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WPOST MON JUNE 2, 1986

SDI Seen Spurring Warhead Growth

By Fred Hiatt and Rick Atkinson
Washington Post Staff Writers

LIVERMORE, Calif.—President Reagan's Strategic Defense Initiative, which he said could render nuclear weapons "impotent and obsolete," may actually force the United States to develop a more powerful nuclear arsenal to overcome Soviet defenses, according to scientists at the federal nuclear weapons design laboratory here.

The scientists said that knowledge about SDI, a research program to determine whether missile defense is possible, remains too

sketchy to allow firm predictions. But they suggested that if both superpowers build missile defenses, the United States might have to compensate by building heavier and more powerful nuclear warheads.

"If you face a wholly new threat, you must beef up your warheads to defeat that threat," Robert F. Perret, a physicist who heads Lawrence Livermore National Laboratory's systems analysis section, said in an interview. "You also have to assume degradation in accuracy. So what do you do to retain the effectiveness? You increase the yield."

The scenario outlined by scientists at the laboratory here, one of two that design nuclear weapons for the U.S. military, was among several views that challenge administration orthodoxy on the controversial SDI program, sometimes called "Star Wars." While most scientists here enthusiastically endorsed SDI research, much of which is being conducted locally, they also raised questions about the management of the \$3 billion-a-year program:

■ Perret said that a number of highly publicized and expensive ex-

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SDI Seen Spurring Warhead Growth

SDI, From A1

periments conducted by the Pentagon's SDI office appear aimed at winning public and congressional support rather than obtaining valuable scientific knowledge.

"There are good experiments and bad demonstrations," he said. "What I can answer is whether all of the demonstrations have supported good experiments. Some of them haven't."

■ Perret and George H. Miller, who heads the lab's weapons program, said that the Pentagon may be setting an unrealistic timetable for SDI, thereby jeopardizing important research. Lt. Gen. James A. Abrahamson, head of the SDI Organization, has said that the government should be able to decide by the early 1990s whether to deploy missile defenses.

Miller said that Abrahamson's determination to prove practicality in the next few years may force him to "down-select"—decrease funding for—promising technologies.

"My personal opinion is, the broad-based research program that has been initiated must continue," Miller said. "My style of running the program would be to push back the milestones rather than making premature down-selects."

■ Perret said that no missile defense should be deployed unless it is "cost-effective at the margin," meaning that it would cost the Soviets more to overwhelm the defense than it would cost the United States to maintain it. Paul H. Nitze, Reagan's senior arms control ad-

viser, devised that formula, but the Pentagon has rejected it in recent months.

"The buy-in cost has to be affordable, and the maintenance cost has to be affordable," Perret said. "If he can overwhelm you through force attrition, you lose . . . Nitze's right, and if they've changed their minds, I can't help that."

■ Several experts at Lawrence Livermore said that no attempt to deploy missile defenses is likely to succeed unless accompanied by an

Attempt to deploy missile defense seen likely to require an arms control agreement.

arms control agreement with the Soviet Union.

"Right now SDI is a research program, and I think it should stay a research program until we get something that makes sense, and then we should sit down and negotiate," Paul S. Brown, the lab's arms control chief, said. "I don't think you can do it without arms control."

SDI is envisioned as a space- and ground-based system of weapons that would shoot down Soviet ballistic missiles. Scientists at Livermore are designing and testing lasers and advanced nuclear weapons

that might form part of the shield. They also are investigating technologies to defeat a shield.

Opponents have said that deployment of defensive weapons could intensify the arms race as the Soviets build more warheads and different types of weapons to penetrate the U.S. defense. Miller said that must be carefully examined.

"While I'm very, very enthusiastic and optimistic about SDI, there are many, many questions we don't have the answers to," he said. "The whole SDI program right now is a study and analysis of move and countermove . . . What could the Soviets do to counter? How easy is it for us to counter what they do? What are the cost trade-offs? In other words, we are still beginning to examine the issues."

Miller agreed with Perret that higher-yield nuclear weapons might be one response to a defensive system. If defensive weapons render missiles less accurate, the weapons might have to be more powerful to have the same destructive effect on "hard" targets such as missile silos or command bunkers and "soft" targets such as cities, he said.

"If you're trying to attack very hard targets, the loss of accuracy is probably not recoverable by a reasonable increase in yield," he said. "On the other hand, if you're attacking or defending cities, it might well be."

The lab is also investigating the possibility of maneuvering warheads that would evade defensive weapons and then home in on their targets, scientists said.

W POST

FRI MAY 13 1986

A25
A26

46 Senators Seek Slash In 'Star Wars' Funding

Goals Are Unclear, Coalition Says

By George C. Wilson
Washington Post Staff Writer

In a severe challenge to President Reagan's "Star Wars" missile defense plan, 46 senators yesterday demanded a huge cutback when the Senate Armed Services Committee sets budget ceilings on Pentagon programs next month.

The bipartisan coalition called for

in the Department of Defense's budget."

Not only are the goals of the research effort unclear, the need for accelerated funding for a long-range program such as SDI has not been demonstrated," they wrote. "We are concerned that the SDI program is being rushed to a premature development decision in the early 1990s in order to meet an unrealistic schedule."

"Challenger and Chernobyl have stripped some of the mystique away from technology."

—Sen. William Proxmire

no more than a 3 percent after-inflation increase for the Strategic Defense Initiative (SDI) rather than the 74 percent rise Reagan requested fiscal 1987, the budget year starting Oct. 1.

"Our concern," the 46 senators said in a letter to the Armed Services panel, "is that the Strategic Defense Initiative has received excessive and inappropriate emphasis

In size and makeup, the Senate coalition represents one of the biggest challenges to SDI since Reagan proclaimed it on March 23, 1983, as an attempt to make nuclear offensive missiles obsolete. The senators' letter to committee Chairman Barry Goldwater (R-Ariz.) and the panel's ranking Democrat, Sam Nunn (D-Ga.), was clearly designed to influence committee decisions on the defense authorization bill when markup sessions scheduled for June 2 begin.

Last night, Rep. Charles E. Bennett (D-Fla.), second-ranking Democrat on the House Armed Services Committee, hailed the Senate drive as a "fine effort" and said he is putting together a similar coalition in the House in hopes of freezing SDI at this year's budget level without allowing for inflation.

See SDI, A26, Col. 3

BEIRUT BUF



A Shiite Moslem woman
Wednesday in Beirut be

Soviet Troubleshooter Finds Work

By Michael Dobbs
Washington Post Foreign Service

VIENNA, May 22—It was a typical moment in the harassed day of Boris A. Semyonov, Soviet nuclear troubleshooter. The normally pliant Finns were complaining about being left in the dark about the Chernobyl nuclear accident, and he had the task of placating them.

ish public opinion, he insisted, was extremely concerned about the effects of radioactivity. The Chernobyl accident had left an enormous impression on Scandinavian countries—and extra information was vitally important in calming the situation down.

The snippet of conversation between the Soviet and Finnish

Domestic Revolution candidate Jacobo Maj... the announcement af... on meeting with former... at Joaquin Balaguer of the Christian Reform Party. agreement ends several of turmoil over results in contested elections, which candidates claimed they on. J... also said either can... would set up a "govern... of national unity, regard... of who wins."

Support for 'Star Wars'

PARIS—Conservative Prime Minister Jacques Chirac gave qualified backing to President Reagan's so-called "Star Wars" defense system in what appeared to mark a major shift in French policy.

Chirac's comments in response to a question at a press lunch contrasted sharply with the negative position on SDI of President Francois Mitterrand.

11 Killed in India

■ AMRITSAR, India—Six assailants, thought to be Sikh extremists, fired on Hindu-owned shops in a crowded shopping district, killing 11 persons and seriously wounding seven, police reported.

The attackers sped away after killing three shopkeepers and eight passersby in the Krishna Nagar district on the outskirts of Amritsar.

For the Record

■ A land mine in Northern Ireland killed two policemen and a British Army major near the Irish border in the bloodiest IRA ambush in Northern Ireland in a year, police said.

■ Typhoon Namu, the worst storm in history to hit the Solomon Islands, killed at least 71 people and left about 90,000 homeless, and rescue workers said the death toll will probably go higher.

From news services and staff reports

come lethal nerve gas only when they are mixed together. Over the next decade, they would replace about 30 tons of aging chemical weapons in the U.S. stockpile.

Weinberger said, "Some member nations expressed unhappiness with the idea of chemical weapons, and everybody is against their use." But he said the United States felt obliged to modernize its arsenal to gain more bargaining leverage with the Soviet Union and in the 40-nation Geneva disarmament conference.

The Geneva negotiations are intended to achieve a global ban on chemical weapons, but the search

clearing the way for production of the new nerve gas supplies.

Ten members of the Senate Appropriations Committee, however, said in a letter to President Reagan that the North Atlantic Council, NATO's governing body, must approve the plan rather than just the defense ministers. The State Department has said that the council only deals with political matters and that the meeting of defense ministers is the only body that can approve force goal decisions.

Despite the objections of several allies, none of those countries could

Denmark and the Netherlands voiced the strongest reservation. They later said they had explicitly told Weinberger to inform Congress about their absolute rejection of new chemical weapons.

"I made it totally clear that Norway cannot support or endorse the U.S. decision to resume production of chemical weapons," said Norway's Defense Minister Johan Jørgen Holst. He told reporters that his country would refuse to allow the storage or transport of chemical weapons on its territory.

46 Senators Call for Slash In 'Star Wars'

SDI From A25

If such a push develops, it appears that Reagan will soon be fighting for the centerpiece of his strategic program on two fronts at a time when both the House and Senate have set goals for his total military budget far below the amounts he requested.

Under the senators' proposal yesterday, the Pentagon's SDI account would rise from \$2.76 billion in fiscal 1986 to just under \$3 billion in fiscal 1987. Reagan is requesting \$4.8 billion. The senators' \$3 billion represents a growth of 3 percent plus a 4 percent allowance for inflation. If Reagan prevails, the SDI account, with Energy Department funds for nuclear research added in, would jump from \$3 billion to \$5.4 billion between fiscal 1986 and 1987, a 77 percent increase.

