

FAS SPACE POLICY: THE WE WON'T IF YOU WON'T APPROACH

We are presently poised to the brink of an arms race in space, that will greatly increase the likelihood of war here on Earth. If we are to avert this, we must act quickly, and effectively. There is both the opportunity and the need for the United States to adopt a series of mutual declaratory policies that will avert an arms race in space. The most important and pressing of these would be a mutual agreement for a moratorium on the testing of anti-satellite (ASAT) weapons.

There is good precedent for the use of mutual declaratory policies to regulate the superpower arms race. We recently marked the twentieth anniversary of the Partial Test Ban Treaty of 1963. That treaty was preceded by a test moratorium, established in 1958 by mutual declarations by the Soviet Union and the United States. The speed with which the treaty was concluded was in part a product of the experience gained during this mutual test moratorium.

The United States has tried two approaches to controlling the space arms race. When we dismantled our early nuclear-tipped ASAT in 1975, some people hoped that this example of unilateral restraint would lead to similar restraint on the part of the Soviets. These hopes were disappointed shortly thereafter when the Soviets resumed testing their ASAT, after a pause of several years. The US and USSR held three negotiating sessions in 1978 and 1979 to consider a possible ban on ASAT's. Given the current political climate, it seems very unlikely that such negotiations will be resumed within the next few years. Even if we were to resume talks by 1985, the continued testing and development of ASAT's and other space weapons would greatly complicate the negotiations.

If we are to avoid an arms race in space, we must act now before it gains irreversible momentum. The six measures we propose require no protracted negotiation. They are subject to ready and unambiguous verification. The burden falls equally on both sides, and the United States retains the ability to act quickly should the Soviets renounce their commitments. These measures can be initiated by a simple Presidential announcement, and the commitments would be honored by the US so long as the Soviets made and kept these same commitments.

These measures would not require ratification by the Senate, but the Congress can play a key role in the effort to implement them, particularly through the budget process. These mutual declaratory policies are not a substitute for a treaty, but they are a much needed prelude, and perhaps an important precondition.

1. A MUTUAL MORATORIUM ON IN-SPACE TESTING OF ANTI-SATELLITE (ASAT) WEAPONS

A mutual moratorium on ASAT testing would slow the momentum of the arms race in space, as well as set the stage for negotiations limiting such weapons. If the new American ASAT is tested to operational readiness, the verification problems it presents will preclude a negotiated ban on ASAT deployment, which should be a major goal of the negotiations. Given the great difficulties that such

(Continued)

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negotiations will face, and the time needed to negotiate and ratify such a treaty, it is important that the goals of an ASAT Treaty not be undercut by continued testing. The present Soviet ASAT has very limited capabilities, and poses no real threat to our national security. Thus a ban on testing would not place the US at a disadvantage. If the Soviets were to resume testing, a continuing development program would allow the American ASAT to be tested in short order.

2. A MUTUAL PLEDGE NOT TO PLACE ANY DIRECTED ENERGY WEAPONS IN SPACE

The 1972 ABM Treaty prohibits space-based directed energy weapons, such as lasers, for use against targets such as ICBM's. Directed energy weapons for use against other types of targets, such as satellites or bombers, are not prohibited. But it would be very difficult in practice, both technically and politically, to differentiate space-based directed energy weapons according to purpose. If either country were to orbit a small ASAT laser, the other side would very likely regard this move as a violation of the ABM Treaty, creating great pressures for its modification or abrogation.

3. A MUTUAL PLEDGE NOT TO INTERFERE WITH ANY OF THE OTHER COUNTRY'S MILITARY SATELLITES

At present, only national technical means of verification are protected from attack, and there is no accepted definition of just which satellites this includes. A mutual pledge not to interfere with any of the other country's satellites would resolve this ambiguity, while extending this protection to other important military satellites.

4. A MUTUAL EXCHANGE OF SPACE CREWS

Both the US and Soviet space programs have invited individuals from other countries to participate as members of flight crews, excluding each other. The extension of this

international cooperation to the two major space powers, with US astronauts flying on the Salyut space station and Soviet cosmonauts flying on the Shuttle, would reduce mutual suspicions concerning the military character of these systems, and pave the way for more extensive exchanges and cooperative activities. The use of existing exchange programs would avoid the cost of technology transfer problems that arose in the Apollo/Soyuz mission.

5. ESTABLISHMENT OF DIRECT COMMUNICATION LINKS BETWEEN AMERICAN AND SOVIET MASTER SATELLITE CONTROL FACILITIES

There have recently been several proposals to upgrade the existing hotline link between the White House and the Kremlin to include Soviet and American military command centers. Establishing similar links between master satellite control centers would provide a means to resolve questions concerning satellite malfunctions, reducing suspicions of attacks on satellites, as well as to facilitate maneuvering satellites to avoid collisions in space.

