiles.

In addition, permitting such large nationwide ABM networks could greatly undermine the independent nuclear forces of U.S. allies Britain and France, vastly increasing the cost and difficulty for each of these countries to maintain an effective strategic threat against the Soviet Union. China might also react by increasing the size and penetration capability of its strategic forces. Substantial increases in these independent nuclear forces could significantly undermine the prospects for deep reductions in U.S. and Soviet strategic forces in START II or START III agreements.

For these reasons, Senator Nunn, among others, has rejected such a multisite ALPS system as straying too far from the basic framework of the ABM Treaty.

In addition to these directly ABM-related issues, any type of ALPS system immediately raises the problem of ASAT weapons, too often neglected in the ALPS debate. Testing and deployment of the ERIS interceptors to be used in an ALPS system would give the United States a robust capability to destroy objects in space with conventional weapons. And once extensively tested against low-altitude space objects, such kinetic-energy interceptors could be placed on larger rockets, allowing them to threaten satellites all the way to geosynchronous orbit, where critical early warning and communication satellites are located. Undertaking such a program could overturn the current Soviet moratorium on ASAT testing, reigniting an ASAT competition and greatly impeding the prospects for an accord to limit such space weapons. (See "Toward ASAT Arms Control" p.148.)

Clearly, the ALPS idea raises a number of important security issues, including some substantial risks. The United States must think carefully before making any decision to proceed with an ALPS system, giving careful attention to the costs and arms control implications, as well as to possible alternatives.

TREATY-LIMITED DEFENSES OF MILITARY TARGETS

Some analysts have suggested that similar treaty-limited defenses might provide partial protection for selected military targets from a direct Soviet attack, rather than merely protecting against accidental, unauthorized, or third-country missile launches. Such concepts, however, face the same basic dilemma confronting ALPS proposals: A defense constrained to the single 100-interceptor site permitted by the ABM Treaty would face severe limitations in both geographic coverage and firepower, but modifying the treaty to permit a more robust system could greatly erode the accord's effectiveness.

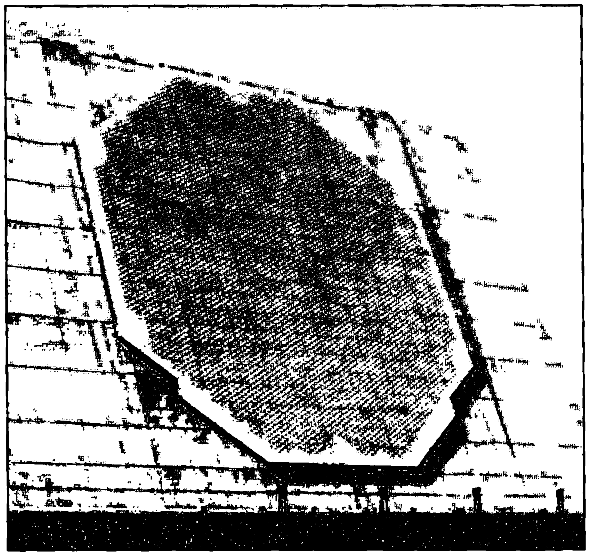
Proposals for such treaty-limited defenses of military targets rely heavily on a tactic known as "preferential defense," in which the defense conserves its resources by intercepting only those warheads aimed at the particular targets the defense has chosen to protect. In theory, a potential attacker would be kept uncertain as to which targets were defended, making it impossible for the attacker to concentrate forces on the defended targets to overwhelm the defense. Proponents argue that with this tactic, even a 100-interceptor system could provide significant protection to such targets as command and control sites, mobile ICBMs, or bomber bases.

For a variety of reasons, however, such a system is unlikely to be as effective as proponents claim. A system designed to stymie direct Soviet attack on military targets would have to cope with Soviet tactics and technologies specifically designed to overcome the defense. Such a treaty-limited defense would be particularly vulnerable to countermeasures, since ABM Treaty constraints would prevent its expansion to counter more capable offensive threats. For example, since the ABM Treaty permits ABM radars only at the single permitted site, and bans mobile ABM components, the radar or radars of a treaty-limited system would be extremely vulnerable to attack. In addition, maneuvering reentry vehicles (MaRVs) would make it impossible to predict exactly where a warhead was targeted, defeating most possibilities for preferential defense, on which these proposals depend. For systems designed to intercept warheads before they reenter the atmosphere, warhead-mimicking decoys could pose a particularly daunting problem, quickly overwhelming the 100 interceptors permitted by the treaty. Depending on the specific design, other penetration aids such as radar jamming, chaff, and precursor nuclear bursts might have a similar impact.

In addition, defense of each of the limited sets of targets that have been suggested raises difficulties of its own. Limited defenses of command and control could not protect the few key sites most central to the U.S. command system, such as Washington and Strategic Air Command headquarters, because the targets are simply too few: by concentrating its attack, the offense could overwhelm any defense of them at relatively low cost. For this reason, the idea of undertaking a treaty-permitted shift of the single U.S. ABM site from Grand Forks, North Dakota, to Washington, D.C., to provide a defense of the so-called National Command Authority, would offer no genuine protection for Washington-based commanders. Indeed, it is unlikely that such a system could even buy additional minutes for decisions to be made, as the Soviet Union could launch more than 100 warheads against it in the first salvo of an attack.

If the mission of a command-protection system is instead to protect a selected portion of the broader command system, to ensure that basic retaliatory orders could be carried out after an attack, there is little reason to believe that a defense is needed. It is widely acknowledged that the current and evolving command system, particularly with improvement programs already underway, is robust enough to provide a substantial retaliatory capability even in the face of a determined "decapitation" attack. If further improvements in command survivability are nevertheless judged desirable, there are many alternative approaches that are likely to be substantially more effective than limited defenses, such as increased reliance on airborne and ground-mobile command posts. Indeed, SDI's own command and control designers now favor mobile command posts to manage a missile defense. As one of them put it: "The way you're going to fight the war is when you're survivable. And that's mobile."

Some analysts have called for a treaty-limited missile defense to protect U.S. bomber bases, particularly against potential future "depressed-trajectory" SLBMs—submarine-launched missiles designed to fly on lower, faster flight paths. But the number of primary U.S. bomber bases is so small that even using preferential defense tactics, a treaty-limited defense could only modestly increase the number of warheads needed for a bomber-base attack. And against such depressed-trajectory missiles, the range of possible defensive interceptors would be greatly reduced, making it impossible to defend bomber bases dispersed nationwide from the single site permitted by the ABM Treaty, or even from the two sites that would be permitted if the United States and the Soviet Union agreed to revoke the 1974 Protocol. It is unlikely that such a treaty-limited bomber defense could even buy additional minutes for the bombers to escape from their bases.



Radar Replacement: *In proposed ALPS concepts, the existing Perimeter Acquisition Radar at Grand Forks (above) would be replaced by a more advanced ABM radar. The new radar would be "cued" to the approach of attacking missiles by existing early warning radars.*

Theoretically, the concept of using a treaty-limited defense to protect mobile ICBMs appears more promising. Destroying such mobile missiles would require barraging a large area: A defense could protect the mobile missiles cheaply by intercepting only the few warheads in each barrage area that were headed toward the actual location of the mobile missile, thereby gaining considerable leverage over the offense. But even the simplest MaRVs would defeat such a plan by making it impossible to determine which warheads were targeted on the actual location of the mobile missile, and such offensive counters could almost certainly be built in the near term. Moreover, current mobile missile efforts are designed to achieve high survivability without the need for such defenses. As a recent study by the nonpartisan Congressional Budget Office pointed out, defenses of such a highly survivable system would protect only a very small additional number of missiles, at a far higher cost-per-missile than simply increasing the number of mobile missiles, or changing their operating pattern—and with far less confidence of success.

THRESHOLD DEFENSE

A few advocates of a treaty-limited defense have argued that in a severe crisis or conventional war, the Soviet Union might be tempted to launch a very small missile attack on the United States—to destroy a few key military targets critical to the defense of Europe, perhaps, or to up the ante in an attempt to coerce the United States into backing down. Defense proponents argue that if the United States had a missile defense in place, even a treaty-limited one, the Soviet Union would be forced to greatly increase the size of such an attack to ensure that it would succeed. The distinction between such a limited strike and an all-out blow would be blurred, heightening the risk of overwhelming U.S. retaliation and thereby contributing to deterrence. This defense role is often called "threshold defense," since it raises the minimum number of warheads needed for an attack, the "threshold" of strategic war.

But even with a missile defense in place, such a limited attack could be carried out by a small force of cruise missiles, possibly launched from submarines. The U.S. coasts are too long to provide substantial protection against such a sea-launched cruise missile attack at reasonable cost. And the few targets that would be critical to U.S. reinforcement of Europe in a conventional war are all on the coasts, critically vulnerable to any number of means of attack other than ballistic missiles.

Moreover, it seems clear that the risk of retaliation, on which deterrence is based, is related to how much damage is done to the United States and its allies in an attack, not to the sheer number of warheads that are launched. If a limited defense succeeded in intercepting most of the additional warheads the Soviet Union might devote to such a limited attack, so that the number of warheads actually reaching their targets was not substantially changed, it is unlikely that Soviet leaders would perceive a significantly increased risk of a major U.S. retaliatory blow. And the U.S. response to a limited attack would probably be more closely related to the damage done than to the number of warheads involved: an attack that destroyed 10 cities with 10 warheads would be far more certain to result in a devastating counterblow than an attack involving a hundred warheads that did little substantial damage. Hence, it is unlikely that increasing the size of the Soviet attack necessary to do any given level of damage would contribute significantly to deterrence of a limited attack.

DEPLOYING AN ABM AS A BREAKOUT HEDGE

Yet another rationale that has been offered for the construction of a treaty-limited missile defense is to provide a hedge against a possible Soviet "breakout" from the ABM Treaty. Advocates point out that maintaining and modernizing the Moscow ABM has given the Soviet Union substantial operational experience with ABM systems, and production lines for ABM components that could conceivably be used for a more widespread deployment. By deploying an ABM system at the permitted Grand Forks site, the United States could gain similar experience and production lines, allowing a more rapid response should the Soviet Union abandon the ABM Treaty and begin building a nationwide missile defense.

While such an approach would undeniably increase the pace at which the United States could expand its missile defenses, it raises several issues. First, as described in Chapter VII, there is little evidence that the Soviet Union is preparing to break out of the ABM Treaty—contrary to the repeated warnings put forward during the Reagan administration—and considerable evidence to the contrary. The substantial cost of even a single-site ABM system would be a high price to pay for a limited additional hedge against such an unlikely threat. Indeed, a better approach to equalizing the two sides' ABM programs would focus on reducing the Soviet potential for ABM expansion, rather than increasing that of the United States: the "zero-ABM" agreement Soviet negotiators have raised informally would force the Soviets to dismantle the Moscow ABM, eliminating much of the available infrastructure for a more widespread Soviet ABM deployment. (See "Toward a Zero-ABM Agreement," p.144.)

Moreover, the most essential response to a Soviet ABM breakout, in the unlikely event one should occur, would be to ensure the continued effectiveness of the U.S. deterrent through offensive countermeasures to overcome the Soviet defenses. (See "Hedging Against Soviet Breakout," p.86.) In response to Soviet air defenses, the United States has built cruise missiles and new bombers, not massive air defenses of its own. Preparing to construct a U.S. ABM system might be a useful adjunct to developing such offensive countermeasures, but it should not be given primary importance.

If it were nevertheless judged desirable to prepare such a defensive breakout hedge, actually deploying a treaty-limited ABM system at Grand Forks or Washington would not be the most effective approach, since it would provide little operational experience. For safety reasons, national policy would preclude firing test missiles toward Grand Forks or Washington for the system's radars to track, or firing interceptors from operational launchers at those sites. In contrast, a complete ABM test system built at the existing ABM test range on Kwajalein Atoll in the Pacific Ocean would not face these limitations, and could be maintained in an "operational" mode if experience with such a system were deemed necessary. Building such a test facility could provide ABM component production lines.