"It is difficult to conceive of a sound rationale for increasing the combined Department of Defense and Department of Energy SDI budget by 77 percent while the entire Department of Defense budget will be frozen at zero real growth and other vital military research programs are facing budget cuts," the senators said in their letter.

The senators also said they were pressing for a slowdown in SDI because of concerns that it was wasting money by going too fast, a fear that its flight tests would violate the 1972 antiballistic-missile treaty, and a belief that conventional military forces would otherwise be excessively slashed to meet House and Senate budget goals.

Said Sen. William Proxmire (D-Wis.), one of those who put together the coalition: "Challenger and Chernobyl have stripped some of the mystique away from technology."

"We could have gotten 51 senators [a majority] to sign the letter if we had a little more time" before the Memorial Day recess, said Sen. J. Bennett Johnston (D-La.).

Joining Proxmire and Johnston in forming the coalition were Sen. Lawton Chiles (D-Fla.), ranking minority member on the Budget Committee, and Republican Sens. John H. Chafee (R.I.), Daniel J. Evans (Wash.) and Charles McC. Mathias Jr. (Md.).

Signers of the letter included moderate conservatives Lloyd Bentsen (D-Tex.); Wendell H. Ford (D-Ky.) and Russell B. Long (D-La.) and liberals Edward M. Kennedy (D-Mass.), Patrick J. Leahy (D-Vt.) and Carl Levin (D-Mich.). Nine Republicans signed the letter: Chafee, Evans, Mathias, Mark Andrews (N.D.), Mark O. Hatfield (Ore.), Nancy Landon Kassebaum (Kan.), Arlen Specter (Pa.), Robert T. Stafford (Vt.) and Lowell P. Weicker Jr. (Conn.).

U.S. Concern Given Terror

The State Department expressed concern yesterday about Syria allowing terrorists to move freely in its territory and said that as long as President Hafez Assad continues that practice, the United States will keep Syria on its list of countries that abet international terrorism.

The statement came after reports that authorities in Britain, Italy and West Berlin have information linking Syria to recent terrorist acts in their areas. Secretary of State George P. Shultz said Wednesday that it would be premature for the United States to comment on the allegations before the ongoing European investigations completed.

However, department spokesman Bernard Kalb, commenting on general question of terrorism, yesterday said "as long as terrorists move freely within Syria, and Syrian-controlled territory is a threat, our serious concern is for Syria's support for international terrorism."

"Syria remains on our terrorist list," Kalb said. "U.S. policy on terrorism is well understood, demonstrated, we are steadfastly countering terrorism and it. Our policy applies to the sponsors of terrorism and state sponsors terrorism."

Kalb also said that Syria

WSJ 4/19/86

The U.S. Can Build a Pinpoint Strategic Defense Now

By MARTIN ANDERSON

Americans are among the most insured people in the world. We have medical insurance, auto-accident insurance, fire insurance, earthquake insurance, burglary insurance, libel insurance, and even life insurance. We are insured up to our chins against almost any calamity that could befall us, except one—accidental annihilation by a nuclear missile.

We all know that the massive and increasing nuclear-missile arsenals of the world have created the small but real possibility that there could be an unauthorized or an accidental launch of a nuclear missile. Adding to that risk is the growing concern that a ruthless radical of the Qadhafi variety will manage someday soon to get his hands on a nuclear bomb and a missile capable of delivering the bomb to a far-away target.

As the risk of a deliberately planned all-out nuclear war between the two superpowers has receded, we have almost totally disregarded the growing risk of a small nuclear attack on the U.S. Neglect of this danger is unconscionable. The consequences of even one nuclear warhead striking a heavily populated area of this country would be catastrophic. The loss of life would be appalling.

That we choose to live so dangerously is baffling. It is baffling because we could build a limited missile defense today, at low cost, in full accord with the current ABM treaty, that would insure against such a tragedy.

The U.S. Army has already demon-

strated conclusively that we have the technology—on our scientific shelves—to build an interceptor missile that can stop and destroy an incoming nuclear missile high above the earth's surface. On June 10, 1984, the Army fired an old Minuteman missile toward a target 4,000 miles away. Once the incoming missile was detected, a new interceptor was launched, a 70-foot engineering marvel, cobbled up from old missile parts and topped with an ultrasecret, state-of-the-art sensing device. The interceptor flew flawlessly and homed in on the incoming Minuteman at a distance of more than 100 miles above the earth. In the brittle cold and near vacuum of outer space, the interceptor collided with the Minuteman missile at a speed of more than 20,000 miles per hour.

What happened was a collision of such power and intensity that both missiles were literally pulverized. We all have a pretty good idea of what happens when two automobiles, each traveling 60 miles per hour, hit head on. The interceptor missile hits its target at least 165 times harder.

And that was the old interceptor missile. By early 1986, the Army had completed plans for a better one. It's called ERIS, which stands for Exoatmospheric Reentry-vehicle Interceptor Subsystem. The new interceptor missile is extremely accurate, carries no explosives in its nose cone, and is only 20 inches in diameter and less than 14 feet long. Utilizing our existing radar system, with some upgrading, we could build a complete limited missile defense system (with 100 missiles) for about

\$150 million a year, or a total cost of \$1.5 billion spread over 10 years. If we started today, the first missiles would be standing guard, ready to fire, in the early 1990s.

Under terms of the ABM treaty, both the U.S. and the Soviet Union have the right to deploy as many as 100 interceptor missiles at designated launch sites. The Soviet treaty site is near Moscow; ours is at Grand Forks, N.D., next to the Canadian border. The Soviet ABM missiles are in place, the only operational missile defense system in the world. We started to build such a system in the late 1960s, but stopped and tore it all down in 1975. So we have a nice building site ready and waiting.

The area of earth that can be effectively protected by an interceptor missile is called its "footprint." The size of the protection footprint is determined by how soon we can detect an incoming nuclear missile and the speed of the interceptor missile. Because of the "footprint" phenomenon, the Soviet missile defense site near Moscow actually can provide a limited defense for a large part of the Soviet Union.

The footprint of an interceptor missile based in Grand Forks, N.D., also would be enormous. It would cover the entire continental U.S., all of Mexico and most of Canada. A single site could provide a limited defense against nuclear missiles for virtually all of North America.

Just one interceptor missile could destroy an accidentally launched nuclear missile. One hundred interceptor missiles could effectively insure us against virtu-

ally anything but an all-out nuclear attack by the Soviet Union. And, in addition to protecting us from an errant ICBM, this new system also could protect us from an errant missile launched from a Soviet submarine lurking off our coast.

Last February, President Reagan talked of "pushing forward our highly promising Strategic Defense Initiative—a security shield that may one day protect us and our allies from nuclear attack, whether launched by deliberate calculation, freak accident, or the isolated impulse of a madman." And then he asked, "Isn't it better to use our talents and technology to build systems that destroy missiles, not people?"

Most people would answer yes. Missile defense is clearly morally superior to the doctrine of mutually assured destruction. But shouldn't we also ask why we don't now build and deploy what we know we can build, why we don't deploy live interceptor missiles while we press ahead with the futuristic research of SDI?

Or perhaps we should put it this way: What will we say to the people living in an American city who, someday in the future, learn that in 15 or 20 minutes they will be annihilated by a nuclear bomb and ask for help? Will we be able to say "no problem," and quickly fire some interceptor missiles, or will we have to say "sorry" and then live with the knowledge of what we could have done?

The full-scale Strategic Defense Initiative has been the subject of intense debate about its scientific feasibility and its complex implications for military strategy. A missile insurance system is not subject to scientific debate. We have already successfully tested a prototype. A missile insurance system does not complicate military strategy. It simply protects us from accidental annihilation.

We should begin immediately to build, and then deploy, the best interceptor missiles we can create. They could turn out to be the most important insurance program the American people ever had.

Mr. Anderson is a senior fellow at the Hoover Institution at Stanford University. He was President Reagan's assistant for policy development from 1981 to 1982.

German defense chief backs SDI research

Wörner suggests it will add 'new stability' to nuclear deterrence

By Elizabeth Pond
Staff writer of The Christian Science Monitor

Bonn

The West German government fully endorses "star wars" in the research stage — in the expectation that strategic defense will strengthen rather than supplant nuclear deterrence.

This was clear from an interview with The Christian Science Monitor in which West German Defense Minister Manfred Wörner discussed the broad impact of the United States Strategic Defense Initiative (SDI, or "star wars") on European security.

In the interview, he also pressed the need for intensive NATO study of intermediate- and short-range missile defense both in conjunction with and independent of the SDI program. And he addressed some of the problems a future world of missile defense would create for NATO's strategy of either conventional or nuclear

INTERVIEW

"flexible response" to any Soviet-bloc attack.

West Germany is generally perceived in the US as one of the strongest allied supporters of SDI. And Christian Democrat Wörner is generally perceived as one of the strongest supporters of SDI within a center-right coalition that has feuded openly about the subject.

His interview suggests that there may be more consensus within the Bonn government than meets the eye, however. And it suggests that West German approval of SDI is much more conditional than Washington has so far recognized.

Thus, Dr. Wörner first stressed that there was "no doubt" that the West German government politically "supports the research efforts of the United States on SDI." But he also made it clear that he regards nuclear "deterrence" — the prevention of war based on a would-be attacker's fear of unacceptable nuclear retaliation — as rather durable. He didn't

really expect the technology to develop in the foreseeable future to the point where it could replace offensive deterrence with some kind of classical physical defense against incoming missiles — the goal set by President Reagan in launching SDI.

"For a long period it [SDI] will stabilize deterrence," Wörner declared. "It will create a new stability, and of course it will do so best if both superpowers would agree on a fixed level of defensive and offensive systems. That means a new mixture, with reduction on offensive, and a limited number of defensive systems."

The implication of Wörner's reasoning was that strategic defense would stabilize deterrence by reducing the vulnerability of offensive missiles and thus increasing the uncertainty and "incalculability of risk" of a would-be attacker.