6. REVERSAL OF PRESIDENT REAGAN'S STAR WARS STRATEGY, AND A FURTHER STRENGTHENING OF THE 1972 TREATY LIMITING ANTI-BALLISTIC MISSILES

The Reagan Star Wars initiative threatens to renew the arms race in ABM systems, as well as to accelerate the offensive arms race, without protecting the nation's population from nuclear attack. It will lead to the abandonment of the ABM Treaty, our most beneficial and enduring arms control achievement. Instead, the President should be working to further strengthen the ABM Treaty, by closing loopholes, resolving ambiguities, and further restricting the development of ABM test facilities with significant ASAT capabilities, with the eventual goal of banning all testing against targets outside the atmosphere, whether satellites or re-entry vehicles.

—John Pike

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FAS HIRES SPACE POLICY SPECIALIST

FAS has hired a fourth senior staff member to help shape its space policy. John Pike, formerly Research Director of the Institute for Security and Cooperation in Outer Space, joined the staff in May. He has prepared, in consultation with other FAS specialists, the six point program of "mutual initiatives," summarized above, on which FAS will be working as a necessary prelude to—and possible substitute for—the much more difficult to achieve treaties.

As part of his duties, Pike convenes weekly a Space Policy Working Group which contains interested specialists on Capitol Hill. At monthly intervals, larger groupings of representatives of interested groups will similarly be convened to be updated on space policy.

Pike would welcome receiving letters or calls from interested FAS members, and other scientists, who would like to work with him on space policy. Send reprints of your work on space policy, and for those persons who seek research topics and problems in space policy, Mr. Pike has a number of issues he wishes to have researched.

The Search for a Nuclear Sanctuary (I)

Millions of dollars are pouring into a series of programs that might one day recapture U.S. strategic superiority

Obviously, if we are able to destroy incoming missiles effectively, I don't think it's destabilizing. I think it would be extremely comforting.—Secretary of Defense Caspar Weinberger

If a small group of scientists is successful, the United States will by roughly the year 2000 have the capability to attack the Soviet Union without fear of devastating nuclear retaliation. It will do so by erecting a shield of sophisticated antiballistic missile systems, while simultaneously exploiting ingenious mechanisms designed expressly to ruin antiballistic missile systems erected by the Soviets.

President Reagan, in a speech last March, lent his blessing to this effort, calling it "a vision of the future which offers hope." As a result, the Pentagon is likely to add hundreds of millions of dollars to the existing annual research budget of \$2.5 billion. The technical directors of the program will decide by late summer exactly how much, and how it will be spent. But more funds will certainly be applied to the development of optical sensors, high-speed projectiles, mirrors, lasers, missile interceptors, ablative materials, and warhead decoys—which together might permit the United States to wield both a sword and a shield.

Yuri Andropov, the Soviet leader, is incensed about the program. Speaking of the United States, he said recently that "the intention to secure for itself the possibility of destroying with the help of the ABM defense the corresponding systems of the other side, that is of rendering it unable to deal a retaliatory strike, is a bid to disarm the Soviet Union in the face of the U.S. nuclear threat." Similar conclusions have been drawn by politicians and newspapers in Europe, as well as by a substantial portion of the U.S. scientific community.

Several prominent Administration officials, including Secretary of Defense Caspar Weinberger, have attempted to allay this concern by suggesting that the deployment of missile shields by both countries will lead to peace, not war. "I would hope and assume that the Soviets, with all the work they have done and are

doing in this field, would develop about the same time an effective defense, which would completely remove these missiles and the fears they cause," Weinberger says.

What Weinberger does not admit is that in many of the key technologies necessary for an effective defense, the United States may be years ahead of the Soviets. Many authoritative but less visible Pentagon officials admit substantial U.S. superiority. More important, Pentagon efforts in this area are not confined to peaceful defense. A series of low-profile government programs has been established to anticipate Soviet defensive technologies and prepare the means to defeat them. The managers of these programs openly predict that Soviet defenses will be useless if deployed simultaneously with U.S. defenses.

The first task in pursuing this strategy is to develop a foolproof antiballistic missile system—an achievement that will require many billions of dollars, as well as nearly miraculous technological breakthroughs. Although the precise components of such a system will not be determined for a decade or so, top military officials favor a three-tiered approach. Robert Cooper, director of the Defense Advanced Research Projects Agency (DARPA), recently told the Senate Armed Services Committee that "the only way of accomplishing the President's purpose" would be to erect a system capable of assessing and attacking Soviet ICBM's repeatedly, throughout their flight. Officials say that the initial missile defense gauntlet will probably be a laser capable of attacking Soviet missiles within a few minutes after their launch; the second defense will be a long-range interceptor that will collide with warheads just outside the earth's atmosphere; and the third will be a short-range interceptor, with either a nuclear or nonnuclear warhead, to knock out Soviet warheads that leak through the other defenses.

Many imaginative ideas for a laser system have been put forward, but only two seriously interest weapons officials at the moment. One, which is highly touted by presidential science adviser George Keyworth, would consist of sev-

eral hundred enormously powerful lasers, each operating at or near the visible light spectrum, dispersed throughout the countryside. The lasers would be fired at huge flexible mirrors, which would be launched in hundreds of missiles on warning of a potential attack. The mirrors would refocus the beams, making corrections for atmospheric disturbances, and refract them onto the skins of Soviet booster rockets. Neither the mirror nor the lasers nor the deployment system has yet been designed or constructed.