> ***"To protect the United States against any of the cases of small missile attacks, the United States would need to deploy a substantial and extensive ABM system. And the risks of deploying such a system outweigh its potential for saving some American lives. I therefore continue to oppose moving to abrogate or modify the ABM Treaty."***
>
> *—Harold Brown, 1984*
> *Former Secretary of Defense*

SUMMARY OF TREATY-LIMITED SYSTEMS

In short, while the ABM Treaty permits each side to build a single 100-interceptor ABM system, there does not appear to be any compelling reason for the United States to do so. The U.S. national security community reached that decision in 1975, when the permitted ABM site at Grand Forks was shut down, since the extremely limited protection it offered was judged not to be worth even the cost of continued operations and maintenance. While the technologies that could be incorporated in such a system have improved since then, the fundamental security issues have not changed. Increasingly scarce defense dollars are more urgently needed for other purposes.

THE ABM TREATY AND HARD-SITE DEFENSE

Another possibility is to substantially modify the ABM Treaty to permit a large-scale defense of existing fixed land-based ICBMs—a concept that had some supporters well before the SDI program began. Since a buried concrete-and-steel missile silo can be destroyed by a nuclear blast only if the weapon detonates within a few hundred meters of the silo (as opposed to the several-kilometer radius of destruction against ordinary civilian buildings), an ABM system could potentially be designed to protect hardened missile silos while having no substantial capability to defend "soft" targets such as cities. Some analysts have argued that such a system would be compatible with the basic deterrent-enhancing rationale of the ABM Treaty, if not its current provisions, since it would protect strategic retaliatory forces without substantially undermining either side's ability to threaten other targets.

While such "hard-site defenses" were the focus of the U.S. ABM research and development program from 1972 until 1983, the SDI program largely abandoned these technologies in its quest for nationwide missile defenses. Hence, despite the recent controversies over the ABM Treaty, the idea of modifying the accord to permit hard-site defenses has received little attention in recent years, and neither the United States nor the Soviet Union is currently prepared to build such a hard-site-specific ABM system.

Design, Cost, and Effectiveness Of a Hard-Site Defense

The primary past U.S. concepts for such hard-site defenses were based on "conventional" ABM technologies, ABM interceptors guided by radars. To protect even 30-50 percent of the 1,000 U.S. ICBMs against a Soviet attack of several thousand warheads, thousands of ABM interceptors would be required. Most if not all of the interceptors would probably be relatively short-range, designed to intercept Soviet missiles well after they reentered the atmosphere. For optimum effectiveness and survivability, a large number of small radars would be used. To complicate attacks on the radars, the radars would have to be mobile or "deceptively based"—hidden among a much larger number of shelters, in a kind of "shell game." Because such a system has received so little recent attention, current government or contractor cost estimates are not available. While some private studies put the cost in the neighborhood of $30 billion, the price tag clearly depends on the particular system design ultimately chosen.

There is some controversy over how effective such a missile-silo defense would be. Given enough time and resources, a responsive offense could overcome such a missile-silo defense—but at what cost? Would raising the price of the attack decrease a potential adversary's incentive to strike, enhancing deterrence? Or would the attacker be able to defeat such a defense for an acceptable cost, perhaps lower than the cost of the defense itself? Critics argue that by increasing the number of warheads involved in the attack, structuring the attack to take advantage of such effects as radar "blackout," and using antidefense penetration aids such as maneuvering reentry vehicles and radar-homing warheads (to hunt down mobile ABM radars), a determined attacker could reliably defeat foreseeable hard-site defenses, at a low enough "attack price" that the system would not contribute substantially to deterrence of an attack. Former Secretary of Defense Harold Brown, for example, warned Congress in 1987 that "the present ICBM basing modes cannot be defended cost-effectively."

As Brown's remark implies, changing the basing of U.S. ICBMs could ease the task of the defense. In particular, a "deceptive basing" concept, in which a group of missiles was hidden among a much larger group of identical shelters, would theoretically allow a much smaller and less costly defense. As in the scheme for protection of mobile ICBMs described above, only the small fraction of the incoming warheads directed toward an actual missile would need to be intercepted. But in this case too, MaRVs could make it impossible to predict which shelter was under attack until the last moment, making the problem of defense substantially more difficult.

A variety of such "deceptive" ICBM basing modes has been proposed in the past, from the "racetrack" MX basing mode of the 1970s (for which the Army developed the Low Altitude Defense System (LoADS) concept), to more recent "carry-hard" ideas, in which both the ICBMs and their protective steel canisters would be moved periodically among a group of relatively closely spaced shelters. For the moment, however, such deceptive basing ideas are not under active consideration.

Another class of possible defenses for U.S. ICBMs are referred to as "simple/novel" systems: these generally involve destroying incoming warheads with swarms of pellets or tiny rockets, or clouds of dust and debris. The simplest of all these proposals is the "dust defense," which calls for burying "clean" nuclear bombs (designed to produce relatively little radioactive fallout when detonated) north of U.S. missile silos. When radars detected a Soviet attack, the bombs would be detonated, blowing millions of tons of dirt into the likely path of Soviet warheads. Travelling at hypersonic speed, incoming warheads would be destroyed by collisions with airborne gravel, or by erosion of their heat shields as they passed through the dust cloud. In theory, the fallout from the buried bombs would be substantially less than the fallout that would otherwise be created by the detonation of the incoming Soviet warheads. Since it would not have any genuine ABM components, such a defense could be deployed without any need to modify or even make reference to the ABM Treaty.

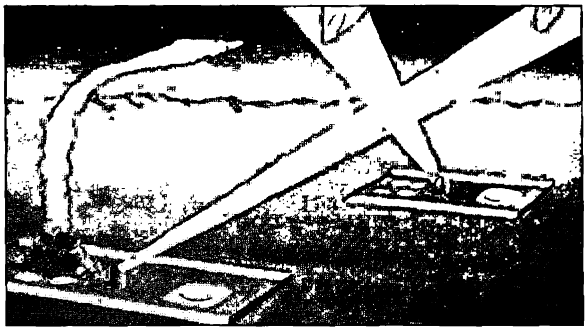
The nonpartisan congressional Office of Technology Assessment (OTA) reported in 1981 that such a defense is "technically feasible and very capable, but could have very low public appeal," since it involves intentionally detonating nuclear weapons on U.S. territory. For that reason, such a defense has never received serious consideration.

Most other defenses in this "simple/novel" class involve intercepting incoming warheads at extremely short range, with a cloud of pellets or tiny rockets. The "swarmjet" concept is typical: it would involve a launcher spraying thousands of tiny rockets to fill the sky in the path of an incoming warhead, ensuring a collision that would destroy the warhead. A very small, relatively low-cost radar north of each silo would tell the system when and where to fire. But because incoming warheads could be designed to detonate when struck by a pellet or rocket, and the fierce winds from such a blast could blow subsequent defensive "swarms" off course, the 1981 OTA study concluded that such a system could only ensure destruction of a single warhead at each silo. That would make it relatively easy for the Soviet Union to overcome the system by increasing the number of warheads devoted to the attack—unless the system were coupled with a deceptive basing scheme for the ICBMs, as described above. Maneuvering reentry vehicles would also increase the radar coverage and number of rockets required, undermining the system's most attractive feature—its theoretically low cost.

Security Issues and Alternatives

The idea of building a major hard-site defense system using traditional ABM technologies poses a number of serious issues.

Most obvious is the system's substantial cost, in the range of tens of billions of dollars. As with ALPS, diverting tens of billions of dollars in the current stringent budget environment could have a dramatic impact on other defense programs.



Hard-Site Defense: *Defenses of hardened missile silos, such as that shown in this artist's concept, can rely on comparatively inexpensive close-in defenses, since such a silo would only be destroyed if a nuclear weapon detonated within a few hundred feet. But such defenses are not urgently needed, as the United States already has an overwhelming and survivable deterrent—and modifying the ABM Treaty to permit the thousands of interceptors that would be needed to defend U.S. missile silos could fatally weaken the treaty's protection against rapid "breakout."*

There is no indication that the Soviet Union would agree to modify the ABM Treaty to permit hard-site defenses. Unlike the United States, the Soviet Union has never focused on hard-site defenses in its ABM research and development program.

Even if agreement could be reached, the changes in the ABM Treaty that would be needed to make room for a hard-site defense would be substantial. Proponents of hard-site defenses argue that the technical differences between defending missile silos and defending cities are so great that it should be possible to design treaty limitations that would permit an effective hard-site system without greatly weakening the ABM Treaty's critical protections against rapid construction of a nationwide missile defense. But detailed examination of the requirements for hard-site defense and the record of past ABM compliance anxieties indicates that the necessary ABM Treaty modifications would substantially undermine confidence in the effectiveness of the treaty regime, greatly increasng the perceived danger of a rapid breakout from the modified accord.

Many of the ABM Treaty's fundamental limitations would have to be changed or eliminated to make way for a hard-site ABM system. To protect the widely spaced ICBM sites on both sides, the number of permitted ABM sites would have to be greatly increased—unless very long-range interceptors like ERIS were used, in which case there would be no meaningful distinction between a hard-site defense and a nationwide ABM system. As with ALPS, the Soviet Union might require a larger number of sites for an effective system, as Soviet ICBMs are based at a larger number of separate locations. To protect current ICBM basing modes, thousands of ABM interceptors would have to be permitted. And to gain survivability for the newly-permitted ABM systems, the ban on development, testing, and deployment of mobile ABM radars would have to be lifted. Other mobile ABM components (such as airborne or space-based sensors) might ultimately be necessary as well.

> ***"If we had agreed to have 1,000 or 2,000 [interceptors] or whatever is needed to field a defense of ICBMs, we would have had to face the prospect of the Soviets having the same thing. If you were concerned . . . about the SAM upgrade problem, I think you would have to multiply your concerns if we were faced with a broadly deployed ICBM defensive system throughout the Soviet Union. That would make SAM-5 look like child's play."***
>
> *—Gerard C. Smith, 1972*
> *Chief U.S. Negotiator of the ABM Treaty*

Even if the permitted interceptors were limited by agreement to very short ranges—which might interfere with preferential defense, greatly reducing the defense's effectiveness—such a modified accord would permit the Soviet Union to increase its current ABM capabilities dramatically, opening new avenues for concerns over compliance and breakout. The substantial production lines needed to produce the interceptors and radars for such a system would be available for a rapid expansion beyond treaty limits. The mobile radars would make it far easier to expand the system to new sites not permitted by the modified accord. New longer-range interceptors might be built relatively rapidly to augment the system, and concerns would inevitably be raised over such possibilities as adding an additional rocket stage to each of the existing interceptors to extend their range. Given the concerns that have recently been expressed over the possible ABM potential of Soviet air defense systems such as the SA-12b and the SA-10, it is easy to imagine the fears that a genuine ABM system involving thousands of interceptors would raise.

These concerns would be exacerbated by the substantial asymmetries in the location of U.S. and Soviet ICBM fields. American ICBMs are deployed in remote areas, far from most major urban centers, while many Soviet ICBMs are deployed throughout the heart of European Russia (including the Moscow area). As a result, an effective Soviet ICBM protection system could be readily expanded to provide limited coverage of critical urban and military targets.

In short, modifying the ABM Treaty to permit widespread hard-site defenses on both sides would greatly undermine the treaty's contribution to U.S. security. The Soviet ABM infrastructure would be enormously increased, increasing uncertainties as to the effectiveness of U.S. deterrent forces. U.S. planners could no longer safely assume that the Soviet Union could not rapidly build a nationwide ABM defense.

Fortunately, there is no urgent need for the United States to deploy such a hard-site defense system, particularly in the new international environment following the revolutions of 1989. The overall U.S. strategic triad is already highly survivable, protected by means other than active defense. And if U.S. ICBMs are to be made more survivable, mobile ICBMs provide a means of doing so that is likely to be both more cost-effective and more resistant to Soviet countermeasures, without undermining the ABM Treaty. (See Chapter X, "Nationwide Missile Defenses or the ABM Treaty?")