Wörner also confirmed that the original conditions Bonn set in approving SDI in government statements a year ago continue in force: that endorsement applies expressly to the research stage (with any support for subsequent testing or development reserved for a future decision); that US SDI research remains within the constraints of the Soviet-US Antiballistic Missile Treaty of 1972 and that efforts for arms control continue; that

REPORT...Continued

tional laboratories were using the same threat assessment. In fact, the study says, one Air Force officer referred derisively to the many different assessments as "the threat-of-the-month club."

Additionally, the study says scientists at the national weapons laboratories conducting SDI research fret about the "schedule-driven" nature of the SDI program, which requires a development decision in the early 1990s.

First, the scientists worry that promising long-term research will be compromised to reach an arbitrary schedule, according to the report. Second, the scientists say that in an effort to maintain public support for high funding levels and an early development decision, SDI experiments may degenerate — in the words of one senior scientist at Lawrence Livermore Laboratory in California — into "a series of sleazy stunts."

CONTINUED NEXT PAGE

AIR DEFENSE INITIATIVE BEGUN TO COMPLEMENT SDI

Washington - After years of telling SDI critics that the Soviet strategic air - breathing threat would be dealt with in due time, Pentagon officials now have a more convincing argument: the Air Defense Initiative (ADI). The new program is being begun by the Air Force to provide defense against Soviet bombers and cruise missiles comparable to the protection that SDI will provide against ballistic missiles.

Funding of about \$50 million for ADI in the FY 1987 Air Force budget is the latest indication that the Reagan Administration wants to develop active defenses against the full spectrum of strategic nuclear threats. The Strategic Defense Initiative is one facet of this effort, but it is directed exclusively at dealing with the ballistic missile threats; it does not address air - breathing systems.

The ADI concept has its roots in a series of continental air defense plans and documents prepared earlier in the Reagan Administration. The most important of these is the Air Defense Master Plan drawn up in 1981, which identified the need for more vigorous active and passive defenses of the U.S. against Soviet bombers and cruise missiles.

The Master Plan gave impetus to a variety of air defense programs such as the effort to provide over - the - horizon backscatter (OTH-B) radar coverage to the eastern, western, and southern approaches to the continental U.S. It also assigned high priority to modernization of the Distant

Early Warning (DEW) line and called for replacement of existing fighter interceptors with more capable aircraft.

Shortly after completion of the Air Defense Master Plan, the Under Secretary of Defense for Policy, Dr. Fred Ikle, initiated a new study called Strategic Defense Architecture 2000. SDA 2000, which is still in progress, is a two - phase assessment of both ballistic missile defense and air - breathing defense; it is intended to serve as a long - range planning document for U.S. active defensive measures during the remainder of the century.

In addition to charting BMD and air defense needs during the next 15 years, SDA 2000 is supposed to examine the interaction between the two types of defense in producing an integrated defensive system. It is also supposed to relate defensive capabilities to war plans and force posture for the strategic offensive forces.

The Air Defense Initiative now contemplated by the Air Force focuses on three facets of atmospheric defense: surveillance, battle management, and engagement. By examining all three areas, and studying how USAF assets can be combined with those of the Army and Navy to accomplish each task, Air Force planners hope to provide much improved air defense capabilities for the U.S.

ADI development programs will involve several of Air Force Systems Command's product divisions. Senior officials of the Strategic Defense Initiative Organization (SDIO) are expected to be heavily involved with ADI planning, and technology developed for the SDI may eventually be used by ADI in air defense applications.

Report: SDI Progress Overstated

Senate Staff Says Questions Remain on Threat, Development Schedule

By TRISH GILMARTIN
Defense News Staff Writer

WASHINGTON — Discriminating the difference between enemy warheads and decoys is much more difficult than Congress has been led to believe. Moreover, there is no consensus among researchers involved in the Strategic Defense Initiative (SDI) on the kind of threat a U.S. strategic defense system will face in the future, according to a Senate staff report.

These and other findings are contained in a study prepared at the behest of Sens. William Proxmire (D-Wis.), Lawton Chiles

(D-Fla.) and J. Bennett Johnston (D-La.), all of whom serve on the Senate Appropriations Committee. *SDI: Progress and Challenges* concludes that much of the progress that has been achieved by the Reagan administration's SDI effort has been overstated and at best has shed light on program difficulties that are "much more severe than previously considered."

And furthermore, the report says, there have been no major breakthroughs in the SDI program that would make deployment of a missile defense system in the 1990s more feasible than it was three years ago.

Senior Reagan administration and key SDI officials, however, contend there have been significant breakthroughs and progress in the 3-year-old program.

The study was based on interviews and visits with more than 40 scientists, engineers, defense experts and military officials involved in research for SDI.

One area requiring more detailed analysis is the threat strategic defenses would face, according to the report. An analysis should be made not just of the threat projected for today or into the next decade, but also the generated threat into the 21st century when a U.S. strategic defense system might be deployed.

Government officials indicate that neither the Air Force, the Army nor the na-

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Jeff - let's get this

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Press contact: Laura Wessner (212) 887-4995

NIGHTLINE

SDI: Windfall or Payoff?

In Washington

TED KOPPEL Anchor

Guests:

In Washington

RICHARD PERLE Assistant Secretary of Defense

GORDON ADAMS Defense Analyst

In Boston

JOSEPH NYE Harvard University

Report from ABC Correspondent

STEVE SHEPARD in Washington

RICHARD N. KAPLAN Executive Producer

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SDI: Windfall or Payoff?

TED KOPPEL [voice-over]: Star Wars. The media has named it after one of the most successful movies of the decade. But some feel that the President's program is no more than a Hollywood dream.

[on-camera] Good evening. I'm Ted Koppel, and this is Nightline.

[voice-over] The official name is the strategic defense initiative, and it promises to be a bonanza but only for selected areas of the country. Is it a windfall or a payoff? That's our story tonight.

ANNOUNCER: This is ABC News Nightline. Reporting from Washington, Ted Koppel.

KOPPEL: For a moment set aside any personal bias you may have for or against the President's strategic defense initiative. The President doesn't much care for the term Star Wars, but if you're more familiar with that name, that's what we're talking about. Put yourself in the President's shoes. He is convinced that it is possible to develop a program that some day will be able to protect this country against incoming nuclear missiles and their warheads. But committed as he is to the concept, that for the moment is all it is. Just a concept, one which will take many years, perhaps decades, and tens of billions of dollars to develop. How do you protect that kind of a vision against the possibility that future presidents and congressmen and senators yet to be elected might let the project lapse? That's what this broadcast is about. As Steve Shepard reports, the Reagan administration is buying itself a lot of insurance.

Pres. RONALD REAGAN [March 23, 1983]: I call upon the scientific community in our country, those who gave us nuclear weapons, to turn their great talents now to the cause of mankind and world peace, to give us the means of rendering these nuclear weapons impotent and obsolete.

STEVE SHEPARD [voice-over]: Three years ago President Reagan outlined a bold new scheme to protect America against nuclear attack.

REPORTER [voice-over]: President Reagan's plan to put weapons in space to shoot down Russian missiles--

REPORTER [voice-over]: Almost instantly a laser canon fires a beam into space.

REPORTER [voice-over]: Lasers and high-energy electron beams in space--

SHEPARD [voice-over]: In no time at all the TV networks and other news organizations turned the President's hazy vision into very real looking hardware.

SPEAKER: Fanning into space, a layered defense to protect the country from nuclear devastation.

SHEPARD [voice-over]: But the program the President began, now known as the strategic defense initiative, or SDI, wasn't created to build giant X-ray lasers like this or anti-missile systems like this, or even like this.

[on-camera] Indeed, the SDI program isn't going to build any weapons systems at all. Instead, SDI is a five-year, \$33-billion feasibility study, a study that all by itself is going to cost more than designing, building and deploying the B-1 bomber.

JOHN PIKE, Federation of American Scientists: When they say that it is a long-range program they are not kidding. Most of the money that is going into the SDI today is not going to have any visible payoff in this decade.

SCIENTIST: Can you adjust the solenoids? Set the current at a better level.

SHEPARD [voice-over]: The key word is visible. Scientists are conducting basic research. They're working on new lasers, developing software programs, designing advanced electronics. But that kind of basic lab work, while vital, doesn't produce exciting pictures, doesn't allow SDI supporters to show what they're doing with all their money. To make up for that, exciting pictures are invented. The problem is, the experiments displayed by those pictures, while plenty flashy, don't involve particularly new technology and don't show the kinds of problems SDI researchers are actually investigating. In fact, critics charge the experiments are for the most part irrelevant to the SDI program.

Mr. PIKE: They've got a new special effects program coming up that is going to

provide a much larger, much flashier, hopefully more impressive special effects to try to convince people that they're actually making progress.

SHEPARD [voice-over]: But flashy pictures by themselves aren't enough to keep billions of SDI dollars flowing. What's needed are some fulltime SDI salesmen.

Lt. Gen. JAMES ABRAHAMSON, SDI organization [November 26, 1985]: The bottom line is that the program is indeed coming along well.

SHEPARD [voice-over]: Lieutenant General James Abrahamson, the man in overall charge of SDI research, is a salesman par excellence. His efforts are complimented by his superior, Defense Secretary Caspar Weinberger, and Weinberger's superior, President Reagan.

Pres. REAGAN, [February 6, 1986]: We're not about to abandon the strategic defense initiative.

SHEPARD [voice-over]: But to keep SDI going for the years needed to reach its goal, Supporters must sell it not only to this Congress and the Reagan administration, but to congresses and presidents yet to come. One way to accomplish that is to spend money in very specific places.

ALICE TEPPER MARLIN, Council on Economic Priorities: We find that 77% of the contracts in '83 and '84 for the strategic defense initiative went to the home districts of members of Congress who sit on just two key committees in the House and the Senate, the Armed Services Committee and two subcommittees of appropriations, the defense appropriations subcommittees. That's a very strongly concentrated pattern of constituency building.

SHEPARD [voice-over]: Wherever SDI funds go, they're going to develop a constituency. Take Huntsville, Alabama. There SDI research money has helped spur a local boom.