A second concept, which has been suggested to President Reagan by Edward Teller, involves the construction of hundreds and perhaps thousands of lasers powered by low-yield nuclear bombs. Like Keyworth's mirrors, the lasers would be positioned atop missiles and launched into space on warning of a potential Soviet attack. When the bombs are detonated, the radiation they create would supposedly slice through Soviet boosters shortly after their launch. Hans Bethe, a Nobel laureate at Cornell who is generally critical of antiballistic missile concepts, says that "this is the one and only one proposal that scientifically makes sense." At Teller's invitation, Bethe recently visited Lawrence Livermore National Laboratory, where the idea is under investigation, and discovered that "the physics they have done—the purely theoretical studies and designs—seemed very well done. But of course such a device is a long way from actually working, even in a test circumstance, and to translate this into an operational device is a fantastic business." To name just a single drawback, each laser would self-destruct upon detonation, so there would be no prospect of firing a second time.

A third concept, which has attracted a great deal of publicity but excited little or no interest in the weapons bureaucracy, is advanced by a group known as High Frontier, directed by Lieutenant General Daniel Graham, a former director of the Defense Intelligence Agency. Graham envisions more than 400 satellites in permanent orbit, each armed with missile interceptors that use infrared sensors to home in on Soviet boosters and destroy

them through high-speed collisions. Graham claims that this system could be deployed within a decade, using equipment available now. But John Gardner, the director of defensive systems at the Pentagon, says that he and others have serious reservations about its vulnerability to Soviet attack or relatively simple countermeasures. Teller also dislikes it. "Pre-deployment in space will not work," he says.

According to existing plans, the Pentagon will spend roughly \$2.6 billion over the next 5 years, investigating a variety of laser systems as well as less promising particle beam ideas. On 23 March, Major General Donald Lamberson, who manages the Defense Department's directed energy weapons technology program, told the Senate Armed Services Committee that "a great amount of thought went into [this] plan" and that he "would not recommend an acceleration at this point." Later that day, President Reagan, who had neglected to consult with Lamberson—or even to give him advance notice—suggested on national television that the program needed more attention. Consequently, there will be a substantial acceleration anyway.

Millions of dollars are also being spent on the Pentagon's High Altitude Defense System Program, which would form the second tier of a missile defense. Under this program, the Army is conducting a series of Homing Overlay experiments, in which an interceptor attempts to collide at high speed with a simulated warhead above the earth's atmosphere, using ground-based radar and longwave infrared sensors aboard a series of specially equipped aircraft roving beneath the projected warhead path. The first two tests, on 7 February and 28 May, were failures, but additional tests are scheduled for later this year.

The third and final tier of an antiballistic missile system will probably be a series of short-range interceptors, each capable of emerging from concealment to destroy enemy warheads within seconds of their impact. Although it would be fairly straightforward to arm the interceptors with nuclear bombs, the Pentagon is investigating the possibility of nonnuclear warheads that could dispense a hail of pellets or shrapnel. At present, the Pentagon plans to spend \$7.2 billion on the second and third tiers of a potential antiballistic missile system over the next 5 years, with the bulk of it intended for the design and engineering of better computers, radars, optical sensors, and short-range nonnuclear interceptors. Major General Grayson Tate, who manages the ballistic missile de-

fense program for the Army, notes that "there is a specific pot of money that is allowing us to go forward with . . . [preparations] to have a system in the field in the near future," using existing technology. The money was appropriated by Congress in response to Defense Department fears that the Soviets could on short notice abrogate a treaty barring antiballistic missile systems, signed in 1972.

Each of the ideas for such a system suffers from technical defects that may render a perfect or near-perfect defense impossible. Short-range interceptors may be incapable of destroying more than half of the missiles in a potential Soviet attack. Some scientists claim that long-range interceptors, which operate outside the earth's atmosphere, may be



Major General Donald Lamberson

"We do not know what these systems will look like . . . [or] cost."

easily fooled by decoys. Critics such as Richard Garwin and Sidney Drell assert that more advanced systems—such as Teller's x-ray lasers or Keyworth's mirrors, intended for quick deployment on warning of a Soviet attack—will be unable to reach a sufficient altitude above the earth to be effective; the systems might also be vulnerable to Soviet spoofing, which would result in their deployment when no real aggressive action is threatened. As to the High Frontier idea, Daniel Graham acknowledges that his system "is designed to go automatic if there is a massive attack," and that "you always have to worry about a mechanized device somehow malfunctioning." The worst that could happen, he says, is that "one day you might shoot down something that would annoy the hell out of the Soviets. But what a better situation than today's world where if somebody fires a nuclear missile, there is nothing that can happen until it hits where it's going." Obviously, the Soviets may disagree.