A TREATY-COMPLIANT RESEARCH PROGRAM

Given the problems inherent in each of these deployment options, it appears that for the foreseeable future, the best course for the SDI program is a continued focus on research, rather than a rapid move toward deployment of even limited missile defenses. That judgment represents the consensus of a remarkably broad spectrum of the national security community. As recently as late 1988, for example, Brent Scowcroft, now President Bush's national security adviser, recommended an SDI program staying within the traditional interpretation of the ABM Treaty, with no near-term deployments of missile defenses. Similarly, when the Bush administration conducted its "strategic review" in the first months of its term, the Joint Chiefs of Staff reportedly favored the only SDI option under consideration that involved only research, not deployment, and recommended that funding for the program be cut back. Arnold Kanter, now Scowcroft's deputy for defense and arms control matters, summed up the situation in 1988: "A consensus appears to be emerging that probably *no* BMD [ballistic missile defense] deployment option makes good strategic or technical sense over the next decade." The recent dramatic changes in the Soviet Union and the Warsaw Pact have only confirmed that conclusion.

There are a number of important reasons, however, to continue a robust ABM research program even if it is not expected to lead to deployment of an ABM system in the foreseeable future. First, it seems likely that the Soviet Union will continue its long-standing ABM research and development program, and a parallel U.S. program can help guard against technological surprise. Similarly, a strong U.S. ABM technology base can be an important factor in Soviet calculations, keeping Soviet leaders convinced that they can gain no advantage by starting an ABM race. At the same time, ABM research and engineering, combined with development of cost-effective ABM countermeasures, can provide an important hedge for U.S. security should the Soviet Union nevertheless decide to abandon the ABM Treaty and begin constructing a nationwide ABM defense. ABM and countermeasures programs work together, each providing expertise and equipment to help test the effectiveness of the other. Finally, continued study of advanced technologies that are not yet well understood will help identify the most promising areas for further research (as well as areas that face insurmountable problems and can be abandoned), and the most threatening possibilities for future Soviet advances.

An ABM research program structured around these objectives would mark a substantial change from the current SDI effort, which is focused on preparation for near-term deployment of a widespread missile defense. A more sensible SDI program would:

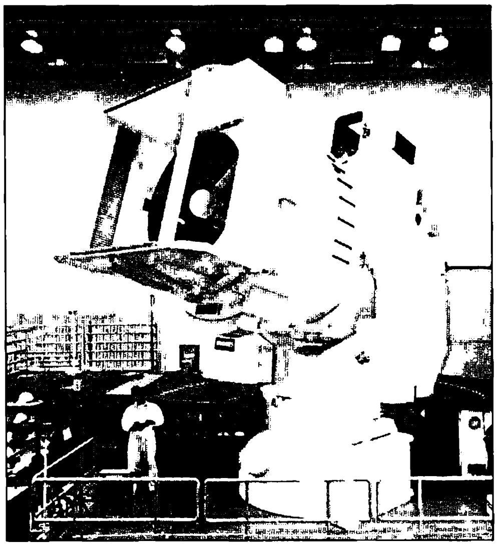
- Deemphasize technologies that would not be effective against a responsive Soviet threat in the long term, such as space-based interceptors and space-based chemical lasers.
- Increase work on countermeasure technologies.
- Maintain a strong emphasis on sensor technologies, particularly those which might offer promise for early warning, space tracking, and verification.
- Maintain significant research on long-term technologies such as advanced directed-energy weapons.
- Deemphasize expensive "technology demonstrations," which tend to freeze in technology prematurely, while diverting funds from further technological development.
- Continue to deemphasize nuclear directed-energy weapons, which could create devastating antisatellite weapons but are unlikely to lead to an effective missile defense.
- Most important, avoid experiments that would contravene or undermine the traditional interpretation of the ABM Treaty.

In addition to a focus on sensors, long-term technologies, and countermeasures, some analysts have argued that a revised SDI program should focus some of its effort on full-scale development of an ABM system based on known technologies. Such a test system, which could be built at the Kwajalein Atoll ABM test range in the Pacific Ocean, could provide an ABM deployment option in the unlikely event of a Soviet ABM breakout, and could be used to test the effectiveness of ABM penetration aids. But other analysts, such as Scowcroft aide Arnold Kanter, have argued that further work on conventional ABM is largely unnecessary. In Kanter's words: "We are reasonably confident now that conventional [ABM] technologies do not harbor the potential for a dramatic Soviet (or American) breakthrough in ballistic missile defenses, and that an appropriate U.S. response to a Soviet ABM breakout in the near term probably would be in the area of offensive countermeasures."

As Brent Scowcroft and his colleagues in the Aspen Strategy Group have pointed out, the traditional interpretation of the ABM Treaty "would not seriously hamper" such a "sensible research and development program" for at least another decade. As a result, in their words, "we would forfeit very little in technical terms by remaining in compliance with the treaty and thereby continuing to reap its contributions to our security."

Such an SDI program involves substantially scaled-back objectives, when compared to the current program, and could be effectively accomplished at a lower level of funding. The current funding level of nearly $4 billion a year is simply too high a price to pay for such limited goals in an era of declining defense budgets. As former Secretary of Defense Harold Brown said in response to initial plans to spend $26 billion on SDI over five years, "that's a lot of money, and it is unwarranted."

In short, the United States can and should maintain a robust long-term ABM research program. By abandoning the unrealistic current focus on near-term deployment, a more focused and effective research program can be put together that would provide tangible security dividends, without compromising the substantial benefits we already gain from the traditional interpretation of the ABM Treaty.



The Sealite laser beam director at the White Sands missile test range.

XII. Reaffirming the ABM Treaty

As the previous chapters in this book have described, the ABM Treaty remains a critical component of U.S. security strategy, providing enduring restraints on Soviet ballistic missile defenses that ensure the effectiveness of U.S. offensive forces, avoid an offense-defense race, and provide the essential foundation for offensive arms reductions. It is therefore important to ensure that this unlimited-duration accord remains effective in the changing technological circumstances of the twenty-first century, and is not eroded by compliance disputes and the exploitation of ambiguities.

The first step is to reaffirm the treaty's basic principles: with the Soviet Union dismantling the illegal Krasnoyarsk radar, President Bush could go a long way toward resolving domestic disagreements over the SDI program and smoothing the path for Senate approval of START by simply reaffirming the ABM Treaty in its traditional interpretation. If President Bush continues to offer rhetorical support to the discredited "broad" interpretation of the ABM Treaty when START is sent to the Senate, with the Soviet Union continuing to indicate that any violation of the traditional interpretation of the accord would be grounds for withdrawal from START, the Senate is likely to act to reaffirm the traditional view. (See "START Ratification and the ABM Treaty," p.157.)

With the Soviet decision to dismantle Krasnoyarsk, such a resolution of the interpretation issue would remove the last of the fundamental threats to the ABM Treaty regime. But some ambiguities will remain. The ABM Treaty is a contract intentionally drafted in broad terms, to cover the widest possible array of issues: like the U.S. Constitution, its basic principles do not change over time, but specific limitations are likely to require adaptation and new specificity as technology evolves. With the new, more constructive Soviet attitude toward compliance with arms control agreements, and the drastic decline of SDI's political and financial fortunes, clarification of these ambiguities may not be urgent. It is possible, even likely, that remaining contentious points of the treaty's application can be resolved in the Standing Consultative Commission (SCC) as specific issues arise. (Because of the intense politicization of the ongoing Defense and Space Talks, they are unlikely to be the best forum for addressing these highly technical issues.) But even if solutions for these potential issues are not urgent, it is important to begin thinking now about what those answers might be—defining how the ABM Treaty can adapt to the changing technological circumstances of the twenty-first century.

The questions that are likely to arise fall into three main categories. First, even the elimination of Krasnoyarsk will leave some ambiguities in the ABM Treaty's treatment of large phased-array radars (LPARs); agreed clarifications might help forestall future disagreements. Second, continuing issues are likely to be raised by the overlap between ABM and non-ABM technologies, such as air defenses or antisatellite (ASAT) weapons. Third, more specific limitations will ultimately need to be developed for new technologies, such as the lasers and infrared sensors under development in the SDI program.

The fundamental criteria for judging proposed solutions to these problems are their ability to achieve the basic goals of the ABM Treaty in a verifiable manner, without unduly interfering with other important military or civilian missions, such as early warning or air defense, or with continued research on ABM. (Military missions whose restraint is desirable for other reasons, such as ASAT, might be limited without undermining U.S. security.) As with the original ABM negotiation, the goal must be to ensure that militarily significant nationwide ABM systems are prohibited, and that neither side can develop a ready "base" for quickly deploying such a nationwide system—whether by rapidly building additional ABM components, or by upgrading ostensibly non-ABM systems to have an ABM capability—without clearly and observably violating the accord. Whether a particular proposal meets these criteria can only be judged in the context of the treaty regime as a whole: if the existing restraints on one category of ABM technologies (such as sensors, for example) are loosened, tighter restraints on other ABM technologies (such as interceptors) may be required, to compensate.

Fortunately, the studies of possible clarifications of the ABM Treaty that have been conducted to date indicate that these criteria can, by and large, be met. Indeed, with respect to most technologies, there appears to be a broad range of choice for limitations that would continue to ensure an effective ABM Treaty regime without substantially restricting other missions.

While it is impossible to foresee all the ABM-related technologies of the future, new clarifications need only address issues as they arise, while allowing flexibility for further adaptation—just as the original ABM negotiation did. As with any discussion of such a complex intersection of technology and arms control, particularly one where negotiations have yet to make significant headway, the discussion that follows must be considered illustrative, not definitive.

RESOLVING THE LPAR ISSUE

The ABM Treaty's LPAR limitations are critical, for such large radars are the guiding eyes of traditional ABM systems, and take longer to build than any other component. Fortunately, the current LPAR compliance issues appear to be essentially resolved. The Soviet Union has admitted that its radar near Krasnoyarsk violates the ABM Treaty, and has agreed to dismantle it in its entirety. The United States continues to reject Soviet charges that its early warning radars at Thule, Greenland, and Fylingdales Moor, United Kingdom, also violate the treaty's LPAR restrictions, but has agreed to allow Soviet inspectors to examine the facilities. (See "The Radars at Thule and Fylingdales Moor," p.100.) It now appears that the Soviet Union will acquiesce in the completion of the Fylingdales facility and the continued operation of Thule.

But because the ABM Treaty exempts space-tracking and verification radars from LPAR restraints without defining the differences between these and other types of radars, ambiguities remain that could raise additional issues in the future. A clarification of the LPAR issue going beyond resolution of the Krasnoyarsk problem would strengthen the treaty's restraints. Soviet negotiators at the 1988 ABM Treaty Review Conference proposed exploration of such an LPAR clarification, but the U.S. side was not willing to consider the issue until the Krasnoyarsk violation was resolved—a condition that can now be met. The sides could agree, for example:

- not to build additional LPARs without prior consultation and agreement between the sides; or
- to establish specific limits on the total number of LPARs, or on the number of LPAR "faces," the flat, antenna-covered sides of such radars, each of which can cover one-third of the horizon. In radars operational or under construction, the Soviet Union leads in the first category (and would therefore be more tightly constrained by an equal limit), while the United States leads in the second, since a larger proportion of its LPARs have more than one active face; or
- to establish means of distinguishing space-tracking radars from other types of LPARs, such as requiring that space-tracking facilities be designed to be physically capable only of looking upward.

> ***"We urge President Reagan and General Secretary Gorbachev to negotiate new measures which would prevent further erosion of the [ABM] Treaty and assure its continued viability."***
>
> *—Harold Brown, James Schlesinger, Robert McNamara, Melvin Laird, Clark Clifford, and Elliot Richardson, 1985*
> *Former Secretaries of Defense*

PREVENTING AIR-DEFENSE/ATBM UPGRADE

While placing strict limits on defenses against strategic ballistic missiles, the ABM Treaty permits defenses against both bombers and shorter-range missiles, the latter known as antitactical ballistic missiles (ATBMs). Both the United States and the Soviet Union are deploying improved air-defense systems vein familiar to a U.S. audience) that the limited protection it offers is not worth the cost of continued operation.