GUY NERREN, Huntsville Chamber of Commerce: Fifteen to 16 companies that are involved in the SDI program, employing upwards to 1,000 people, and those are top-paid engineers, scientists, technicians and so on, with many more support people that are required to help them. We wouldn't want to downplay it at all. It is a significant part of the economy.

SHEPARD [voice-over]: And it is clear it will remain important to any congressman from Huntsville and any senator from Alabama. SDI managers have taken these familiar legislative tactics and gone them one better. They are also developing a constituency among America's colleges, universities and publicly funded research centers. At MIT, SDI is funding research into new materials. At the University of Alabama, optical computers. And at Massachusetts General Hospital, SDI funds are paying for research into high-powered medical lasers.

Dr. JOHN PARRISH, Massachusetts General Hospital: And it's more difficult for established scientists to maintain their funds because it's-- there are less funds available at the National Institute of Health. So as medical researchers we are now beginning to have to look in other places for our funding.

SHEPARD [voice-over]: Dr. Parrish can't see any direct relationship between medical research and laser weapons, but like many other researchers he is now at least partially dependent on SDI funds. Critics say that connection is the result of deliberate government policy.

VERA KISTIAKOWSKY, PhD, MIT physicist: They are trying to coopt the university scientists by offering them support, by having contracts shifted from other agencies to SDI and then the scientist is faced with ending his or her research or operating on SDI money.

SHEPARD [voice-over]: Much the same kind of thing appears to be happening with private firms. Julius Feinleib's company does research on advanced computers.

JULIUS FEINLEIB, President, Adaptive Optics: We're not like the Japanese, who has a government who can put money into something when they want to develop it. We need the government to do it through different means. Defense, basically. And that's how we get the money to develop technology.

SHEPARD [voice-over]: SDI supporters argue that these technological spinoffs will benefit the entire economy, but critics say that's snake oil.

Ms. TEPPER MARLIN: This is an area where the spinoff is likely to be far, far

less than if we spent it on an area that wasn't so hemmed in by classified restrictions, an area that wasn't so esoteric and an area that was more directly applicable to the many commercial applications for which we so badly need scientific advances.

SHEPARD [voice-over]: But whatever its benefits to the economy, not all SDI money is staying in the U.S. Research contracts are being dangled in Europe and elsewhere. It will be hard for U.S. allies to take SDI money and then complain about the program.

[on camera] There is nothing very new about the way this administration and its supporters have gone about selling the SDI program. In fact, it's pretty much standard procedure here in Washington. But there may be at least one troubling difference. The same people now receiving SDI money to determine if SDI is feasible are the people who will benefit if they should decide that SDI should indeed be built. It has to make one wonder how objective they can be. Steve Shepard, ABC News, for Nightline.

KOPPEL: When we come back we'll be joined by Richard Perle, assistant secretary of defense and one of the prime administration advocates of the strategic defense initiative, and by Gordon Adams, who analyzes defense spending for a private research organization that keeps tabs on the federal budget.

[Commercial break]

KOPPEL: Joining us live now in our Washington bureau is Richard Perle, assistant secretary of defense for international security policy, and defense analyst Gordon Adams, who heads the defense project, or budget project, at the Center on Budget and Policy Priorities, which is a private research organization that monitors defense spending and policy.

Secretary Perle, where does the American public look to find its objectivity when it comes to who makes the decision ultimately on whether SDI is actually feasible?

Sec. RICHARD PERLE, Assistant Secretary of Defense: Well, ultimately this decision will be made not by this administration but by a successor administration, and it will be made in the form of a recommendation to the Congress, which I am sure will conduct exhaustive hearings and make the best judgment that the Congress can after hearing all points of view on the evidence on all sides. That's the way we've made every major weapons decision in recent history, and I expect that will be true in the case of SDI as well.

KOPPEL: All right. This is going to be perhaps an offensive analogy, and I realize it's a little bit offensive, but there is some truth to it also. Aren't you passing out free nickel bags of heroin here in a sense, and saying to people all around the country, "Here, take a little snort of this," or "Use a little bit of-- use a bag of this and see how you like it," and "There's plenty more where this came from. There's an awful lot of money being thrown around this country to people who a year from now, two years from now, three years from now after they get used to it, they're going to have a very hard time saying, "You want to know something, President Whoever--it's going-to-be, this isn't going to work."

Sec. PERLE: Well, you can't conduct a research program without inviting large numbers of talented individuals and institutions to carry out the hundreds of separate elements aimed at developing technology that, taken together, will validate -- or not, as the case may be -- the technologies that we're looking at. It's a little bit unfair to characterize a research program which in its early stages inevitably entails lots of small contracts because we're looking for innovation in lots of areas as an effort to hook the scientific community on the program. Test results are test results, and scientists conduct peer reviews, and no one is going to publish results that are not subjected to analysis elsewhere and that will not have to stand the test of the scientific evidence and logic.

KOPPEL: Mr. Adams, what do you think will be the earliest time and the least amount of money expended at which a group of scientists could even hypothetically come along and say, "You want to know something? This thing isn't going to work"?

GORDON ADAMS, Defense Analyst: It's kind of hard to judge that timing, Ted, because part of the problem the department is clearly having is in being able to spend the money they have in fact brought in budgetary resources at a rate that is far faster

than they can spend them. It's kind of an eye and stomach problem. They're actually spending out at probably half the rate of a normal R&D program on something like Star Wars. It's very, very complicated and it's a difficult program to manage.

KOPPEL: How much money has been allocated this year, for example?

Mr. ADAMS: Well, so far this year, 1986, there were \$2.75 billion budgeted. The spend-out rate on that money is running 25, 30 percent. That's about half the rate for an normal R&D program. But the real problem is that we have-- you know, you have to ask yourself, we have a program spending out very slowly that has at the same time a very large and active marketing effort going on by its director and its deputy directors and the heads of the various offices, and you kind of have to ask yourself just exactly what is going on here? Do we have a program that is bigger than what we can really manage?

KOPPEL: What do you think, Secretary Perle? Obviously you don't believe that.

Sec. PERLE: Of course not. I think the low spending rate indicates careful and deliberate management. If the spending rate were higher than normal, we'd be accused of indiscriminately throwing money at technical problems that are not mature enough to receive research support.

KOPPEL: But let me ask you--

Mr. ADAMS: The problem is--

KOPPEL: Let me ask you the question, if I may, that I just posed to Mr. Adams. How long -- \$10 billion, \$20 billion -- how many billion dollars down the road and how many years down the road before someone is going to be in a position to say, yes, this thing will work or not a chance?

Sec. PERLE: Well, I don't think it's going to be an either/or proposition. What I think we're likely to arrive at is a collection of technologies which, in the aggregate, could give us some level of protection for some level of investment. And the right balance between investment and protection will be the decision that ultimately has to be made.

KOPPEL: Now that, of course, is not the picture that the President has been sketching for the last three years. He has not been sketching some kind of program that may give us some level of protection. He's been sketching out a program that gives us total protection against nuclear assault.

Sec. PERLE: Well, I think the long-term objective is a highly reliable system that would afford levels of protection that I think we're not going to be able to achieve in the near term. And I think the critics of the program would be among the first to argue that you can't achieve perfection early in the program or even with the first generation system in my judgment.

KOPPEL: All right. We've got to take a short break. When we return, we'll be joined by Joseph Nye, a former Carter administration official who has had firsthand experience at pushing complex technical programs through the political process.

[Commercial break]

KOPPEL: Joining us live now in our Boston bureau is Joseph Nye, director of the Center for Science and Technology at Harvard's John F. Kennedy School of Government. Professor Nye served as a deputy undersecretary of state in the Carter administration and is the author of a number of books on nuclear policy, the latest entitled *Nuclear Ethics*. Now, when Secretary Perle, Professor Nye, talks about long-term, short term, what is he talking about?

JOSEPH NYE, Harvard University: Well, I think he is talking about two different things. The President's idea to make nuclear weapons impotent and obsolete is indeed very, very long term.

KOPPEL: Ten years? Twenty years? Thirty years?

Prof. NYE: Oh, I suspect it's 30-plus. And what bothers me about this program is that it's got too much exaggeration and hype. We should indeed be doing some research in this area, but we shouldn't be overselling it. For example--

KOPPEL: You're talking about his program or our program?

Prof. NYE: No, I'm talking about the SDI program.

KOPPEL: Oh, all right.

Prof. NYE: But if the surgeon general came in and he said, I've got a perfect cure for heart disease and then some scientist said, or a good number of scientists said, well,

you know, I'm not sure it's a perfect cure. In fact, it might even bring on more heart attacks than it cures. But then we noticed the surgeon general spending vast amounts of money and spending [it] at every congressional district that was politically influential. We've raised questions about the program. Or if a toothpaste company came in and they said, "Gee, we've got perfect toothpaste. You'll never see another cavity." And then it showed television pictures of just one perfect tooth, you know, flashing there in front of the camera. You'd raise questions about that program as well. My feeling is that what you have with Star Wars is something that's been hyped too much, hyped by the administration. The question really is this is a program that needs about half the money and about twice the accuracy in its advertising.

KOPPEL: Secretary Perle, I quoted the President in his initial euphoria about SDI. As of late, it seems to me, he has been backing off a little. Has he?

Sec. PERLE: I think he still shares that vision of rendering nuclear weapons impotent and obsolete. But it's a long way to get there. I think that's a perfectly fair and valid point.

KOPPEL: You agree with the notion of 30 years-plus?

Sec. PERLE: Well, I don't think it has to be that long. I think a first-generation system could be in place in the 1990s.

Prof. NYE: But wait a minute, Richard. Is that right that you believe that some day we can make nuclear weapons impotent and obsolete, there'll be no nuclear deterrents?

Sec. PERLE: Well, I believe that you can at the very least intercept ballistic missiles with such a high degree of reliability that the other side won't have much interest in maintaining ballistic missiles.

Prof. NYE: But that's not the same thing, is it?

KOPPEL: All right, gentlemen, we are in grave danger of getting into an argument about whether SDI works or not, and I promised--

Mr. ADAMS: Part of the problem here, Ted, I think, is that we really, I agree with Joe Nye, we have a problem of hype and sales pitch here that has gone far beyond the capabilities of the program to produce, and the thing that concerns me about it is we can't approach a program with care and caution when we pour so much money into it and hype it as fast as we can. This isn't a careful spending approach. This is really a kind of a snake oil approach that tries to lock in the program.