All of the concepts rub up against technical uncertainties in the area of tracking and pointing, as well as operational uncertainties stemming from the speed at which they need to operate. Cooper says that "currently we have no way of understanding or dealing with the problem of battle management in a ballistic missile attack ranging upward of many thousands of launches in a short period of time." Major General Donald Lamberson, who manages the Defense Department's directed energy weapons technology program, acknowledged last March in congressional testimony that "we do not know what these systems will look like; we do not know what they would weigh; [and] we do not know what they would cost." The only estimates made thus far range between astronomi-



Edward Teller

Believes that "pre-deployment in space will not work."

cal (\$100 billion) and horrific (\$500 billion).

Uncertainties such as these have led experts such as George Rathjens of MIT to suggest that "the President is ill-informed on military matters, perhaps out of touch with the scientific community." Noel Gayler, a former director of the National Security Agency and former deputy chief of naval operations, recently told a congressional subcommittee that "what we are observing is the will to believe, and it is irreducible. People will believe in hopeful things. Cancer sufferers still go to Mexico and get a shot full of laetrile, and this is that kind of operation."

Weinberger, on the other hand, says that he sees no reason why a total missile defense cannot be made to work if sufficient effort is applied. "I think it's a noble cause and one that certainly needs doing and one that I'm confident American ingenuity can solve. . . . Whether or not we have a majority of scientists at the moment who say it can be done

within a number of years is unimportant."

Some of Weinberger's confidence may stem from the substantial advantage that the United States has over the Soviets in the technologies critical to an effective defense. According to a recent report by Richard DeLauer, the under secretary of defense for research and engineering, the United States is equal to the Soviets in directed energy technology, but superior in virtually every other technology needed to fashion a working antiballistic missile system, including computers, optics, automated control, electro-optical sensors, microelectronics, propulsion, radar, signal processing, software, telecommunications, and guidance systems.

George Keyworth, the President's science adviser, lists this superiority as a principal justification for developing an antiballistic missile system. "I see this shift [from offensive to defensive weapons] as a decided advantage to the West in maintaining a stable peace," he recently told an aerospace manufacturers convention. "The reason stems from the superiority we and other Western countries have over the Eastern bloc in terms of industrial capacity and industrial base." He went on to say that the Soviets

"have to play catch up when it comes to advanced technology"—a circumstance that the United States can exploit by continually operating "at the knowledge frontiers. In that way, by the expedient of always staying several steps ahead, we can thwart even the most aggressive attempts by adversaries to keep up."

The U.S. advantage in short-range antiballistic missile systems, which operate within the atmosphere, is particularly large. At present, the Soviets depend on a system that was first deployed around Moscow in the 1960's, consisting of several dozen interceptors with nuclear warheads, and a series of large, outmoded radars surrounding the city. Because the system is obviously of little value in defending against a U.S. attack, Western intelligence experts have long expected that the Soviets would improve it by constructing newer, more survivable radars and other components. They were astonished several years ago when the Soviets instead decided to construct a single, enormous, highly vulnerable radar at Pushkino, 35 kilometers north of Moscow. Richard Ruffine, a Pentagon analyst who specializes in antiballistic missile systems,

says that "initially there was speculation that it was a pyramid; or perhaps Brezhnev's tomb—it was so unlikely. It is not a good way to build a system." Ruffine says that the radar, together with other modest improvements, makes the Soviet system only slightly better than what the United States developed 15 years ago under the Safeguard program. Everyone concedes that U.S. scientists have made significant progress since then.

The U.S. effort might be damned whether it succeeds or not. If a workable defense is never constructed, a lot of time and money will have been squandered. If by some stroke of luck it eventually proves successful, the Soviets will undoubtedly be at an enormous strategic disadvantage. Knowing this in advance, the Soviets might be tempted to initiate a preemptive strike, so as to eliminate the prospect of nuclear subjugation. And finally, a danger always exists that an ineffectual system would be deployed anyway, providing a leaky umbrella for more provocative U.S. behavior.

—R. JEFFREY SMITH

EXCERPT from "U.S. Blundering into a Swamp", by Carlos Fuentes,
published in the Manchester Guardian Weekly, July 31, 1983:

"Make no mistake about it: an American blitzkrieg or surgical operation against Nicaragua is no longer possible. The people and the army would fight inch by inch, take to the mountains and jungles and hold down United States forces for years to come, draining resources from other, more important needs and permanently damaging both relations between the United States and the rest of Latin America, and between the people and the Government of the United States. This would indeed be a great victory for the Soviet Union: the second Vietnamization of American foreign and internal politics—this time in the United States' sphere of influence... The solution lies elsewhere... The solution is diplomatic, it is political and it must be negotiated. The real challenges in Latin America concern questions of nationalism and self-determination, economic development, social justice and cultural identity. Washington should not fiddle around with gunboats as these challenges grow throughout the hemisphere. Attention should be paid to negotiations in Central America before events in Mexico and Brazil, Argentina and Chile show the true nature of the opportunities and dangers of change in Latin America. Distracted in the Central American swamp, once again United States diplomacy runs the risk of being caught unawares when the real problems show up."

The Search for a Nuclear Sanctuary (II)

In a little noticed effort, Pentagon scientists work to create an invulnerable offense as well as an impregnable defense

Most damage-limiting strategies represent an effort by one belligerent to maximize the damage to his enemies and minimize it to himself.—Secretary of Defense Donald Rumsfeld, in the 1978 DOD annual report.