Such a ban on ABM deployments might logically be coupled with a ban on ABM development and testing, extending the existing ban on development and testing of all mobile ABM systems and components to cover fixed-site ABMs as well. Such an accord would involve both additional benefits and additional opportunity costs. On the positive side of the ledger, such an agreement would prevent the Soviet Union from full-scale development and testing of new ABM systems and components which might be more effective or more rapidly deployable than their current technologies, further strengthening the ABM Treaty's protections against Soviet "breakout." Banning fixed-site ABM development and testing would also help clarify the treaty's limits, reducing the risk that activities in grey areas would erode the agreed restraints. No longer would any distinction need to be made between "mobile" ABMs and those that were simply "rapidly deployable." No longer could either side attempt to evade the ban on space-based ABM testing by "lofting" test ABM technologies into space from permitted land-based test ranges, without actually placing them in orbit. The restrictions on testing infrared sensors "in an ABM mode" described elsewhere in this chapter would become substantially easier to implement—since there would no longer be any testing "in an ABM mode" taking place.

In addition, an ABM test ban would complement an accord limiting antisatellite (ASAT) systems, should such an agreement eventually be pursued. (See "Toward ASAT Arms Control," p. 148.) ASAT and ABM are technological cousins: virtually any technology that can shoot down a ballistic missile warhead in mid-flight can be adapted to shoot down satellites in low orbit. Effective limits on testing of low-altitude ASATs will only be possible if testing of ABM systems designed to operate beyond the atmosphere is restrained as well. In much the same way, limits on ASAT testing could help clarify the ABM Treaty, removing the loophole permitting testing of potential ABM technologies against satellites in orbit rather than against ballistic missiles in flight. In short, bans on all deployment and testing of both ABMs or ASATs—a new "double zero" in space—would work together, each helping to clarify the other.

Although such an ABM test ban would interfere with continued work toward a deployable ABM system, it should be kept in mind that development and testing is already prohibited for all space-based, air-based, sea-based, and mobile land-based ABM systems and components—categories which include the vast majority of the technologies slated for eventual deployment in current SDI concepts. Despite this ban, a great deal of exploration of new concepts can be done with permitted research, involving experiments well below the level of field testing of a full-scale "prototype" or "breadboard model" of an ABM component. Currently planned tests of full-scale ground-based ABM interceptors and ABM radars would have to be canceled or substantially modified, but the basic outlines of these technologies and the role they might play in a future missile defense are already well known. There is little need to proceed with full-scale testing unless the United States plans to go forward with deployment of an ABM system.

The common concern that an ABM test program should be maintained as a hedge against Soviet defenses does not argue strongly against such an ABM test ban, for the agreement would dramatically reduce the threat such a hedge would be directed against. While it could be argued that development of antidefense penetration aids would be more effective if an ABM system could be built to test them against, it should be remembered that the United States has not had a full-scale ABM radar at its ABM test ranges for many years, and has only briefly had ABM interceptors in place during that time, yet has continued development of a wide array of penetration aids using instrumentation radars and other available sensors.

For those who view the ABM Treaty as only a temporary pause until more effective ABM systems are developed, a zero-ABM accord is unlikely to be acceptable. But for those who recognize the ABM Treaty as an accord of "unlimited duration," who accept the enduring rationale for an agreement effectively banning all strategically significant defenses against ballistic missiles, the advantages of such an accord far outweigh the disadvantages.

utilizing surface-to-air missiles (SAMs) with limited ATBM capabilities, and the United States has expressed concern over the possible ABM potential of the Soviet systems. As a result, the ambiguities raised by the technological overlap between air defense, ATBM, and ABM systems—questions collectively referred to as "SAM upgrade"—are probably the next most urgent issue for resolution. (See Chapter IX, "Grey-Area Systems and the ABM Treaty.")

The ABM Treaty addressed the SAM upgrade problem by banning testing of air-defense systems and components "in an ABM mode," and barring either side from giving such systems an ABM capability. However, because of 1972-era Soviet sensitivities over avoiding limits on their air defenses, neither of these prohibitions was defined in specific technical terms. While SCC agreements in 1978 and 1985 addressed this issue, some ambiguities remain. To clarify and strengthen the ABM Treaty's limits on SAM upgrade, the two sides might agree:

• To define testing "in an ABM mode" more specifically. The Intermediate-range Nuclear Forces (INF) Treaty's ban on all U.S. and Soviet ground-based missiles with ranges between 500 and 5,500 kilometers removes most of the threat within that broad swath of missile ranges, creating an opportunity to make a clearer distinction between defenses against tactical and strategic missiles. The two sides could agree that any SAM tests against targets with the trajectory characteristics of missiles with ranges greater than 500 kilometers—corresponding to a top target speed of roughly two kilometers per second—will be considered prohibited testing "in an ABM mode." (The Soviet SA-12b system has reportedly been tested against somewhat faster tactical missile targets in the past—though not since the INF Treaty entered into force—and would probably have to be "grandfathered" in such an accord, preferably with some numerical and geographic restrictions on its deployment.)

• To set specific limits on the technical capabilities of SAM systems, defining the ban on giving such systems an ABM capability. Limiting the maximum speed of air defense and ATBM interceptors to two to three kilometers per second would drastically constrain their ABM potential, without significantly limiting their air-defense capabilities. A limit on SAM radar capabilities might also be useful, but is likely to be less important, as SAM radars are unlikely ever to be able to detect and track small, fast-moving strategic missile warheads without outside assistance—and the advent of stealth technologies may blur the distinction between the radar capabilities needed for air defense and those needed for an ABM role.

• To formally agree on the 1972 U.S. position that air-defense interceptors should not be deployed near early warning radars, to limit the interceptors' ability to defend the radars, and the radars' ability to "cue" the SAM systems, telling them where to look for incoming missile warheads.

ABM Mode: *The distinction between systems designed for tactical defense, such as the Soviet SA-12b, and ABM systems designed to intercept strategic ballistic missiles could be clarified with a more specific definition of testing "in an ABM mode."*

ADAPTING THE ABM TREATY TO NEW TECHNOLOGIES

Adapting the treaty to properly constrain new technologies, such as those being developed in the SDI program, is both technically more complex and (for the moment, at least) politically more contentious. Fortunately, the state of development of most of these advanced technologies allows some time for reflection and negotiation. The U.S. SDI program does not envision space-based testing of lasers, particle beams, or infrared sensors capable enough to raise serious ABM issues until the mid-1990s, and similar Soviet space-based tests are probably even farther in the future. (Some U.S. airborne sensor experiments and ground-launched brilliant pebbles testing could raise significant treaty questions in the nearer term. See Chapter VIII, "U.S. Compliance With the ABM Treaty.")

The ABM Treaty's current restrictions focus on development, testing, and deployment. Research is not limited, both because verification of such limits would be difficult and because both parties wished to continue ABM research. "Development," as used in the treaty, essentially begins when potential ABM technologies leave the laboratory and are ready for field testing. As a result, most approaches for adapting the ABM Treaty regime to the new, largely space-based technologies now being considered for ABM missions focus on limiting such field testing as the key to restraining potentially threatening developments.

Two complementary avenues for such adaptations have been widely discussed. One approach, based on the treaty's ban on testing non-ABM systems "in an ABM mode," is to bar all testing of a particular type, regardless of the specific capabilities of the technologies involved. The other approach, based on the treaty's limits on technologies with ABM capabilities, is to set specific capability limits, or "thresholds," beyond which testing of particular technologies would be forbidden, but below which testing would not be restrained.

TESTING PRINCIPLES

Under the current treaty as traditionally interpreted, development and testing of all space-based ABM systems and components is prohibited. This would bar, for example, any testing involving an orbiting weapon intercepting a strategic ballistic missile—regardless of the specific capabilities of the weapon. Similarly, any tests involving an orbiting sensor directing an interceptor or laser in the destruction of a strategic missile are prohibited. These prohibitions would apply to testing against any target whose trajectory, over the part of the flight involved in testing, was similar to that of a strategic ballistic missile, regardless of its size, shape, or other characteristics.

But in planning SDI tests, the U.S. Defense Department has seized on two principal avenues for preliminary testing of space-based ABM technologies that it argues are permitted, even under the traditional interpretation of the accord. Exploiting either of these means of working around the treaty's restraints would legitimize similar Soviet behavior: a better approach for U.S. security would be to nail down agreed limits before loopholes in the treaty are irrevocably opened.

"Pop-up" tests. One planned means of evading the ban on space-based testing is to launch a space weapon or sensor into space from a fixed, land-based launcher at an agreed ABM test range. The test device would perform its ABM role as it was falling back to earth, without ever going into orbit and thereby becoming "space-based." The Defense Department acknowledges, however, that such a "pop-up" test must not involve a full-scale "prototype" of an ABM component.

To close this loophole, "pop-up" testing against rockets in the boost or post-boost phases of flight should be prohibited. Since ABM systems operating in those phases of flight would have to have substantial space-based components, such tests are only useful for the development of prohibited space-based ABMs.

ASAT tests. Space-based weapons and sensors could also be tested against satellites, rather than ballistic missiles. The tested components must not have ABM capabilities, but in the Defense Department view, there is no requirement that this lack of ABM capability be either verifiable or difficult to change quickly. Moreover, the Defense Department takes the questionable position that even testing against thrusting satellites, essentially mimicking the motion of a ballistic missile in boost phase, does not constitute prohibited testing "in an ABM mode."

Here, the sides should first agree to define testing against thrusting satellites as testing "in an ABM mode," since the trajectory of such satellites during the test closely models that of a strategic ballistic missile in the boost or post-boost phases of flight. Space-based tests against such satellites would therefore be prohibited, as would "pop-up" tests against them.

In addition, a broader clarification of the overlap between ASAT and ABM testing is necessary. One option would be to impose a prohibition on development and testing of space-based ASATs, equivalent to the existing prohibition on space-based ABMs. Such a restriction would not enormously inhibit the ASAT mission in the near term, as space-based ASATs are likely to be more expensive, complex, and vulnerable than Earth-based systems—with the important exception of so-called space mines, small satellites orbiting near their targets with an explosive or other means of sudden attack on command. The prohibition could be extended to other areas where ABMs are barred, including sea-based, air-based, mobile land-based, and multiple-warhead ASATs, if the superpowers agreed that ASATs should be so constrained.

A more sweeping measure, dealing decisively with the ASAT-ABM overlap, would be to prohibit all further testing of intercepts of objects in space, whether missiles or satellites. Such a ban would prevent development of new ASAT weapons and bar testing of exoatmospheric ABM interceptors even at fixed, land-based test ranges, two results which would be seen by some as substantial disadvantages. However, a ban on ASAT testing has considerable security merit in its own right, as does the possibility of a "zero-ABM" accord, removing the ABM Treaty's current permission for one ABM site and for testing of fixed, land-based ABM

Toward ASAT Arms Control

U.S. security is critically dependent on military satellites, for early warning, communications, navigation, intelligence, and verification of arms control agreements, among other tasks. Hence the United States has "a major security interest" in arms control measures to limit the threat to U.S. satellites, as National Security Adviser Brent Scowcroft concluded in 1987.

Today, the Soviet Union has a crude antisatellite (ASAT) system, capable only of slow attacks against low-altitude satellites, and potentially susceptible to countermeasures. It has not been tested since 1982, as a result of a unilateral Soviet ASAT moratorium announced in 1983. A more sophisticated U.S. system designed to be launched from F-15 fighter aircraft was cancelled in the Fiscal Year 1989 defense budget, as a result of cost overruns and a ban on testing imposed by Congress in response to the Soviet moratorium. One U.S. chemical laser has already been upgraded for a possible ASAT role, and other laser types are being studied. Some large Soviet ground-based lasers may have some potential to damage particularly sensitive components on low-altitude satellites, although a recent visit by a U.S. team revealed that the particular laser that U.S. intelligence had expressed most concern over is far too small to pose a significant ASAT threat. (See Chapter V, "The Soviet ABM Program.") None of these systems poses a significant threat to satellites in high, geosynchronous orbits, where the most critical U.S. satellites reside, including spacecraft for both communications and early warning. The Soviet Union also possesses nuclear-armed ABM interceptors, and both sides deploy nuclear ballistic missiles, both of which could be reprogrammed to attack satellites—but such nuclear blasts in space would also destroy "friendly" satellites over a wide area, and create a massive electromagnetic pulse (EMP), threatening electronic systems over tens of thousands of square miles. The use of such nuclear weapons is probably only credible in the context of a nuclear war.