Sec. PERLE: Look, just repeating the assertion that the administration is hyping the program doesn't make it true. There hasn't been a shred of evidence that we're hyping the program.

Mr. ADAMS: Well, Richard, we have seen the administration hold private briefings for Wall Street, hold private briefings for contractors, do a tremendous amount of traveling that Abramson and Johnson and the rest of the office do across the country trying to bring an industry into a program in an attempt, I think, to build a constituency, to try to lock in that program so that by the time the next administration comes it's going to be very hard to approach with the kind of care we need to for technological options.

KOPPEL: That's really what I wanted to focus on, Secretary Perle, and that is building this constituency by throwing out sufficient money and putting it in the right places in the right congressional districts around the country and at the right universities, that eventually people are going to be hooked into supporting this program--

Sec. PERLE: Ted--

KOPPEL: Because that's where the money comes from.

Mr. ADAMS: Ted, I'm not sure that I agree with that "being placed in the right places" because I think really, if you'll look at the contracting it goes pretty much to the contracting companies in the states where the contracting has traditionally been done for the Defense Department. Part of the real problem here is a lot of the smaller companies that are becoming quite dependent on this program, 50, 75, 90 percent, for companies like Science Applications and Sparta, Inc., Nickles Technology, places that are really small and really rely on this program are going to find it hard to back out when technical decisions and choices have to be made.

KOPPEL: All right, that's--

Sec. PERLE: No one's arguing that a few small companies are going to drive national

policy.

KOPPEL: Secretary Perle, do me a favor. Hold on. I promise I'll come back to you first, but we have to take a break. We'll continue our discussion in just a moment.

[Commercial break]

KOPPEL: Continuing our discussion now with Assistant Secretary of Defense Richard Perle. You were going to respond to this notion of money being funneled out to people who are eventually going to become totally dependent on it.

Sec. PERLE: Well, I think every conceivable accusation has been made against the SDI program tonight, that we're throwing money all over the place, we're not spending money fast enough, that we're corrupting scientists and suborning industry, that we're overclaiming for the program, and there hasn't been a shred of evidence on any of these points. And the fact is it is a well-managed research program with recognized and achievable objectives. We're spending money at what seems to us an appropriate rate, given the level of technology that already exists in the areas where we have to concentrate our effort. And like any other research program, contracts are being awarded on the basis of the ability of contractors to perform the task.

KOPPEL: But there is--

Sec. PERLE: They are not being awarded according to congressional districts. They're being awarded competitively and where talent is to be found.

KOPPEL: All right, hold on just a second, Mr. Adams, because I'd like to go to Professor Nye for a second.

Prof. NYE: It is worth noticing we have some history on projects like this. For example, in the '70s there was the breeder reactor. They promised us inexhaustible supplies of energy, but in fact it turned out to be too expensive to be economic. It took two--

Sec. PERLE: And we abandoned it.

Prof. NYE: It took two presidents more than seven or eight years to abandon it.

KOPPEL: After how much money being spent?

Prof. NYE: After hundreds of millions of dollars being spent. And this is going to be billions.

Sec. PERLE: Well, Joe, I thought the breeder was a bad idea, too.

Mr. ADAMS: But the problem here with all these programs, breeder was a smaller program and it wasn't as widely contracted. We have about 500 major primes working on SDI, 70 college campuses and universities. There's a lot of activity here going on, and what strikes me as interesting about it is, unlike some of the previous programs, the breeder and others that Prof. NYE mentioned, is that SDI in this case is a program where the hype, the sales job, is being done by the Department of Defense--

KOPPEL: All right.

Mr. ADAMS: --on a somewhat reluctant industry.

KOPPEL: Secretary Perle, take the last shot because it's been two to one here. So go ahead.

Sec. PERLE: I think the record shows that the comments and statements, the testimony from officials of the administration responsible for the program have not overstated either our expectations or our ambitions or the progress that's been made to date.

KOPPEL: All right--

Sec. PERLE: It's been a fair representation.

KOPPEL: Gentlemen, Secretary Perle, Mr. Adams, Professor Nye, thank you very much. That's our report for tonight. I'm Ted Koppel in Washington. For all of us here at ABC News, good night.

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INDIANAPOLIS, IN 46204
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February 4, 1986

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COMMITTEES:
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Dear Colleague:

Attached is testimony the American Israel Public Affairs Committee (AIPAC) offered last Thursday to the Senate Strategic and Theater Nuclear Forces Subcommittee supporting U.S. development of an anti-tactical ballistic missile system. It deserves attention and proves a point I have long been making: That not only our own security, but that of our most important allies will be jeopardized unless we get serious about developing missile defenses.

As AIPAC's testimony makes clear, Israel already is vulnerable to a Syrian attack with accurate Soviet SS-21 missiles and will become more vulnerable as the SS-23 and other new tactical missiles are introduced into the Middle East. These new missiles, unlike their inaccurate predecessors, are more than terror weapons. They are accurate enough to disable military air bases and other important military point targets.

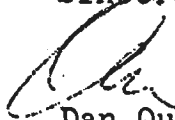
Unfortunately, Israel's only military answer today is to find these missiles and attack them before they are ever used--i.e., to strike first. This is hardly a prescription for stability or peace and the Israelis, reasonably enough, are worried.

They are not alone. As the Subcommittee hearing last Thursday made clear, our own forces in Europe face the same threat. Soon, unless NATO is willing to strike first against these new missile systems (which is unlikely) the Soviets could knockout all our key NATO military assets in seconds without nuclear weapons.

What AIPAC recommends, we in the Senate should at least be willing to consider--that defenses against missiles are our best hope to head off instabilities likely to produce wars and that SDI technologies and their near-term application against tactical missiles deserve funding.

If you are interested in receiving copies of the other testimony given before the Subcommittee, please contact me or call my assistant, Henry Sokolski, at 224-5623.

Sincerely,


Dan Quayle
U.S. Senator

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5530 SOHL AVENUE, #103
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(219) 937-5380

NORTHEAST OFFICE:
340 FEDERAL BUILDING
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SPACE WEAPONS, THE KEY TO ASSURED SURVIVAL

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INTRODUCTION

As a result of congressional efforts to ban U.S. testing of weapons in space¹ and the recent testing of an anti-satellite (ASAT) weapon by the United States, increased attention is being directed to the question of whether the United States should have a space weapons² capability. Given the Soviet space weapons and treaty compliance record, along with the benefits to U.S. military security, the continued development of space weapons is in the U.S. national interest. Perhaps more important, a ban on space weapons would prevent the U.S. from deploying defensive space weapons as part of the strategic defense system envisioned by President Reagan. Such a strategic defense system would help protect the U.S. homeland from nuclear attack, reinforce deterrence, protect U.S. conventional forces and satellites from Soviet threats, and help stabilize crisis situations.

The control of space weapons through a negotiated agreement with the Soviets is a flawed idea. First and foremost, an ASAT ban would deny the U.S. the opportunity to develop and deploy the most essential feature of a strategic defense system--a ballistic missile defense (BMD) system. A BMD system would inevitably have ASAT capabilities and would be banned also. The U.S. thus would be locked into reliance on offensive nuclear forces to deter attack, and the threat of almost total societal destruction in a nuclear conflict would remain.

Second, an ASAT ban would not even accomplish what its proponents claim it would, that is, the protection of U.S. space assets. Such a ban would be virtually impossible to verify, and the Soviets' compliance with past arms control agreements is poor enough to suggest that, given the opportunity, they would find ways to circumvent an ASAT ban.

August 23, 1984

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INTRODUCTION

Strategic defense is probably the most exciting and promising defense concept in a generation. At long last, it could end reliance on the balance of terror by giving the U.S. a defense that really defends. What makes this now possible has been the emergence of technologies for constructing weapons systems that can intercept and destroy a substantial portion of an incoming ballistic missile attack. The technological issues related to strategic defense are complex, but the basic operational principles are not.

A multilayered, multitechnology approach to ballistic missile defense (BMD) shows the promise of achieving the capability to intercept a very high percentage of offensive nuclear weapons after they have been launched at the U.S. Attacking ballistic missiles in each phase of their flight with weapons that destroy them in different ways forces the offense to attempt the difficult task of overcoming various threats. This requires various and sometimes self-contradictory countermeasures. Critics argue that strategic defense is not technologically feasible, yet many of the relevant technologies have been researched since the 1960s, and there have been many recent dramatic breakthroughs. From the technological perspective, therefore, the weight of the data supports strategic defense.

SUPPORTING TECHNOLOGIES

Every system of defense against ballistic missiles must perform certain functions to achieve its goal. A system must be capable of: target acquisition (the search for and detection of an attacking object such as an intercontinental ballistic missile or its warheads); tracking (to determine its trajectory); discrimination (to distinguish missiles and warheads from decoys or

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INTRODUCTION

In his address of March 23, 1983, President Reagan directed a "comprehensive and intensive effort to define a long-term research and development program, to begin to achieve our ultimate goal of eliminating the threat posed by strategic nuclear missiles." The media quickly, but inappropriately, characterized it as the "Star Wars" initiative.

The message was clearly directed at goals rather than means. The technological basis for this fundamental policy shift involves new technology and innovative concepts in space. Prevailing military space policy does not explicitly provide the clear directives needed to support the President's initiative. It is now essential, therefore, to reexamine and revise U.S. military space policy.