Buried inside the Defense Department's bureaucracy is a small, well-run program of enormous significance in the ongoing debate over whether or not the United States should construct a large-scale antiballistic missile system, as President Reagan proposed in his widely publicized "Star Wars" speech last March. It is known as the Advanced Strategic Missile System (ASMS) program, and almost everything that falls under its jurisdiction is considered secret. Its major function is the design, construction, and testing of sophisticated military equipment that will ensure the success of a nuclear attack on the Soviet Union.

For roughly two decades, the technical managers of ASMS and its bureaucratic antecedents have analyzed potential Soviet strategic defenses and devised the means to defeat them. During the 1960's and 1970's, the program masterminded the development of the multiple independently targetable reentry vehicle, or MIRV, for the express purpose of confusing and overwhelming the Soviet Union's fledgling antiballistic missile system. During the 1970's, the program was instrumental in the development of the highly accurate MX warhead, for the express purpose of countering an extensive Soviet effort to harden its missile silos against the effects of a nearby nuclear explosion. More recently, the program has supervised the development of a warhead that flies erratically toward its target, as well as an impressive collection of what the Pentagon calls "advanced penetration aids"—such as chaff, aerosols, and warhead decoys—each designed to defeat Soviet defenses.

Historically, the funding for ASMS has risen and fallen along with the U.S. assessment of Soviet defense capabilities. At present, its budget is just \$50 million, a proverbial drop in the Pentagon bucket. The budget is expected to double next year, however, and an additional increase is scheduled for the following year. Those who are familiar with

the program say that the closer that either the United States or the Soviet Union get to deploying an authentic, large-scale antiballistic missile system, the richer the ASMS program will become. "If you are working seriously on missile defense, then you'd better prepare yourself with penetration aids in anticipation of similar work by the Soviets," says one official in describing prevailing Pentagon sentiment.

ASMS, along with several newer Pentagon programs aimed specifically at countering potential Soviet space-based laser systems, will have a significant impact on the strategic balance in the event that the United States proceeds with Reagan's plan to "counter the awesome Soviet missile threat with measures that are defensive." Such a dramatic development would lead to peaceful U.S.-Soviet relations only if both nations erected equally successful missile defenses, at roughly the same time. But the United States is well ahead of the Soviet Union in missile defense technology (*Science*, 1 July, p. 30), and the technical managers of the ASMS program are confident that Soviet defenses will be useless even if they are deployed simultaneously with U.S. defenses.

If Soviet defenses indeed fail, while U.S. defenses work as planned, the United States will possess a capability to strike first against the Soviet Union without fear of significant retaliation. This possibility, in turn, sharply undercuts the President's hope that the deployment of such a system will lead to peace and not war. As noted by Victor Weisskopf, a physicist at MIT who was briefed on the President's proposal at the White House, the Soviets can hardly be expected to permit the creation of such a strategic imbalance. "They will start a war to prevent deployment of this system," he predicts.

The confidence of the Pentagon in its ability to ruin potential Soviet defenses stems in part from the development and testing of ingenious devices under the ASMS program that apparently are beyond the current capability of Soviet defense planners. The Air Force, which directs the ASMS program, does not like to crow about the program's technological successes, preferring that the Soviets, and perhaps the general public, be

kept in the dark about what is obviously one of its most sensitive scientific endeavors. But questions about the program's accomplishments came up in congressional hearings several years ago on the MX missile. Senator Jake Garn (R-Utah), who sits on a defense appropriations subcommittee, wanted to know where the United States would stand if both sides deployed antiballistic missile systems in the near future. The answer, which came in writing from Antonia Chayes, who was then the Air Force under secretary, and from Lt. General Kelly Burke, who was then the top Air Force scientist, was as follows: "If the Soviet Union were to deploy an antiballistic missile system, we would still have confidence in the ability of MX to destroy hard targets through the use of chaff, decoys and other penetration aids . . . combined with such tactics as saturation." As to the chance that the Soviets would use similar tactics against a potential U.S. antiballistic missile defense, the Air Force was unconcerned. "We feel we are ahead of the Soviets in this area," the answer read.

The support for this statement was deleted from the record, but bits and pieces of relevant information can be gleaned from conversations with weapons experts inside and outside Washington. One measure of the U.S. lead in devices that can ruin antiballistic missile systems is the successful development of a chaff dispenser for use with the Minuteman II and the Minuteman III intercontinental ballistic missile. The chaff consists of lightweight, knotted strands of metal, which form small clouds as they are released from a dispenser that flies alongside the warheads of the Minuteman III after they separate from the missile itself.

The purpose of chaff is to saturate defensive Soviet radar with false signals, obscuring the location of the real warhead. It is primarily suited for use outside the earth's atmosphere, where Soviet defensive missile interceptors now operate. Not all of the Minuteman missiles are equipped with chaff, but the Soviets have no way of knowing which missiles have it and which ones do not. A new form of chaff, to be used in conjunction with the warheads on the MX, will be tested next year aboard two Air Force

sounding rockets. The success of this effort to date apparently gives the United States a substantial edge in strategic competition. A top weapons expert notes that, although the intelligence data on Soviet antiballistic missile tests are not definitive, the Soviets seem to have conducted no tests of their interceptors against warheads obscured by chaff.