By contrast, over the next decade both superpowers have the potential to develop ASAT weapons capable of rapidly attacking large numbers of satellites at all altitudes—weapons that could be conventionally armed, and therefore offer the potential of ASAT use from the first moments of a conventional conflict or crisis, drastically increasing the likelihood of ASAT use and the potential for crisis escalation. Unilateral survivability measures such as hardening or maneuver could go a long way toward protecting U.S. satellites against current threats—but against the new dangers posed by such future ASATs, effective protection might be prohibitively expensive to provide.

The ASAT arms control issue is an urgent one, for tests planned in the near term—both for SDI and for ASAT itself—have the potential to end the current informal testing moratorium, touching off a renewed ASAT competition. The main current U.S. ASAT program, a ground-based rocket being developed by the Army, is scheduled for flight tests in 1994, and other ASAT concepts could be tested in the years immediately before and after that date.

Because it would be far more difficult to verify limits on deployment of a highly capable and fully tested system than to restrain such systems before testing is complete, extensive ASAT testing could thwart agreement on ASAT limitations—just as U.S. MIRV testing two decades ago guaranteed that it would be impossible to bar Soviet MIRV testing, leading to new Soviet weapons that pose significant threats to U.S. security today.

Excellent opportunities for agreement on ASAT arms control are available should the United States choose to pursue them. The Soviet Union has demonstrated its commitment to negotiated limitations on ASATs by holding to a unilateral moratorium on ASAT testing since 1983, and tabling several specific proposals to ban all ASAT testing and deployment. Soviet President Gorbachev has returned to the subject repeatedly, arguing that "we shall never be able to bridle the rabid charger of the arms race if it is let loose in outer space."

Unfortunately, however, both the Reagan and Bush administrations have so far rejected ASAT arms control in favor of ASAT development. ASAT supporters argue that U.S. ASATs are necessary to match the existing Soviet ASAT system and to deter its use, and to attack Soviet satellites that might play critical roles in future tactical battles. But the Soviet Union has offered to dismantle its ASAT system, and accepted on-site inspections, greatly reducing the need to "match" the Soviet capabilities. Moreover, if the Soviet Union develops more threatening ASATs in the absence of an agreement, ASAT deterrence may not be effective, for with the Soviet Union's lesser reliance on space and much greater launching ability to replace satellites lost in battle, Soviet leaders might have comparatively little to lose from a tit-for-tat space shoot-out. As for the threat from Soviet spacecraft, the United States must balance the potential threats future Soviet spacecraft might pose against the substantial dangers of an advanced Soviet ASAT threat to U.S. satellites in the absence of arms control. In the particular case of ocean-tracking satellites which might direct fire against U.S. fleets, it should be remembered that these spacecraft have been in use for two decades, and the U.S. Navy has long had other means of dealing with them, including electronic countermeasures and other tactics. Moreover, the Soviet Union has a variety of other means of monitoring U.S. naval movements, including aircraft, ships, submarines, and ground stations. And with the virtual collapse of the Soviet threat to Western Europe, and the new more defensive orientation of the Soviet Navy, the threat posed by these spacecraft has been further reduced.

ASAT limitations could take a variety of forms. The Reagan administration argued for no limits, or at most some "rules of the road" limiting the risk of satellite incidents in peacetime, and the Bush administration has not so far changed that approach, despite Scowcroft's earlier support for ASAT arms control. Others have called for permitting most types of low-altitude ASAT work, while banning tests of high-altitude ASATs, arguing that low-altitude limits would be difficult to verify, and that the need to shoot down some potential future Soviet low-orbit spacecraft is greater than the need to protect U.S. satellites in comparable orbits. Still others have argued that the most effective accord would be a complete ban on all further ASAT testing, coupled with inspected dismantlement of the existing Soviet system.

The complete ASAT ban offers several important advantages over the high-altitude-only approach. First, it does not write off the multibillion dollar U.S. investment in low-altitude satellites, particularly intelligence spacecraft. (The Bush administration's pursuit of ASATs designed to attack such spacecraft poses an interesting contradiction to its proposal for an "Open Skies" agreement.) These satellites are becoming increasingly expensive, and increasingly essential to U.S. military operations: Undersecretary of Defense for Policy Paul Wolfowitz warned Congress in 1989 that "we would be in very deep trouble if we lost everything that is in low orbit." A complete ban would also provide greater protection to high-altitude satellites, for once extensively tested at low altitudes, the newer small ASAT weapons the United States is developing—which the Soviet Union could probably match within a decade—could potentially be placed on larger rockets for high-altitude ASAT attacks. The "kill vehicle" intended for SDI's Exoatmospheric Reentry-Vehicle Interceptor System (ERIS), for example, could be placed on a somewhat upgraded Minuteman booster and carried to geosynchronous orbit in three hours, by one estimate. Moreover, the new Soviet acceptance of on-site inspection substantially improves the prospects for cost-effective verification of a complete ban on ASAT testing: inspectors could monitor the destruction of the existing Soviet ASATs and their associated facilities, and new monitoring devices now in development could be placed near major laser sites, reducing the cost of effective monitoring of laser ASAT tests.

In addition, it is low-altitude ASAT testing that provides the partial loophole in the ABM Treaty that some SDI tests seek to exploit; however, a ban on testing of space-based ASATs would do a great deal to eliminate that ambiguity even if other low-altitude ASATs were permitted.

No ASAT agreement would remove every threat to satellites. Nuclear-armed ballistic missiles will still exist, as will electronic jamming capabilities and possible covert ASATs. Unilateral measures to improve the survivability of U.S. satellites are therefore essential—and could do much to improve the effectiveness of any ASAT agreements that are negotiated. But negotiated measures to limit the threat are essential as well, for against an unlimited Soviet ASAT threat, planning for survivability will become inordinately uncertain and expensive. There is still time to avoid a space arms race, but that time may be running out.

systems and components. (See "Toward ASAT Arms Control," p.148, and "Toward a Zero-ABM Agreement" p.144.) While the other proposals described above could appropriately be agreed to as common understandings in the SCC, such a sweeping ban on space intercepts would be a major agreement, requiring congressional approval as either a treaty, a protocol, or an executive agreement.

THRESHOLDS ON SPECIFIC TECHNOLOGIES

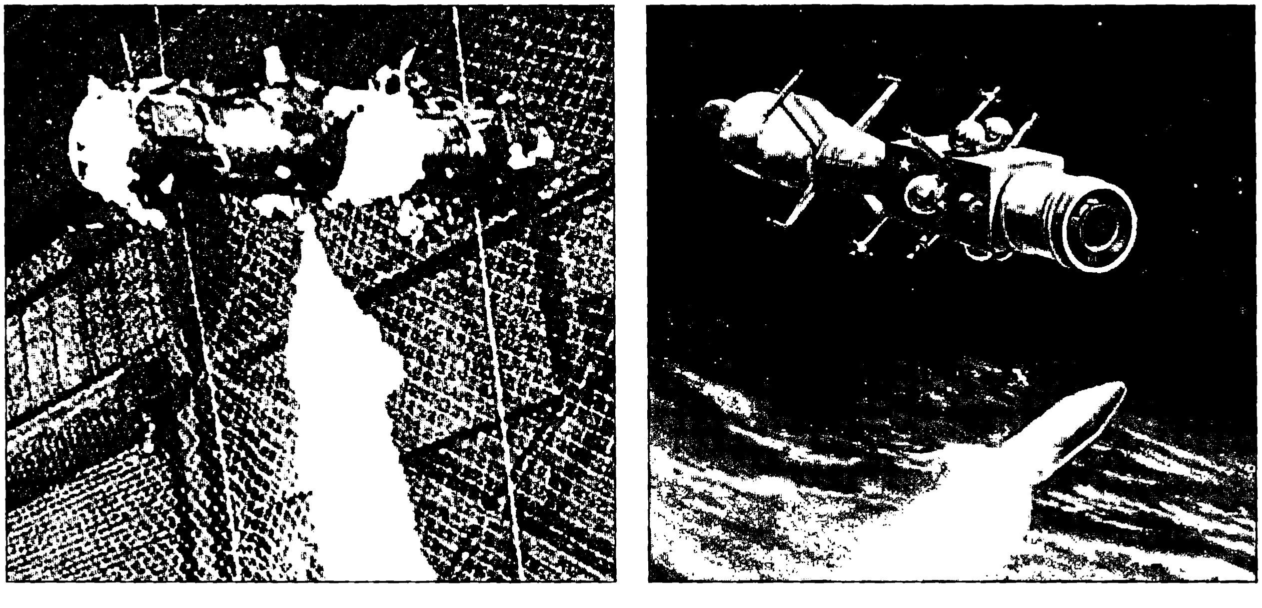
These broad limitations on testing would go a long way toward clarifying the ABM Treaty's limitations on space-based ABM technologies. But even the most sweeping limitations would leave some room for disagreement over specific technologies, particularly in cases where systems ostensibly having a legitimate non-ABM function (such as space-tracking sensors, for example) could appear to have an ABM potential.

Setting "thresholds" on the permitted capabilities of specific technologies—analogous to the 1972 limitations on all phased-array radars whose average power multiplied by their antenna area is greater than three million watt-meters-squared—is the primary approach that has been suggested for resolving such ambiguities. Such specific limitations would have to be designed carefully, so that engineers could not devise ways to test ABM capabilities by "designing around" the limits—by adjusting the power used in tests of a high-power laser to fit just below an agreed limit, for example. If the limits are set substantially below what is needed for a plausible missile defense, it will not be possible to gain adequate confidence in a system's ABM capability through such "work-arounds," particularly when the test modes are also constrained, as described above.

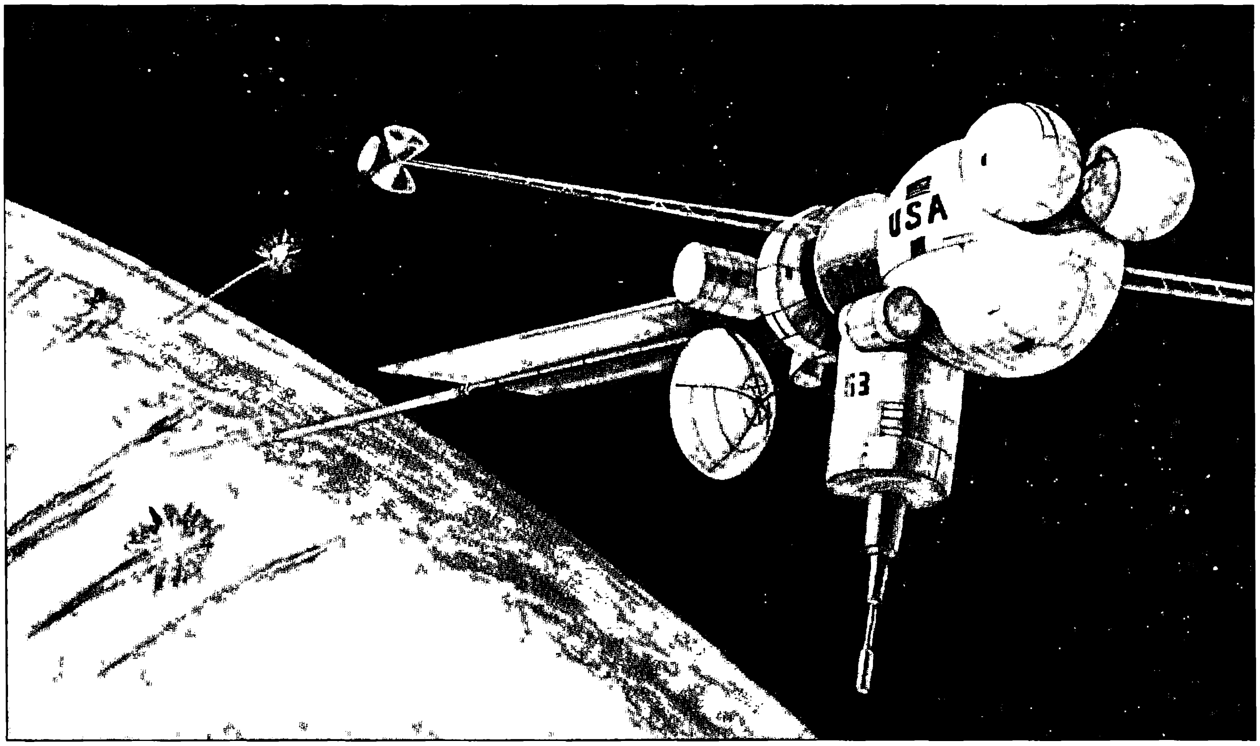
For some technologies, appropriate thresholds could only be monitored within a fairly wide range of uncertainty, particularly if monitoring is limited to national technical means alone. But in most cases the enormous gap between the capabilities necessary for ABM missions and those needed for non-weapon purposes will dwarf any monitoring uncertainties. While we may be uncertain that a specific threshold is being adhered to, there is little question that development and testing of a genuine and substantial space-based ABM capability would be obvious long before deployment began, giving ample time to respond. Taking such monitoring uncertainties into account, the best approach may be a two-tier system of thresholds: A relatively low threshold would identify a particular activity as cause for concern, requiring prior notice, discussion, and perhaps certain cooperative verification measures, with only activities above a much higher threshold banned outright.