BACKGROUND--SPACE IN NATIONAL POLICY

Present military space policy is set within the framework of national space policy, which was first established by the National Aeronautics and Space Act of 1958. While the NAS Act encompasses the civilian and military aspects of space, the specifics of the act deal mostly with the establishment of the civil space program and the organization of the National Aeronautics and Space Administration (NASA). It was intended to project the peaceful and scientific objectives of the space program to the world community.

set forth the basic national policy for a response to the Soviet space challenge. It estab-
lished the authority for a new class of programs that did not fit within the civilian agency structures. Congress

More 'Masked Politics' From Anti-SDI Scientists

By KARL O'LESSKER

In recent days scientists from across the country have burst into a chorus of denunciations of America's Strategic Defense Initiative, or Star Wars. A computer scientist serving as consultant to the Office of Naval Research quits his SDI consultancy, claiming the computer problems are insuperable. A physicist from the University of Illinois, speaking on behalf of 46 of the 72 members of his department, refuses to accept any SDI research funds. The Union of Concerned Scientists produces six of its number who worked on the Manhattan Project and who now, on the anniversary of the first atomic explosion, hold a Washington news conference to denounce the folly of Star Wars. To the trained ear it all sounds suspiciously well orchestrated: another example of the unrivaled organizing abilities of the political left.

Whether it is, is less interesting than what it tells about the politicized state of American science—a point that Gregory Fossedal and others have made in these pages. But the point bears repeating in the aftermath of this most recent outburst because the anti-SDI scientists continue to claim *scientific* warrant for their opposition when in fact their principal arguments are of the sort the American Spectator's R. Emmett Tyrrell Jr. has rightly called "masked politics."

Consider the case made by physicist Larry Smarr of the University of Illinois in a July 16 interview on National Public Radio's "All Things Considered." In its relentlessly anti-defense way, NPR had somehow managed to find this otherwise obscure academician, whose credentials as a weapons-technology expert it somehow neglected to mention, and interviewed him

at length about his anti-SDI stance. (Devotees of "All Things Considered" will not need to be told that it interviewed no one of opposing views.)

The professor began with the standard assertion, unsupported by any evidence, that Star Wars can't possibly be made to work and therefore should not even be looked at. When NPR's interviewer asked what was wrong with just research into the possibility of it, Prof. Smarr responded that the projected costs of the effort amounted to more than all the federal funds for all other university-based scientific research combined. At this point the mask began to slip a little. He was no longer talking about whether a space-based missile defense was practicable; he was complaining about what he and his colleagues saw as a misallocation of federal dollars—away from their own pet projects and toward a scientific enterprise they disapproved of on other grounds.

And then the other grounds came into focus at the end of the interview. It was a matter of broad national priorities. Mr. Smarr said. With all the unmet human needs in the U.S., the government just shouldn't be spending billions of dollars on a new weapons system. What unmet needs did he have in mind? The interviewer refrained from asking. Had he done so, doubtless we would have been treated to the full litany of grievances that the San Francisco Democrats made imperishably their own last summer. Doubtless, too, both interviewer and interviewee thought it altogether unnecessary to state such truths to the listeners of "All Things Considered."

Those who are condemned to live in the mean world outside Academia may per-

haps be impressed by the consensus among more than half the members of Illinois's physics department. Surely that bespeaks a solid scientific indictment of Star Wars? Well, for reasons that only social psychologists may one day fathom, physicists generally have been the most leftward leaning of all university scientists. As long ago as 1948, for example, the University of Pennsylvania physics department sent its own delegate to Henry Wallace's Progressive Party convention. It is a safe assumption that its enthusiasm for the former vice president had more to do with his outspoken Stalinist sympathies than his grasp of quantum mechanics.

The six ex-Manhattan Projectites set their opposition to Star Wars squarely on politico-strategic grounds. The effort to deploy a missile defense, they argue, will precipitate a new arms race, just as the U.S. development of the hydrogen bomb and MIRVs, or multiple-warhead missiles, did. Coming from laymen, this charge would be merely ignorant and silly; coming from men who helped build the first atom bomb and have remained conversant with nuclear weapons development since then, it is close to inexcusable. For they know as well as any men alive that, in the case of the former, the Soviets detonated a thermonuclear device within 18 months of America's, proving incontestably that they had been working on it at least as long as the U.S. was. The American decision to try to build an H-bomb, far from impelling the Russians to do so as well, spared the world the nightmare of a Soviet monopoly of this most destructive weapon.

The issue is less clear with respect to MIRVed missiles, because it took the So-

viets almost six years to catch up with the U.S. But that proof of U.S. technological superiority is by no means proof that the Russians would never have attempted MIRVing if the U.S. had "shown restraint." One wonders how the Concerned Scientists can have forgotten that the Soviet Union led the U.S. by a wide margin in the development and deployment of intercontinental ballistic missiles.

The whole 40-year record of weapons system competition between the two superpowers shows beyond doubt that the Soviets' policy has been to push ahead of the U.S. whenever they could and try to blunt America's technological advantage through arms control when they couldn't.

More immediately relevant is the fact, known to everybody in the national security community, that the Soviets are hard at work on their own strategic defense system, major elements of which are already in place; they are if anything ahead of the U.S. in this. Yet the Union of Concerned Scientists adherents continue to insist that the U.S. will be guilty of starting a new arms race if it goes ahead with SDI. The truth, here again, is that the U.S. is already in a strategic-defense arms race whether it likes it or not, and the only result of it opting out of it will be to hand the world to the Soviet Union on a high-tech platter of the Russians' own design.

No one, contrary to an indignant letter to the editor of this newspaper that appeared July 16, wants to deny scientists the right to speak out on issues of national concern. Still less does anyone question the value of scientists' addressing themselves to matters of scientific controversy within their own areas of expertise. But when they decide to enter the political arena in an effort to influence public policy, they have an obligation to abide by two rules of fair conduct: to distinguish between scientific fact and political opinion, and to speak the truth. So far, too many of the scientists opposed to Star Wars have failed to meet those standards.

Mr. O'Lessker is professor of public and environmental affairs at Indiana University and a senior research fellow of the Hudson Institute.

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Vision of Space Defense Posing New Challenges

By LESLIE H. GELB

Special to The New York Times

WASHINGTON, March 2 — President Reagan's vision of defensive systems to render nuclear weapons "impotent and obsolete" is moving strategic thinking and nuclear competition toward a new era.

For Mr. Reagan's vision has done nothing less than to assault the core of nuclear philosophy, namely deterrence based on the threat of retaliation. He and his senior aides are saying that the 40 years of nuclear peace built on that threat cannot last and is, in any event, immoral.

Weapons in Space

The Controversy
Over 'Star Wars'

First of six
articles.



Most experts say they think that perhaps decades of research will be required before they know with confidence whether the vision can be translated into workable technology.

Consequences of the Vision

Yet proponents and critics alike are well aware that the vision itself, along with accelerated research programs and the attending debates, is shaking the foundations of American military policy — strategic doctrine, the shape of military spending, alliance relations and arms control.

National attention is focusing more and more sharply on the plan as the two superpowers prepare to resume arms talks in Geneva on March 12, as current research and testing proceeds apace, as Congressional debate gets under way on proposed spending for such research and more and more technical and doctrinal questions emerge.

The President's ideal is a defensive system that saves lives. But the reality could be new and more powerful offensive and defensive capacities that could be used for a decisive nuclear first strike. Thus, the debate centers on how far the reality is from the ideal: Is the President's so-called Strategic Defense Initiative, more popularly known as "Star Wars," well conceived to save countless lives and enhance deterrence, or is it more likely to lead to an ever-more-precarious nuclear balance?

For the next five years, planned spending is about \$30 billion out of more than a trillion dollars in military budg-

ets. When and if the program gathers momentum thereafter, it could become a dominant element of that budget.

The Allies' Position

Publicly, American allies are supporting research. Privately, they continue to express the deepest fears that the program will bring a space arms race that will reduce or eliminate the links between American security and their own.

Administration officials assert that the Strategic Defense Initiative brought the Soviet Union back to arms talks and will lead to real reductions in offensive arms. But Soviet leaders insist they will make no such reductions until the program is reined in. And Mr. Reagan said in a recent interview that he would not limit his initiative, even if Moscow agreed to deep reductions in missiles and even if all nuclear forces were eliminated. Administration officials also say he has put aside his earlier offer to share defensive technologies with Moscow.

Publicly, the Administration says the Soviet Union already has the jump in missile defense, both in a deployed antiballistic missile system and in development of new technologies. Indeed, no one disputes that the Russians have a small ABM system around Moscow

and that the United States has not deployed a system. Privately, however, the weight of opinion in the Administration is that hard American knowledge of Soviet research in this area is negligible and that the United States leads in most if not all areas of research.

All of the agonizing decisions and judgments that will have to be made in years to come on developing and deploying a panoply of the most futuristic technologies will have to be done without ever testing them against a full-scale attack. And to fulfill their goal, as former Defense Secretary Harold Brown has written, they will have to work perfectly "the first time."

The unanswered questions now seem legion. Has the momentum for the proposed program already made it unstoppable? What, in fact, is the Soviet technical ability? How was the idea of a vast American antiballistic missile system revived when it seemed so firmly put to rest by treaty more than a decade ago? Who is behind it? Who is against it? Why? Can it ultimately be made to work? Can these defensive abilities also be used as potent offensive weapons?

What is perhaps most striking about a series of recent interviews with officials throughout the Administration is that hard questions about the program are not getting much of a hearing in the inner councils. By almost all accounts,

support for the program has become the touchstone of loyalty to the President.

In fact, whether some of these questions will be answered may depend on the purview of the debate. And that may depend on who defines its terms — the Administration or its critics in Congress and the arms control field.

Officials acknowledge that the Administration wants the vision to dominate what they see as a narrow and practical debate about research into promising technologies.

The critics want to cast the debate in the broadest possible terms now, before the program becomes enormous and politically unstoppable.

Officials and critics alike agree that some research is desirable, if only on the ground of prudence and as a check against Soviet projects.

Moreover, it should be pointed out that neither critics nor Soviet leaders who publicly argue for limits on military research have put forward a plan for monitoring work that for the most part occurs in laboratories.

Mr. Reagan opened the door to the larger debate when he unveiled his ideas on March 23, 1983. In calling on scientists to find ways to render nuclear weapons "impotent and obsolete," he said, "My fellow Americans, tonight we are launching an effort which holds the purpose of changing the course of human history."

The Goal: Escaping Nuclear Nightmare

Mr. Reagan and his senior aides say by way of justification of the program that they want to escape the nuclear nightmare by going from deterrence based on offense or the threat of retaliation to deterrence resting on defense or the security of protection. On moral grounds, this is also consistent with positions on nuclear war recently taken by the Roman Catholic bishops of the United States.