The United States apparently is also well ahead in the development of active and passive warhead decoys, as well as actual warheads perversely designed to look like decoys. Both the active and passive decoys are intended to defeat the

er test aboard the Minuteman I will occur in 1985, followed by two tests aboard the MX missile in 1986 and 1987.

In addition to creating decoys that behave like warheads, ASMS contractors have created an ingenious way of making hot, heavy warheads look like cool, lightweight decoys. The transformation, which occurs in space after the warheads separate from the missiles, is intended to fool infrared optical sensors similar to those now under development by the United States. The deception is accomplished when balloons at the tails of the warheads release a carbonized

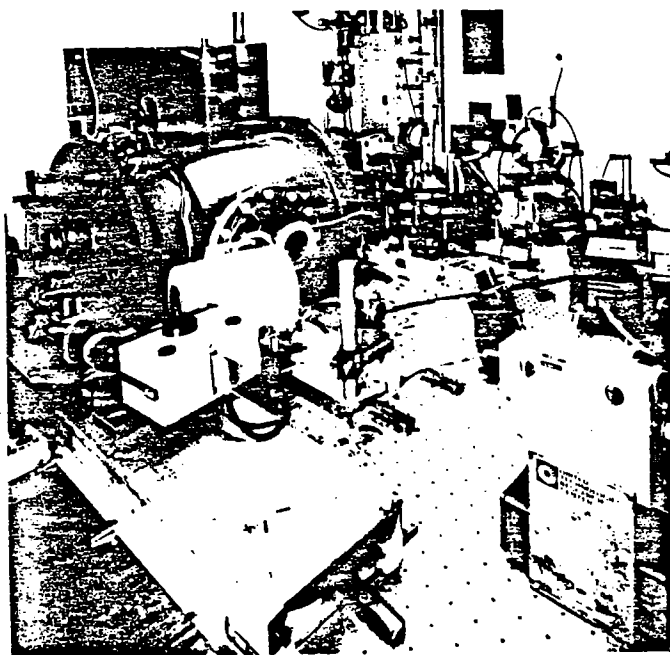
be an enormous antiballistic missile system, albeit one with only limited speed, range, and accuracy. The Mark 500, which maneuvers with fins according to preprogrammed instructions in its on-board computer, has been successfully flown in numerous test flights, and could be quickly produced in the event that the Soviets actually upgrade their air defense system.

A second warhead, known as the Advanced Maneuvering Reentry Vehicle, or AMARV, is designed to defeat still more sophisticated short-range missile interceptors. Intended for use aboard U.S. land-based missiles, the AMARV faces the difficult task of maintaining extreme accuracy despite its erratic, preprogrammed maneuvers immediately before impact. Each AMARV will carry its own inertial navigation system, which must be capable of withstanding enormous acceleration. Although the AMARV program was initiated in 1976, the Air Force has conducted only three flight tests,* and the program is still in its early stages. One official predicts that it could be ready by 1990 if Congress provides enough money.

Several weapons experts say there are other devices already in use that they prefer not to discuss, as well as many clever ideas for devices that might be constructed in the future. Next year, for example, ASMS scientists will begin intensive work on a reentry vehicle specifically designed to jam the radar of a Soviet antiballistic missile system. Pentagon officials justify such work by pointing to the development of a new mobile Soviet radar, as well as a new short-range missile interceptor, and a new short-range anti-aircraft missile that might be made into a missile interceptor. Richard Ruffine, a senior Pentagon analyst who specializes in antiballistic missile systems, suggests that "their ABM technology is lagging, but they could always build a much bigger system to overcome these disadvantages—perhaps within 2 or 3 years." He notes that they are much further along than the United States in the actual deployment of such a system.

It is clear, however, that the goal of the ASMS program is not to stay abreast of the Soviets but well ahead of them. Not only do the Soviets seem incapable of countering U.S. penetration aids, they also seem incapable of developing effective penetration aids of their own. "If both sides use missile defense and penetration aids—if we went all out with the technology in hand—we could eat them

*There were two flights in 1980 and one in 1981.



The Defense Advanced Research Projects Agency is using this experimental device at the United Technologies Research Center to assess the response of ablative materials to possible Soviet lasers. The laser beam enters from an adjacent room (at top center) and strikes a sample mounted in the chamber, where upper atmospheric conditions are simulated. Various instruments measure beam quality, sample response, and ejected particles.