Defining Space-Based ABM Interceptors

ABM and ASAT are the only plausible missions for space-based rocket interceptors. Under the current ABM Treaty, development and testing of interceptors



***Space Rockets**: The only missions for space-based interceptors, such as those shown here hovering in a laboratory test (left) and in space (right) are ABM and ASAT. New ABM Treaty clarifications might prohibit all space tests of such interceptors.*



Electromagnetic Gun: *New ABM Treaty clarifications might prohibit space-based railguns entirely. Ground-based railguns are under development for terminal ABM defense and other military applications, such as improved antitank weapons. The ban on testing non-ABM systems in an ABM mode is likely to be the primary restraint on adapting railguns developed for other purposes than for an ABM role.*

for the former mission would be prohibited, while those for the latter mission would be permitted. The differences between an ASAT interceptor and one designed for ABM will lie in the homing and interception system (where distinctions are unlikely to be verifiable) and in the rocket, which must be faster for a practical ABM than it need be for ASAT. SDI envisions space-based rockets with speeds of five to 10 kilometers per second: much slower interceptors would be ineffective for ABM, as an impractically large number would be needed in orbit for a militarily significant defense.

Some analysts have therefore proposed limiting testing of space-based interceptors to those that demonstrate speeds of less than perhaps one to two kilometers per second, far from that needed for an ABM capability. A more sweeping approach might be more effective, however: Since permitting continued tests of low-speed interceptors would allow development of homing systems to continue, and higher-speed rockets could be tested separately, it might be best to simply prohibit all testing of space-based interceptors, against either missiles or satellites. "Near-miss" tests—in which an interceptor homed in on a target but was programmed not to actually collide with it—would also be prohibited. Since space interceptors are unlikely to be the most survivable and cost-effective ASAT approach, such a ban could be implemented even if the two sides could not agree on sweeping ASAT limitations.

Railguns

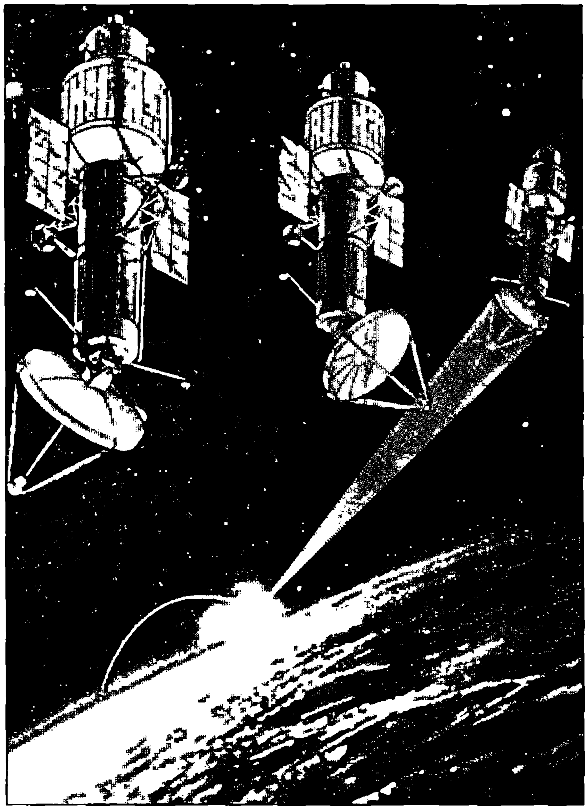
In the longer term, space-based homing projectiles might be propelled by electromagnetic railguns rather than rockets. Some potential civilian applications of such railguns have been suggested, such as large-scale mass transport through space, but such ideas remain little more than distant dreams. For the foreseeable future, an outright prohibition on space-based railguns should be acceptable, with some flexibility to discuss possible civil applications should they ever become real possibilities.

Such railguns are also under consideration as ground-based ABM systems designed for a last-ditch terminal defense. The current ABM Treaty permits development and testing, but not deployment, of fixed, land-based ABM systems and components "based on other physical principles"—a category which probably includes railguns. However, Article V of the ABM Treaty prohibits development and testing of "automatic or semi-automatic" ABM launchers, as well as "other similar systems for rapid reload of ABM launchers," a provision intended to bar rapid-fire systems such as the railguns now being designed. The parties will ultimately have to determine whether they wish to permit or prohibit development and testing of fixed, land-based ABM railguns.

Railguns and similar technologies may offer some promise for other military applications as well, such as more powerful tank guns, artillery, and ATBMs. Continued development and testing of such systems in the future is therefore likely, and in the long run, widespread deployments are a possibility. The prohibition on "testing in an ABM mode" is likely to be the primary restraint on adapting such systems to an ABM role.

Lasers

ABM lasers could be based in space, or the laser itself might be on the ground, with mirrors in space to reflect its beam to its targets. Unlike space-based interceptors, space lasers have a variety of potential nonweapon uses, including satellite-to-satellite communication links, submarine communications, spacecraft imaging, and the like. Hence, a viable treaty regime cannot simply ban all lasers from space, even if such a measure were verifiable (which it would not be): distinctions between ABM-capable lasers and others will have to be drawn.

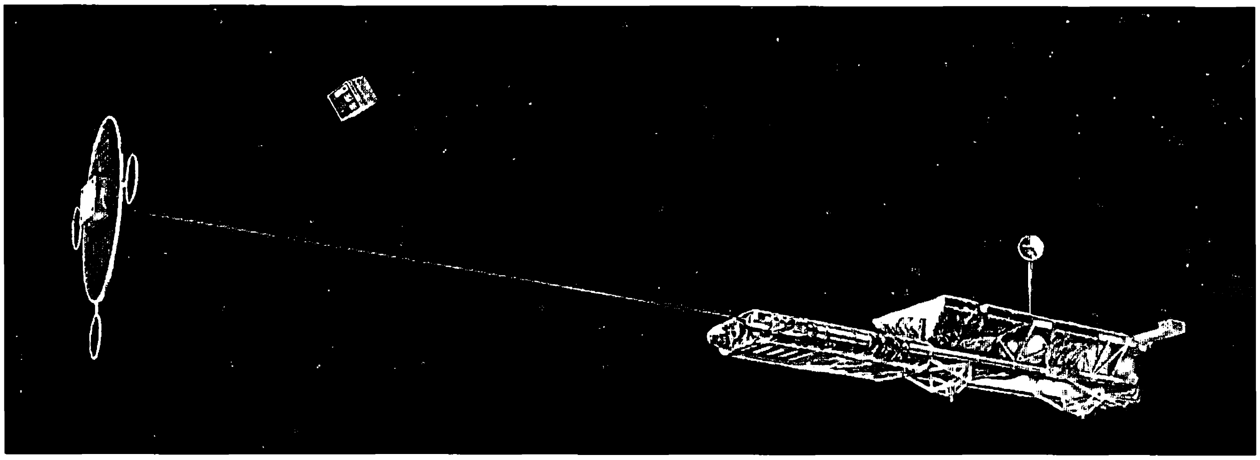


Laser Limitations: *Agreed limits on space-based lasers, such as the ones depicted in this artist's concept, might focus on laser brightness—determined by a laser's power and wavelength, and the size of the mirror used to focus the beam.*

Fortunately, the laser capabilities needed for nonweapon purposes are generally only millionths or billionths of those needed for an effective ABM system. The most important single parameter in assessing the potential ABM capability of a laser is its brightness—a measure of how much power the laser can focus into a narrow beam—which determines how rapidly it can destroy a particular missile at a given range. (Many other factors, such as the precision of its tracking and pointing, and how rapidly it can switch from one target to another, would also have a substantial impact on a laser weapon's ABM capability, but most of these other factors would be difficult if not impossible to monitor.) Brightness is generally expressed in "watts per steradian"—watts measuring the power of the beam, and steradians measuring the width of the cone into which the beam can be focused—and is determined by the laser's output power, its wavelength, and the size of its mirror. (For lasers designed to shatter their targets with a quick pulse, rather than warming them over a period of time, the equivalent measure is joules per steradian, in which the amount of energy in each pulse takes the place of the laser's overall power.)

To be effective at reasonable operational ranges against missiles equipped with some countermeasures—such as laser armor and reduced burn times—a space laser would need a brightness of roughly 10^{22} watts per steradian. But the ABM Treaty should limit much weaker lasers as well, for against current, unmodified U.S. and Soviet missiles, far less impressive lasers could pose a significant threat. To ensure that permitted lasers could not realistically shoot down even a single missile during its boost phase might require an upper brightness limit of 10^{15}-10^{16} watts per steradian, less than one millionth the brightness needed against a future missile threat. That standard, however, is more stringent than strictly necessary to maintain the effectiveness of the ABM Treaty regime.

Besides missile interception, the only missions which would require space lasers with even remotely similar brightnesses are other weapon applications—such as ASAT or aircraft attack—and "interactive discrimination," which would involve tapping, or warming, warheads and decoys with lasers in an attempt to find the genuine warheads. Studies by the American Physical Society and others indicate that such a discrimination task would require roughly the same brightness as would interception: hence any restriction



Beam Restraints: *The neutral particle beam Integrated Space Experiment shown in this artist's concept has been canceled, but a similar space test, code-named Pegasus, is now planned for the mid-1990s. New clarifications of the ABM Treaty might ban such particle beams from space entirely, or like lasers, might limit the brightness of their beams.*

on lasers capable of serving as ABM weapons would also limit laser discriminators. For ASAT, the most plausible near-term weapon application of space lasers, the necessary brightness would be 10-100 times less than the minimum needed to shoot down a single missile in the boost phase, if the laser was directed against current unhardened satellites at relatively short ranges. But to attack distant geosynchronous satellites or satellites equipped with substantial laser armor would require a brightness well into the ABM-capable range.

Hence, if the two superpowers wished to maintain the ABM Treaty's prohibition on testing of ABM-capable space lasers without banning ASAT lasers, a brightness limit of perhaps 10^{16}-10^{17} watts per steradian would be appropriate. To bar both ASAT and ABM lasers, the limit could be set thousands or even millions of times lower, without interfering with nonweapon laser missions.

Verification of such limits would depend on monitoring the individual components of laser brightness—power, wavelength, and mirror size. Each of these poses somewhat different issues for monitoring. Assessing laser power would involve substantial uncertainties, particularly in the case of ground-based lasers using space mirrors; the problem is complicated by the fact that the power of a laser can often be adjusted, within moderately broad limits. Cooperative verification measures such as "black boxes" installed near ground lasers to measure light scattered from the atmosphere could help substantially. For many lasers, wavelength is an inherent characteristic of the type of laser, making monitoring easy, but for others, such as free-electron lasers, the wavelength will be somewhat adjustable. Either ground-based or space-based ABM lasers will require very large space-based mirrors—four meters in diameter and up, substantially larger than the space mirrors likely to be required for any other tasks except perhaps future astronomical telescopes (the Hubble Space Telescope has a diameter of 2.4 meters). Indeed, limiting the maximum size of permitted space mirrors—to perhaps two to three meters in diameter—could be a useful additional restriction on laser ABMs. Mirror size could probably be judged roughly but adequately by the overall size of the satellite, or, better, could be subject to declaration and perhaps some constrained forms of on-site inspection prior to launch. Again, it should be remembered that the uncertainties in monitoring are likely to be dwarfed by the vast gap between the capabilities of plausible nonweapon lasers and those needed for a serious ABM capability.