It is precisely the problem that Mr. Reagan's predecessors from Lyndon B. Johnson on wrestled with. They all said "No" to making the transition from mutual assured destruction to mutual assured defense, in which attacking missiles would be destroyed before they could reach the targets. Their objections were based largely on the ground that such defensive systems were not feasible.

Now, Mr. Reagan and many of his advisers maintain, this has changed. "Current technology," he said in unveiling his plan, "has attained a level of sophistication where it is reasonable for us to begin this effort. It will take years, probably decades, of effort on many fronts."

All the worse, charged a host of American scientists, arms control specialists and the Soviet Union. Rather than a more stable and sensible peace, they argued, Mr. Reagan's vision would touch off a new and more dangerous arms race in space and succeed only in destroying prospects for arms

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control. Soviet officials are saying privately that they will have to accelerate their research program and keep open the option of making more offensive nuclear warheads to overcome prospective defenses. They also express concern that once the research program gains momentum, future American Presidents will find it difficult to stop. They argue that a system to defend populations will not work, but they do tend to think it might be possible to build a limited system for the defense of missile sites. Still, they do not want to open this door either.

As for feasibility and rendering nuclear weapons obsolete, former Defense Secretary Brown, a nuclear physicist, spoke for scientists who are critics of the program when he wrote recently, "The combinations of limitations — scientific, technological, systems engineering costs — and especially the potential countermeasures make the prospect of a perfect or near-perfect defense negligibly low."

Lieut. Gen. James A. Abramson Jr., the director of the Strategic Defense Initiative, disputed this in an interview, saying: "There is very little question that we can build a very highly effective defense against ballistic missiles someday. The question is how soon and how affordable and what degree of effectiveness can initial steps allow us." As for those who disagree, he suggested that it was "because for a lifetime they have been dedicated to another idea and they are not very willing to accept a new thought process."

"What is really happening," he said, "is that there are a large number of dedicated, talented people working on this in Government and industry. And when they all have a goal to march to, and that's what the President gave us, you just cannot stop the progress they are making and that progress is what's happening."

Officials say President Reagan's 1983 speech was inspired in part by his monthly meetings with the Joint Chiefs of Staff, who proposed rethinking the idea of developing defenses to protect missile sites.

Mr. Reagan, in effect, enlarged this notion, and his speech was viewed by Administration officials as essentially a way of telling them that this was one of his top priorities, perhaps his ultimate legacy. He made few concrete decisions about the program other than to approve an increase in spending of about 50 percent over six years, an increase from about \$20 billion to about \$30 billion.

His senior aides, many of whom acknowledged being taken by surprise, proceeded to fill in the blanks and push their own views, often in contradictory ways.

"It's all things to all people," commented Paul C. Warnke, a director of the Arms Control and Disarmament Agency under President Carter. "To the President, it is saving peoples' lives. To Defense Secretary Weinberger, it is a technological steppingstone from missile defense to the President's larger conception of immaculate de-

fense. To others, it is simply a means of defending missiles. To some, it is a bargaining chip in arms control negotiations, while to others, including the President, it is untouchable."

As matters stand, the Administration is asking Congress to approve \$3.7 billion this year, after \$1.4 billion last year, for research on what is envisaged as a three-tier defensive system.

The first line of defense would be in the three- to five-minute boost phase as a missile with its warheads is rising to leave the atmosphere. The second would be in the midcourse flight in space of about 20 minutes when the warheads or re-entry vehicles separate from the missile. The terminal phase is the last two minutes of flight as the warheads re-enter the atmosphere.

Broadly speaking, the technological innovations come for the most part in the first two phases. Here the Administration is looking at an array of possibilities: space- and ground-based lasers, magnetic rail guns that fire projectiles at amazing speeds and directed beams of subatomic particles.

As the skeptics see it, this automatic and automated situation would require almost immediate reaction and could effectively remove the possibility of human decision — even by the President. And in the past, of course, even the 25-minute flight time of intercontinental missiles was regarded as short and always a matter of concern.

The terminal phase of the defense would use existing and more conventional technologies of firing a missile at an incoming warhead. Advocates say this technology could be deployed within a decade.

The Administration remains divided on the feasibility and importance of the idea. At one end are the doctrinal purists such as Fred C. Iklé, Under Secretary of Defense for Policy, who said recently: "The Strategic Defense Initiative is not an optional program, at the margin of the defense effort. It's central, at the very core of our long-term policy for reducing the risk of nuclear war." Like the technological optimists such as General Abramson, they believe not only that it can be done, but also that it must be done.

There are also those who would wait and see, such as Paul H. Nitze, the primary arms control adviser to Secretary of State George P. Shultz. In a recent speech, Mr. Nitze stated, "Quite frankly, it may prove impossible to obtain."

No longer is any official saying publicly what Richard D. DeLauer, former Under Secretary of Defense for Research and Engineering, said in 1983. "This is a multiple of Apollo programs," in terms of the technological advances required, he said, and if it is deployed, Congress will be "staggered at the cost." Still, some officials privately believe this to be the case.

The basic doctrine behind the Administration's position is that the United States cannot be sure mutual assured destruction will work into the next century and that it must be replaced by mutual assured defense.

The centerpiece of the nation's

strategic thinking until now has been the Antiballistic Missile Treaty of 1972, and for now it continues to be. This limited the superpowers to no more than 100 defensive missiles, all defending one site. It was taken by Washington to mean that both sides accepted the doctrine of mutual deterrence through retaliation and that neither would do anything to take away the other's ability to retaliate devastatingly.

Thus, Article V states, "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." This did not preclude research, which both sides have been doing since then, nor could it make absolute distinctions between research and development.

Acceptance of the treaty was also predicated on the assumption that reductions in offensive arms would follow swiftly and that otherwise Washington would reconsider its adherence to the treaty.

The Administration is saying that quantitative and qualitative improvements in offensive weapons, particularly in the powerful and accurate Russian land-based missiles, are threatening to neutralize the American retaliatory capacity.

Officials contend that a few hundred missiles with multiple warheads could destroy virtually all American land-based missiles, submarines in port and bombers on airfields. This would leave future Presidents with only submarine-launched ballistic missiles of insufficient accuracy to destroy anything but Soviet cities. This, they say, is not a credible retaliatory threat because an attack on Russian cities would necessitate an attack on American population centers.

Thus, their argument runs, Washington must build better offensive systems or defensive systems or both.

The Administration is proposing to do both. It is building offensive weapons such as the Trident II and cruise missiles, which would have the accuracy to strike hardened Russian targets such as missile silos and command centers, not just cities. Also for offense, it is developing a small missile known as Midgetman, which Moscow could not count on destroying because of its mobility.

The United States is pushing these programs even though the President's Commission on Strategic Forces said the so-called window of vulnerability that they were designed to overcome had been overestimated. And the Administration has not dismissed the "nuclear winter" theory that says the smoke and dust from even relatively few nuclear explosions would shut out enough sunlight to end human life on the planet.

Officials say the new offensive programs are not enough.

The Balance: Defense vs. Offense

Whatever the reality of the strategic balance the new offensive weapons

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produce, officials say, the perception of Russian superiority will remain because of the powerful land-based missiles. This perception, they contend, would put Presidents in a weak position in future crises.

Asked why they cannot, through public statements, make the perceptions conform to the reality, the answers are generally vague. Instead, they argue that greater and greater offensive power will only make the nuclear balance more unstable. Thus, to them, defense against attacks on missiles — from small or accidental attacks to all-out attacks — is the only moral and practical answer.

Skeptics and critics raise two principal objections to this line of reasoning: It remains easier and cheaper to overcome defenses with offensives than to neutralize offensives with defenses; and in the critical and long transition period from relying on offense weapons to relying on defensive weapons to prevent war, the likelihood of nuclear war would be at its peak.

Mr. Reagan recently argued that the defense could prevail, as it did in World War I when gas masks were an effective defense against chemical warfare. Others suggest that the use of poison gas was stopped when an increase in its use threatened to destroy both sides without benefit to either.

The more typical answer from the Administration comes from Mr. Nitze, who said: "New defensive systems must also be cost-effective at the margin, that is, it must be cheap enough to add additional defensive capability so that the other side has no incentive to add additional offensive capability to overcome the defense. If this criterion is not met, the defensive systems could encourage a proliferation of countermeasures and additional offensive weapons to overcome deployed defenses, instead of a redirection of effort from offense to defense."

Also, as defenses against ballistic missiles are deployed, each side could increase its number of aircraft and cruise missiles flying in the atmosphere to circumvent them. To this, Administration officials reply: Better these slower-flying weapons, which allow time for response, than the fast-flying missiles.

As to the transition period, Mr. Iklé contends that it would not be destabilizing. He says, "As a growing fraction of the Soviet missiles could no longer reach their targets, Soviet planners would face increasing uncertainties and difficulties in designing a rational first strike."

Not so sanguine is Mr. Nitze, who said the transition could take decades, could be tricky and would be dangerous if Moscow developed better defenses first. "We would have to avoid a mix of offensive and defensive systems that, in a crisis, would give one side or the other incentives to strike first."

The real fear felt by critics is that the side that got to the optimal mix first might reason that it could destroy most of the other side's forces in a first strike and blunt the retaliatory blow with de-

fenses. This, in theory, would make nuclear war "rationally" thinkable for the first time.

Mr. Reagan and others say the transition could be managed through arms control negotiations by agreeing on what to deploy and when. Officials say he no longer is willing to share the technology with Moscow because it could be put to many other military and civilian uses. Critics argue that such negotiations would be far more difficult than anything yet undertaken with Moscow.

While critics take the Administration's line to mean that a change in doctrine has already occurred, officials say otherwise. Richard N. Perle, Assistant Secretary of Defense for Policy, said in a recent interview: "It is not true that we've already made the decision to abandon mutual assured deterrence or the policy that seeks to achieve security by the threat of retaliation. That will still be with us for years."