latest Soviet antiballistic missile equipment, which will operate within the earth's atmosphere. The passive decoy will confuse Soviet radar by dispensing in its wake a material that ionizes, making the decoy appear to have as much drag as a real warhead (salt is one of the materials under consideration). The active decoy is a product of substantial wizardry in microelectronics and computing, engineered by MIT's Lincoln Laboratories and by the General Electric Company. Roughly the size of a half-gallon milk carton, the device operates by sensing the pulse of Soviet radar and swiftly determining its frequency and bandwidth. Next it calculates how a real warhead would appear at that particular moment on Soviet radar. And then it generates a signal that simulates the scattered radar reflection of a real warhead. All of this occurs within a microsecond or two after the initial radar contact. Development of the active and passive decoys is to be completed this year in preparation for two flight tests aboard Minuteman I test rockets in 1984. Another

test that "erects itself forward," as one expert describes it. By creating a layer of insulation around the warhead, the foam sharply reduces its radiated heat. This device has been successfully tested on warheads dispensed by an intercontinental ballistic missile. As an alternate means of deceiving the Soviet Union's optical sensors, scientists at Lincoln Laboratories have created a special aerosol, which reflects the earth's shine, thereby creating numerous false light impressions.

The U.S. grab bag of countermeasures also includes several warheads that maneuver erratically just before their impact on Soviet targets, so as to evade potential short-range Soviet missile interceptors. One such warhead, known as the Mark 500, was developed in the mid-1970's by the Navy for use aboard the Trident I submarine-launched missile. The rationale for the effort was that the Soviets might suddenly upgrade their existing air defense network, by substantially improving their interceptors, radars, and computers. The result would

up," Ruffine acknowledges. "They would have enormous trouble against our defense systems"—even a system that lacked space-based lasers. To the best of our knowledge, he says, the Soviets have never even tested the deployment of chaff, much less the acutely challenging technology of a maneuvering warhead. "I would hate to be designing penetration aids for the best that we could do."

The technical accomplishments of the ASMS program are also expressed in the 1981 annual report of the U.S. Arms Control and Disarmament Agency. "The potential effectiveness of U.S. ICBMs and SLBMs [submarine-launched missiles], based on maneuvering reentry vehicle and penetration aids technology, could assure the penetration of sufficient numbers of U.S. reentry vehicles *regardless of Soviet actions with respect to ABM improvements,*" the report states [emphasis added].

Although the bulk of the Pentagon's work in this area is devoted to the defeat of traditional Soviet defensive systems, a variety of newer, smaller programs have been established to anticipate and defeat a more advanced defense, such as a space-based laser system. Under one program, operated by the Defense Nuclear Agency (DNA) at a cost of about \$3.5 million annually, small pieces of U.S. strategic missiles have been exposed to laser beams modeled after those used in Soviet research. The materials include warheads, electronics, fuel tanks, and coated aluminum, as well as the thick, rubberized substance that will be used to protect MX missiles from the debris of nearby nuclear explosions. Eventually, DNA wants to expose an entire assembly of warheads, decoys, and associated equipment, but this will require modifications to existing U.S. lasers. John Mansfield, the DNA deputy director for theoretical research and testing, says that the program has three principal goals: to assess Soviet vulnerabilities, to understand U.S. vulnerabilities, "and to develop countermeasures for U.S. systems."

Another program, supervised by the Defense Advanced Research Projects Agency (DARPA) is charged more specifically with the development of materials that are resistant to the effects of potential Soviet lasers. Edward van Reuth, who directed the program until his recent retirement as chief of the materials science branch at DARPA, says that "in our fondest dreams—if we are completely successful—we will have produced materials that would provide an improvement in laser resistance of 1

or 2 orders of magnitude. Then we would feel confident that no one can put up a laser of sufficient size to destroy our weapons systems." In an initial \$900,000 test with a United Technologies Research Center laser in Hartford, Connecticut, DARPA exposed a handful of lightweight, nonmetallic ablative materials to a 15-kilowatt beam for 10 seconds or less. DARPA will not discuss the results, but additional tests, using a variety of lasers, will be conducted over the next 4 years. "Particle beams are considered way out," van Reuth says. "We're not all that worried about them yet."

The Air Force, with DARPA's assistance, is attempting not only to devise

"The Russians know we're not going to attack them anyway."

mechanisms that can defeat Soviet lasers but also to devise a means of ensuring that U.S. lasers cannot be defeated. Robert Sepucha, the deputy director of space defense technology at DARPA, says that \$10 to 15 million a year is budgeted for an assessment of potential Soviet countermeasures. A so-called "red team," which anticipates such efforts, has been established under the direction of the Air Force Ballistic Missile Office in San Bernadino, with additional help from a group of engineers at the RAND Corporation, as well as some scientists at the Air Force Weapons Laboratory in Albuquerque.

The attempt to ensure a substantial U.S. advantage in laser countermeasures is still getting under way, and many officials are wary about predictions of complete success. "How hard can the Soviets make a booster? Is it easier for them to harden it than it is [for us] to attack? We do not really have the answer to that question at this point," says Major General Donald Lamberson, who manages the Defense Department's directed energy weapons technology program. Little is known about the Soviet laser program, he adds. "We know there is a very significant effort going on, involving several different facilities, and that the people related to it are very distinguished scientists. We are uncertain, however, about the objectives of that effort."