Particle Beams

Like lasers, particle beams could substitute for ABM interceptors, or could assist in discriminating warheads from decoys. Particle beams could potentially also serve as potent ASAT weapons, but do not have the wide array of nonweapon applications lasers have. The brightness of a particle beam can be defined in much the same way as for a laser, and is determined in this case by the particle energy, current, and divergence of the beam. To destroy missiles by heating them, the particle-beam brightness required is likely to be similar to that discussed above for lasers, but a brightness as much as 1,000-10,000 times less might be adequate to disable current, unhardened missiles by destroying their internal electronics. In that case, however, the missile would usually give no obvious outward sign of having been disabled, and defensive planners are likely to be hesitant to rely on such an uncertain method of attack. The brightness needed for an effective discrimination system would probably be similar to that needed for thermal destruction of missiles, since the energy that must be deposited on each target is dramatically smaller but the number of potential targets is dramatically larger. As with lasers, the brightness needed to attack low-orbit satellites will be significantly less—for either mode of destruction—since satellites can be attacked at a slower pace from closer ranges.

> ***"The ABM Treaty does provide a path for compromise if both sides are ready to reach agreement. . . . If the United States is prepared to modify its position that all development and testing of space-based systems are allowed, and if the Soviet Union is willing to clarify further its positions on what level of research and testing should be allowed, major progress should be possible."***
> *—Brent Scowcroft, 1988*
> *President Bush's National Security Adviser*

If the two superpowers agreed that space-based ASATs should be banned along with space-based ABMs, it would make sense to prohibit all detectable particle beam operations in space, as with space-based interceptors. If room must be made for particle beam ASATs, a brightness limit of either 10^{14} watts per steradian (to prevent electronic kill of missiles) or 10^{17} watts per steradian (if only thermal kill was considered militarily significant) might be an appropriate limitation. In addition, some analysts have suggested limiting the particle energy of such beams, as lower-energy particles penetrate less deeply into targets and therefore might be simpler to shield against. Similar limitations might be placed on the operation of particle beams launched from the ground to operate in the lower reaches of space.

New Types of Sensors

As described in Chapter IX, the new ABM-capable sensor technologies now being developed pose critical challenges to the ABM Treaty regime. If development and deployment of some types of infrared sensors were left unrestricted, they could directly substitute for the large ABM radars that have been the long-lead-time items of past ABM systems, working in concert with already-developed ground-based interceptors to provide a ready base for rapid "breakout" to a prohibited nationwide ABM defense. Hence, as Harvard physicist Ashton Carter has charged, the authors of the current U.S. proposal to let all such sensors "run free" were "not watching over U.S. long-term military interests."

But controlling these technologies poses daunting challenges. Like the large ground-based radars of 1972, new types of sensors would be useful for early warning, verification, and space tracking as well as for ABM. And unlike LPARs, these sensors would be small (making them both harder to monitor and more rapidly deployable once developed), and in many cases would not emit monitorable radiation characteristic of their capabilities, as LPARs do.

Not all of the new potential types of sensors would have such worrisome implications. High-orbit satellites using short-wave infrared sensors to track missiles in the boost phase probably need not be limited, for they would have little ABM potential unless there were boost-phase weapons to go with them—a situation the limits described above should help to forestall. New laser radars and laser cameras could not search vast reaches of space for incoming missiles, the primary task of the largest ABM radars, and similarly may not require limitation. Lasers and particle beams for "interactive discrimination" also could not conduct wide-area searches, and in any case would be restrained by agreed limits on the use of such beams for missile interception, as described above. Space-based LPARs—unlike other types of space radars, such as those carried by Soviet ocean-tracking satellites and new U.S. intelligence satellites—are already prohibited for any purposes other than space tracking and verification. For those purposes they might be useful but would not be essential, and therefore the best approach to such space-based LPARs is likely to be a complete ban.

The most difficult and critical sensor issue is that raised by long-wavelength infrared sensors designed to track warheads and decoys in the midcourse phase of flight—whether based on satellites, on high-altitude aircraft, or carried into space aboard ground-based rockets. (Development and testing of rocket-launched infrared sensors would not be prohibited by the current treaty, but such rocket-borne sensors could fulfill many of the same roles as airborne or space-based sensors, and should therefore be included in future limitations.) It is these sensors that could potentially take over essentially all the tasks heretofore handled by LPARs, providing a substantial base for breakout. Limitations on these systems will be difficult but essential. In the end, no single restraint is likely to be sufficient: rather, an interlocking web of notification and data exchange measures, restrictions on testing, and capability restrictions will help ensure that such sensors do not undermine the ABM Treaty regime.

The most important restraints are likely to focus on limiting the testing of infrared sensors "in an ABM mode," while permitting limited uses for purposes such as intelligence collection, early warning, and space tracking. For radars, testing in an ABM mode is currently defined, in essence, as guiding an ABM interceptor in an attempt to intercept a strategic ballistic missile, or tracking the missile while another radar guides the interceptor. If, as mentioned earlier, the two sides could agree to a zero-ABM accord in which there would be no such ABM interceptor tests, the problem of ensuring that infrared sensors were not so tested would be solved.

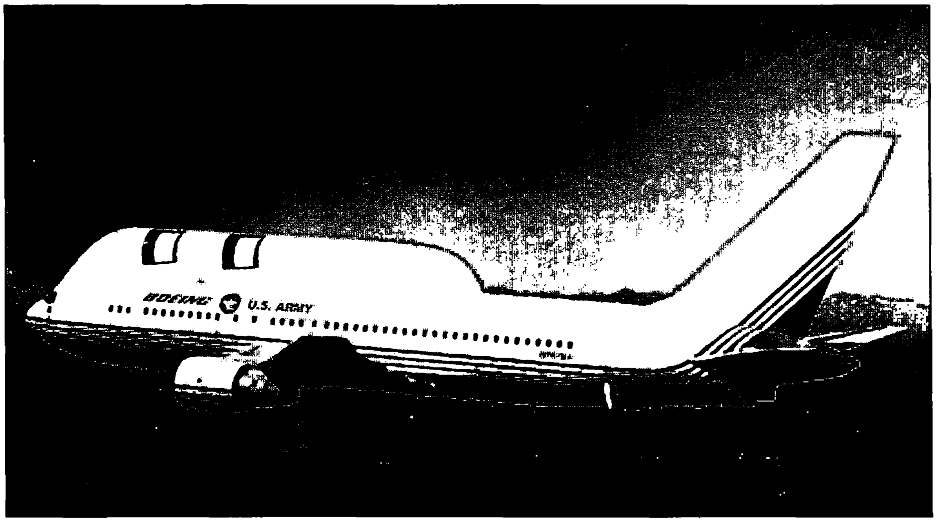
But as long as ABM testing continues, ensuring that such sensors are not tested in an ABM mode will pose greater difficulties than in the case of radars, because infrared sensors do not necessarily give any external indication that they are operating. A ban on encrypting or otherwise denying the telemetry and communications from such sensor platforms—as has now been agreed for strategic ballistic missiles in the START negotiations—would ease the problem substantially, if both sides accepted such a measure. But some officials in both superpowers are likely to raise security concerns over providing such information to the other side.

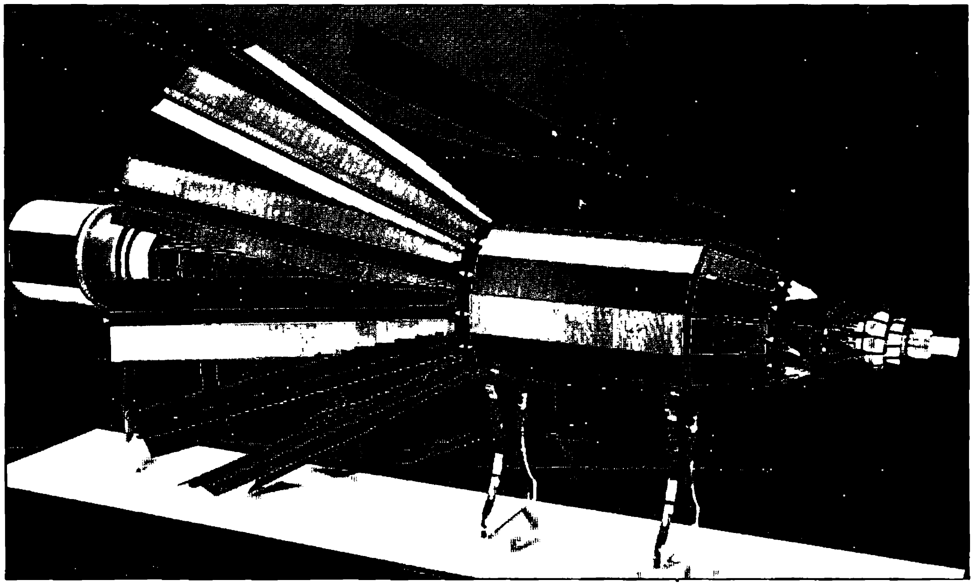
One alternative or additional approach would be to prohibit even the presence of potentially ABM-capable infrared sensors within plausible sensor ranges—perhaps 1,000 kilometers for aircraft, and several times that for potentially longer-range space-based or rocket-borne sensors—during ABM tests. To simplify the task of monitoring such a provision, each side would designate all infrared sensor platforms even remotely capable of playing an ABM role, based on agreed criteria. (Unambiguously non-ABM-capable sensors already used for such purposes as collecting engineering data during missile and ABM tests would not be restricted.) While monitoring specific capabilities of infrared sensors is likely to be difficult, potentially ABM-capable infrared sensors are likely to be large enough to make their simple presence detectable, deterring efforts to build "undesignated" sensors and conduct a major ABM test program with them. The U.S. Airborne Optical Adjunct (AOA) aircraft, for example, has a bulbous cupola and a large window to accommodate its sensor, making it easily identifiable, and at least the large window is likely to be necessary for all potentially ABM-capable infrared sensor aircraft. Similarly, ABM-capable satellite and rocket-borne long-wave infrared sensors are likely to require mirrors of substantial size.

In addition to limiting testing in an ABM mode, efforts could be made to restrict the capability of space-based sensors, to implement the ABM Treaty's ban on development, testing, and deployment of mobile sensors "capable of substituting for ABM radars." Unfortunately, however, an infrared sensor's ABM potential is likely to be determined in large part by nonobservable features such as the materials and design of the sensor's internal detectors, its computer processing capability, and the like. The size of the sensor mirror creates a potentially monitorable upper limit on an infrared sensor's capabilities, but the mirror sizes planned for SDI satellites are not significantly different from those needed for other purposes, such as space tracking and astronomy. It may be that the best that can be done is to agree to data exchanges and consultations concerning all spacecraft carrying large mirrors, to help ensure that they are not ABM sensors. Even such data exchanges may be difficult to agree on, given the extreme secrecy in which both sides have shrouded their military space programs.

Ultimately, the greatest reassurance about the ABM capability of infrared satellites is likely to be their severe vulnerability, and likely susceptibility to blinding by

Sensor Declarations?
Monitoring the capability of infrared sensors, such as that carried by the Airborne Optical Adjunct (right) is likely to be difficult, posing new challenges for the ABM Treaty regime. But the simple presence of a sensor large enough to be potentially ABM-capable is likely to be observable, deterring efforts to conduct a major ABM test program involving such sensors in secret—as suggested by the size of the bulbous cupola containing the sensor on this aircraft.





Space Reactor: *While the ABM Treaty does not limit power supplies, the treaty's restraints might be strengthened by a ban on orbiting nuclear reactors, such as the U.S. SP-100 reactor under development, pictured here.*

precursor nuclear blasts and confusion by decoys and other penetration aids. Even if the two sides agree to prohibit further development and testing of ASATs, in a nuclear conflict, low-orbit satellites will still be vulnerable to reprogrammed nuclear-armed ICBMs. As a general rule, the lower the orbit, the greater that vulnerability will be: it may therefore be desirable to require that all satellites carrying large mirrors (and all satellites designated by agreement, as described above) be deployed in low orbits—below 500 kilometers, for example—a limit analogous to the ABM Treaty's requirement that early warning radars be on the periphery of the country and oriented outward, where they would be particularly vulnerable to attack.