Nevertheless, there are signs that the United States possesses at least some advantage already. Richard DeLauer, the Pentagon's top scientist, has stated that the U.S. is superior to the Soviet

Union in structural materials technology, which obviously plays a large part in laser countermeasures. Hans Bethe, a Nobel laureate at Cornell who helped devise the ablative materials now in use on U.S. warheads, says that the United States is ahead of the Soviets in this area, although it is difficult to say by how much.

Many of the officials and politicians who are pressing for construction of a large-scale antiballistic missile system acknowledge that it may impart a significant strategic advantage to the United States, but argue that this need not be feared by the Soviets. Secretary of Defense Caspar Weinberger has stated that "[one] reason the Soviets have no need to worry is that they know perfectly well that we will never launch a first strike." General John Vessey, chairman of the Joint Chiefs of Staff, has been reported as saying, "The Russians know we're not going to attack them anyway." This view is also stated by Senator Malcolm Wallop (R-Wyo.), one of the principal congressional proponents of a missile defense. "We had at [one] time the ability to annihilate the Soviet Union, bring them to heel, to do anything we chose to do to them, and did not. There is nothing historical that says when this country has great power it abuses it."

Wallop is of course technically correct, but the historical record offers only thin evidence to support a benign view of U.S. strategic intentions. The United States last enjoyed clear nuclear superiority in the 1950's, when, according to historian David Alan Rosenberg at the University of Houston, top U.S. officials, including President Eisenhower, actively considered initiating a nuclear attack on the Soviet Union. Rosenberg, writing in the spring issue of *International Security*, reports that the Pentagon was fearful that the Soviets would soon have the hydrogen bomb, which would sharply increase their retaliatory capability. Eisenhower's advisers rejected a proposal that they threaten nuclear conflict if the Soviets failed to capitulate within a specified period of time, but Eisenhower himself wondered if "our duty to future generations did not require us to initiate war at the most propitious moment we could designate." In May 1954, Rosenberg says, a special study group of the Joint Chiefs of Staff urged Eisenhower directly to consider "deliberately precipitating war with the USSR in the near future," before Soviet strategic power became "a real menace." Eisenhower apparently deliberated for several weeks before saying no.

The United States would clarify its

intentions, as well as relieve some international anxiety, by simply abandoning its plans to construct a large-scale antiballistic missile system. The only safe alternative, according to Weisskopf and Bethe, is to build the system jointly with the Soviet Union. But this is obviously more of a debating point than a realistic solution. Such a joint effort would be tantamount to mutual disarmament, which surely could be achieved more easily and less expensively in other ways. Major General Lamberson refuses even to discuss the prospect of sharing military secrets with the Soviets. Fred Ikle, the undersecretary of defense for policy, says that "we have had [previous] exchanges and cooperative ventures in the space area. If I were to structure the priorities of areas where we would cooperate, I do not think I would put space on top. . . . I would pick other areas—health, agriculture, and so on."

Three months ago, Soviet premier Yuri Andropov proposed that U.S. and Soviet "scientists, specialists in the field," conduct talks on the implications

of large-scale missile defenses. Recently, the Administration rebuffed the offer. "Our position is that discussions could be mutually beneficial, that we are not opposed to talking about the issues," says a State Department spokeswoman. "But we believe that we should hold such discussions within the framework of the ongoing strategic arms reduction talks or the standing U.S.-Soviet consultative committee. These are not merely scientific subjects." President Reagan, at a press conference on 29 March, said that "I have to tell you I haven't given . . . any thought" to joint development of a missile defense. "That's something to think about and look at." Reagan's other remarks that day indicate that he favors independent U.S. research, followed by an offer to share the technology, or a directive to the Soviets that they "do away" with all of their offensive missiles, and the United States will do likewise.

The aggressive and provocative U.S. effort to develop a foolproof missile defense, and to defeat any Soviet missile

defense, creates several quandaries for defense policy-makers in Washington. First, it suggests that the equilibrium publicly sought by the Administration is unlikely to be achieved. An impregnable defense in combination with an invulnerable offense—which the Pentagon openly seeks—may well give the United States a real first-strike capability. Second, it points up the fallacy of the last move in weapons invention. When Colonel Richard Rene, the ASMS program director, is asked to predict the final outcome of the U.S.-Soviet countermeasure competition, he answers by noting that "there is no such thing as a static situation for offense or defense." It seems likely that, even if both sides simultaneously deployed workable missile defenses, Rene and his counterpart in the Soviet Union will be hard at work devising mechanisms to ruin the other's defense and alter the strategic balance.

—R. JEFFREY SMITH

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*EXCERPT from the speech
of Alexandr Solzhenitsyn on receiving the Templeton Award
presented at Buckingham Palace [Templeton Foundation,
Nassau, Bahamas]. As reported in the National Catholic
Reporter, July 15, 1983:*

"Unnoticeably, through decades of gradual erosion, the meaning of life in the West ceased to stand for anything more lofty than the pursuit of 'happiness', a goal that has even been solemnly guaranteed by constitutions. The concepts of good and evil have been ridiculed for several centuries; banished from common use, they have been replaced by political or class considerations of short-lived value. It has become embarrassing to appeal to eternal concepts, embarrassing to state that evil makes its home in the individual human heart before it enters a political system."

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