Space Nuclear Reactors

As it stands, the ABM Treaty places no limits on the power sources associated with ABM equipment. But prohibiting nuclear reactors in orbit could be a useful additional treaty-strengthening measure, as such reactors would be extremely useful—if not absolutely essential—to many of the possible space-based ABM weapons and sensors now being researched. An orbiting-reactor ban would have other benefits as well, restraining other potentially threatening uses of space nuclear power (such as the radar ocean-tracking satellites the Soviet Union has long used to track U.S. ships at sea, whose destruction is a primary impetus for the U.S. ASAT program), and removing the environmental hazards so graphically demonstrated by the 1978 crash of a Soviet space reactor, which spread plutonium over thousands of miles of Canadian territory. Reactors for deep-space missions, where solar energy is less readily available, could continue to be permitted.

PREDICTABILITY AND VERIFICATION MEASURES

Whatever restrictions on new or existing ABM technologies are ultimately agreed to, so-called national technical means of verification (NTM)—the combination of reconnaissance satellites, radars, signals intelligence, and associated technologies each superpower uses to monitor the other's military activities—will continue to provide the backbone of the ABM Treaty verification regime. But the Soviet Union's new willingness to accept cooperative verification measures such as on-site inspection creates opportunities for supplementing such technical means, potentially reducing the cost and difficulty of effective verification substantially.

Some limited cooperative measures, such as data exchanges on planned ABM activities and invitational visits to selected ABM-related sites, have already been tentatively agreed upon in the ongoing Defense and Space Talks. These measures might be broadened to include a more comprehensive series of data exchanges, notification, and cooperative verification measures. Ideally, they should also be extended to cover non-ABM systems with capabilities in grey areas that might raise concerns, such as large space sensors, antitactical ballistic missiles, and the like. As suggested earlier, the best approach is likely to be to set a rather low set of capability standards beyond which extensive consultations, data exchanges, and cooperative verification measures would be required: Only beyond a much

START Ratification and The ABM Treaty

Despite the Soviet decision to accept a strategic arms reduction (START) agreement without a specific accord on the meaning and future of the ABM Treaty, the indissoluble link between reductions in offensive strategic forces and limits on the defenses those forces must overcome makes it likely that the ABM Treaty will play a major role in the ratification of START.

As of mid-1990, it appears that the START treaty will be presented to the Senate with the Bush administration still insisting on the discredited broad interpretation, and the Soviet Union insisting that any violation of the traditional view would be grounds for withdrawal from a START agreement. Senator Sam Nunn (D-GA), chairman of the Senate Armed Services Committee, and others have already questioned this arrangement. In considering substantial offensive reductions, the Senate is likely to insist on clarity in the defensive restrictions—both to make clear what circumstances the Soviet Union would consider grounds for withdrawal from START, and to ensure that the limits on Soviet ABM defenses that might undermine reduced U.S. offensive forces are well understood.

A strong majority of the Senate supports the traditional interpretation of the ABM Treaty. If presented with a START agreement with interpretation of the ABM Treaty still in dispute, the Senate has several options. It could approve the START accord without explicit action on the ABM issue, but this would leave open the possibility of a START-threatening implementation of the broad interpretation at some time in the future; even if an understanding was reached with the Bush administration not to pursue the broad interpretation, future administrations would not be bound, and the ultimate resolution of the issue would remain uncertain. At the other extreme, the Senate could refuse to give its advice and consent unless the negotiators return to the table and resolve the ABM interpretation issue. Such a step is unlikely, however, as it carries the potential for prolonged delay.

Perhaps the most likely Senate approach to resolving the issue is to attach attach a condition reaffirming the traditional interpretation of the ABM Treaty to its resolution of advice and consent to START. Attaching such a reservation requires only a simple majority, not a two-thirds vote. The Senate took a similar approach with the Intermediate-range Nuclear Forces (INF) Treaty, attaching a condition on the general issue of treaty interpretation which both supporters and opponents agreed had the effect of further strengthening the case for the traditional interpretation of the ABM Treaty. Though attaching the reservation provoked a prolonged partisan battle, the treaty was ultimately given overwhelming bipartisan approval, and was accepted by the Reagan administration with the reservation. With Reagan out of the White House and perceptions of the Soviet threat rapidly declining, an ABM-interpretation condition would likely cause even fewer problems for START; those few senators who might be provoked to vote against a treaty carrying such a condition are unlikely to support the START agreement in any case.

> ***"Papering over disagreements about strategic defenses is a prescription for real trouble down the road."***
>
> *—Harold Brown, 1987*
> *Former Secretary of Defense*

Nonetheless, presenting START to the Senate with the ABM issue unresolved inevitably carries with it the risk of provoking a renewed Senate ABM battle, which could delay approval of the START treaty. President Bush could avoid these complications (and carry out his constitutional responsibility to present treaties whose terms and implications are clear) by reaffirming the traditional interpretation of the ABM Treaty.

With opportunities for deeper reductions and other limitations in a START II accord now opening, firm agreement on the meaning and future of the ABM Treaty will be even more essential. The greater the clarity of missile defense limits, the less will be the need for either superpower to maintain substantial extra offensive forces to hedge against a potential deployment by the other. Whether through action by the president or by the Senate, the United States will have to return to the basic principles of the ABM Treaty as the foundation for seizing the new opportunities of a new age.

higher set of limits would activities actually be prohibited. All weapons and sensors in the grey area where consultation is required could be "designated," as described above in the case of infrared sensors.

Specifically, a broadened regime of cooperative verification and predictability measures could include some or all of the following:

Data Exchanges. As already agreed, the sides could exchange comprehensive data on plans for all ABM activities past the research stage, and conduct annual or semi-annual audits of the exchanged data. Data on selected ABM research activities could be exchanged as well, along with data on planned development, testing, deployment, modernization, and replacement of designated grey-area technologies. In selected cases, the sides could exchange data on the specific capabilities of particular systems, to clarify their potential ABM role. Such data exchanges have been a successful part of the INF verification regime, and have helped resolve some past arms control compliance concerns: for example, when the United States expressed concern that the Soviet Union might be constructing new missile silos prohibited by SALT I, the Soviet Union explained in the SCC that the silos under construction were not missile launchers but command posts, and provided data that settled the issue.

Notifications. The sides could agree to provide prior notification of all ABM tests and most types of operations of other designated technologies. Such notifications—also incorporated in the INF verification provisions—would permit the other side to concentrate its monitoring resources on the scheduled tests. Similarly, the sides should agree to prenotification of all space launches of designated grey-area items, with data exchanges as to their purpose. Such a measure would undoubtedly raise security concerns in some quarters, particularly in the case of reconnaissance spacecraft, where both sides still attempt to maintain prelaunch secrecy as to both launch times and satellite roles. But since U.S. journalists are almost always able to decipher such basic facts before launches of U.S. satellites take place, it is hard to imagine that such "secrecy" actually impedes Soviet intelligence collection to any significant degree.

Noninterference with NTM. The ABM Treaty already bars interference with monitoring by national technical means, as well as "deliberate concealment measures." These provisions could be extended by prohibiting encryption and other forms of denial of telemetry information and communications from ABM tests and other prenotified activities. As mentioned above, some would also raise security concerns over this measure. In general, however, if the Soviet Union accepts such measures, the United States will gain more than it will lose through increased openness.

Cooperative Enhancement of NTM. In the INF Treaty and the START negotiations, the United States and the Soviet Union have agreed to limited measures to make monitoring easier, such as opening the roofs of missile shelters. Similar measures could improve monitoring of ABM and designated grey-area technologies.

On-site Inspections and Test Observations. The Soviet Union has now agreed to on-site inspections of declared sites in a wide range of arms negotiations. Although the ABM Treaty does not require such inspections, the Soviet Union permitted a U.S. congressional team to examine the Krasnoyarsk radar in 1987, permitted an official U.S. inspection team to examine parts of dismantled radars at Gomel and Moscow that the United States had raised questions over, and later permitted a team to confirm the destruction of those remaining parts. To supplement NTM, the two sides could agree to a wide array of inspections of ABM systems and components and designated grey-area items at declared sites.

Strictly limited prelaunch inspections of certain types of satellites might also be useful. Here it would appear that with some creativity, inspection protocols could be designed that would provide significant verification tools while mitigating some of the most troubling security concerns such inspections would raise. For example, displaying a satellite mirror while shrouding the rest of the spacecraft would give away little information beyond the size of the mirror. There is precedent for such shrouding of non-treaty-limited items in the inspection procedures agreed under the INF Treaty and those being developed for the START negotiations.

In addition, it would be useful to arrange cooperative monitoring of notified tests, including ground or air observers. The sides might also agree to allow each other to operate agreed types of monitoring equipment at test sites, as they have agreed in the nuclear testing talks: "black boxes" installed at ground-based laser sites could examine light scattered from the atmosphere to monitor laser operations and measure laser brightness; analogous systems might even be put directly on laser or particle-beam satellites, dramatically reducing the cost of monitoring their capabilities. Similarly, small minimally manned radars and optics facilities might be set up at ABM test ranges to monitor ABM tests.

Clearly, the array of verification measures that could be imagined is broad. Most of these measures could quickly be agreed to as executive agreements, without requiring congressional approval, as similar notification and data measures on offensive strategic arms and chemical weapons have been. Not all of these measures will be necessary. As with any treaty regime, the goal of verification is not 100 percent assurance that no limit is ever even slightly breached, but rather a verification system effective enough to ensure that any violation that would have a substantial impact on the military balance could be detected in time to respond effectively. By that standard, the ABM Treaty is effectively verifiable today, and with the combination of NTM and cooperative measures that will be available in years to come, will remain so for the indefinite future.

The bottom line is that the claim that advancing technology has rendered the ABM Treaty impotent and obsolete is simply a myth. Appropriate restrictions and monitoring measures are available to ensure the effectiveness of the ABM Treaty well into the twenty-first century. All that is needed to ensure that the ABM Treaty continues to fulfill its promise is the political will to do so.

CONCLUSIONS

President Ronald Reagan announced the SDI program as "a vision of the future which offers hope"—hope, as he often said, of lifting the terrible threat of nuclear war from mankind's shoulders forever. Unfortunately, it was a false hope, an empty promise. No foreseeable defense will be able to protect the population of either the United States or the Soviet Union from the devastating destructive power of nuclear weapons. Nationwide missile defenses designed for more limited purposes would not fundamentally reduce the nuclear threat we all face, but would inevitably provoke a new technological race between offensive and defensive forces on both sides, destabilizing the current nuclear balance and extending the arms competition into space. The faith that we can find security through technology alone is a false one, betrayed again and again over the course of the nuclear age. As Brent Scowcroft warned before taking office as President Bush's national security adviser: "We cannot, in any sense, 'go it alone' with SDI and expect technical fixes to solve our security problems."

> ***"The ABM Treaty is the absolute foundation of offensive arms control. Without that treaty, the lid will be off."***
>
> *—Robert McNamara, 1985*
> *Former Secretary of Defense*

With the walls of Cold War confrontation crumbling at a dramatic pace, and with the most sweeping arms reduction agreements of the nuclear age now in sight, it should be absolutely clear that now is not the moment—if there ever was one—to embark on such a path of confrontation. Rather, now is the time to seize the new opportunities, reaffirming and strengthening existing agreements—of which the ABM Treaty is the keystone—while pursuing new accords that offer the potential to drastically reduce the nuclear danger. The ABM Treaty provides the necessary building blocks both for START and for subsequent agreements that could go still further in cutting back and stabilizing the offensive nuclear arsenals of the United States and the Soviet Union. In that sense, the ABM Treaty is truly the foundation for the future—a future that offers genuine, not illusory hope; a future in which negotiation and cooperation can take the place of confrontation, improving security while beginning to lift the nuclear shadow.