Officials such as Mr. Perle and Mr. Nitze seem far less concerned with the

President's ultimate vision than with what they see as the closer and realizable goal of defending American land-based missiles. They argue that this would enhance deterrence by substantially reducing the Soviet chances of destroying these fixed targets in a first strike.

Critics of this view of enhanced deterrence say a system to defend missiles could readily blossom into a defense of the general population, putting the debate virtually back where it started.

This fiscal year, research on missile defense constitutes about 5 percent of the Pentagon's research and development budget. By 1990, the Congressional Budget Office estimates, it will rise to 17 percent.

General Abramson questions these figures and feels even more strongly about estimates of deployment costs, which he says will not be known until the Government finds out which systems will work.

Nonetheless, estimates by many experts run from half a trillion to a trillion dollars. This does not include the cost of a possible air defense system, which former Defense Secretary James R. Schlesinger said could be as much as \$50 billion over several years.

Even smaller guesses would be far more than is being spent on offensive nuclear programs and would consume the bulk of spending on strategic forces. Pentagon analysts also say that deployment would bite deeply into spending on conventional forces.

Allies' Worries and Arms Control

"One of the worst problems we're having with the President's plan is with the allies," a high State Department official said, "and it only looks as if we have it under control for the moment."

Some Pentagon analysts argue that missile defenses are good for Western Europe and Japan. These analysts say that in the short run, protecting the United States will lend credibility to Washington's threat to use nuclear

weapons to protect them. In the long run, they hold out the promise of extending the protective umbrella to the allies as well.

But the allies did not see it this way at first, and Administration officials say that Mr. Reagan worked out a deal with Prime Minister Margaret Thatcher of Britain to patch over the disagreements. In effect, the agreement is that the allies — minus France — will publicly support research, and in return the Administration will consider decisions on the ABM treaty and deployment to be matters for allied consultations and negotiations with Moscow.

In the meantime, Britain and France are concerned that an American defensive system would make the Soviet Union develop a full-scale system that could negate French and British nuclear missiles. Their concern is that the Soviet network might not be good enough to block an American attack but might be good enough to neutralize the West European deterrent.

The allies in general are worried that in the short term, defensive systems to protect the superpowers will make Europe alone the likeliest nuclear battlefield.

Finally, West European diplomats worry that uncertainty about American plans for defenses will complicate and perhaps undermine the chances for progress on arms control and particularly on reducing medium-range nuclear forces in Europe.

Administration officials maintain that Mr. Reagan's defense initiative brought Moscow back to the bargaining table it left in late 1983 when the first American medium-range missiles were deployed in Europe. They also argue that the specter of competing with the United States in this area will drive Moscow toward concessions on reducing offensive forces.

The officials have said that when Soviet and American negotiating teams convene in Geneva on March 12, the Americans will try to persuade the Russians to accept a three-stage approach: radical reductions in offensive forces, then a transition to a mix of offensive and defensive weapons and finally the total elimination of nuclear weapons and deployment of full-fledged defenses.

As explained by the Administration, bargaining leverage would be derived from Moscow's fear of engaging in an all-out technology race with Washington. At the same time, the officials acknowledge that this leverage depends on how much Congress supports the strategic programs — the Strategic Defense Initiative and the MX missile in particular — and that Congressional support depends on the sense that the Administration is negotiating in good faith.

So far, Moscow has totally rejected the Administration's approach. The Soviet position is that Moscow will not commit itself to a radical reduction in

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Excerpts From White House Report on the MX

Special to The New York Times

WASHINGTON, March 4 — Following are excerpts from President Reagan's report to Congress on continuing the acquisition of the MX missile, which the Administration calls the Peacekeeper, issued today by the White House:

No change is apparent in the Soviets' continued efforts to build up their strategic nuclear forces both quantitatively and qualitatively. They did not slow any aspect of their program, as indicated by these developments that occurred during 1984:

Modernization of the Soviets' fourth-generation Intercontinental Ballistic Missile (ICBM) continued with the modification and deployment of an additional 30 SS-19's (carrying a total of 180 highly accurate warheads). At the same time, development and flight test of both the new SS-X-24 ICBM with 10 warheads and the single-warhead SS-X-25 ICBM continued (despite the fact that SS-X-25 testing violates at least two provisions of the unratified SALT II Treaty as documented in the February 1985 Report to Congress on Soviet Noncompliance). We anticipate that both SS-X-24's and SS-X-25's will be deployed in silos as well as on mobile launchers over the next few years.

Three types of strategic bombers are in production or development. Production continues on the Backfire and Bear H bombers. The Bear H achieved its Initial Operational Capability (IOC) with the new As-15 air-launched cruise missile during 1984. This deployment is advancing more rapidly than we projected one year ago. Advanced development of the new Blackjack bomber, similar to but larger than the B-1B, also continued, and we expect it to be ready for deployment before the end of the decade.

An additional Typhoon-class missile submarine (SSBN) (the third), joined the Soviet Navy, as did the first and second ship of a second new class of SSBN's, the Delta 4. Testing of the Delta IV's sea-launched ballistic missile, the SS-NX-23, also continued throughout 1984, and an IOC in the near term is expected. In a related development, flight testing of a long-range sea-launched cruise missile (SS-NX-21) appears to have been completed and the missile may already be operationally deployed on submarines near U.S. coasts.

In addition to this accumulation of offensive intercontinental nuclear forces, the Soviet Union in 1984 continued to:

Improve its massive air defenses;

Upgrade the Moscow antiballistic missile (ABM) system and construct large phased-array radars (one of which constitutes a violation of the log obligations under the ABM Treaty);

Perform extensive research and

development (R&D) on a rapidly deployable ABM as well as extensive R&D on a space-based strategic defense system, and on new air-defense missiles with capabilities against some types of ballistic missiles; and,

Deploy significant numbers of new intermediate- and short-range nuclear missiles and artillery systems.

As last year's report made clear, this accumulation of vast military power, coupled with current Soviet advantages in strategic forces, should — if unchecked — result in the Soviet leadership becoming far more confident about using its political and military leverage to exert influence against other nations around the globe. A perception that the United States is unable or unwilling to take the steps necessary to offset this growing Soviet power could further increase the Soviets' inclination to become involved in regional conflicts, even if such involvement would risk engaging U.S. interests.

Furthermore, a growing risk of direct confrontation with the Soviet Union would cause regional powers to become more inclined to accept a great level of Soviet interference in their affairs.

Finally, and most dangerously, this perception could over time begin to suggest to the Soviet leadership that the threat, or actual use, of military force — including nuclear weapons —

against United States forces or against those of our allies could result in significant military advantages for them. Thus, from this evidence we can only conclude that the Soviets have not changed either strategy or policy. They continue to build and modernize at a very high rate.

To reverse these dangerous and destabilizing trends, this Administration initiated the Strategic Modernization program in October 1981. The program resulted in some improvements in our deterrent capabilities in 1982 and 1983. In 1984 this long-range program began to secure truly significant enhancements to our forces.

Successful Test Flights

Nineteen eighty-four witnessed three more highly successful Peacekeeper test flights (the fourth, fifth and sixth tests in that series), concluding Phase I of the test-flight program. The seventh test flight, which occurred on Feb. 1, 1985, was also successful. The Peacekeeper continues to perform exceptionally well, achieving accuracies which are better than design requirements. Additionally, production of the first 21 Peacekeeper missiles is under way, as well as support facility construction. All aspects of this program are progressing smoothly and are well within cost estimates. In fact, with the release of the F.Y. '85 funds, the program will be over 50 percent com-

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offensive forces until it knows that defenses will be limited.

But Moscow has not spelled out exactly what limits it wants on defenses. Soviet diplomats here are well aware that laboratory research cannot be monitored effectively, and the feeling among American officials is that Moscow is simply conducting a propaganda campaign to try to reduce public support for the Administration's research program without curtailing its own research.

Administration officials voice special concern about a Soviet radar system nearing completion in the central part of that country. They contend that this is a clear violation of the ABM treaty, while Moscow answers that it is merely a satellite tracking station. Administration officials vow that this will be a key issue in the coming talks.

There matters stand on arms negotiations, with neither American nor Soviet officials evincing much optimism that they will be able to solve these problems through negotiations.

The prevailing view in the Administration is that whatever effects defensive prospects ultimately have on negotiations, the immediate effect has been to create a deadlock.

NEXT: The genesis of "Star Wars."

plete in terms of total program funds.

An ICBM test program does not, however, constitute a deployed asset.

In particular, the inherent high alert rates, low day-to-day operations cost, and responsiveness of the ICBM force, which includes Peacekeeper missiles, provide a powerful disincentive to a Soviet first-strike. With 100 Peacekeeper missiles in our inventory, the Soviet leadership finally will have to weigh more seriously the vulnerability of key elements of their own forces to retaliation. Peacekeeper thereby will help to induce caution and restraint into Soviet geopolitical activities by removing any perception the Soviet leadership might harbor about its ability to dominate a crisis or to conduct and emerge successfully from a nuclear conflict with its most valued assets intact and its war aims achieved. As a result, deployment of Peacekeeper starting in 1986 will clearly decrease the risk of war. These facts have not changed in over a decade of debate about this missile.

At the same time, however, the size of the Peacekeeper force was not chosen arbitrarily. A limited deployment of 100 missiles will not give the USSR legitimate grounds for fearing a first-strike from U.S. forces. With 100 missiles, U.S. strategic forces will fall far short of possessing a first-strike capability — given the num-

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Reagan's ASAT Boomerang

By Noel Gayler

THE REAGAN administration appears intent on testing our newest anti-satellite weapon soon. Many observers think this move is part of a new get-tough offensive on the part of the United States, to get a leg up on the Geneva arms-control negotiations and the Reagan-Gorbachev summit. It seems more likely, however, that the timing was determined by the weapon program itself — never mind the consequences.

It's time to take a look at the consequences of making space still another battle area. We are shooting ourselves, not in the foot, but a lot closer to the head. Of course, we are responding to the current Soviet effort, itself a possible response to our own earlier capability. This cycle is a formula for continuing escalation of the arms race indefinitely.

In the past, none of these weapons has had a capability against many of the satellites that are most important to us. But when the Soviets match us again, as they inevitably will, then even in the outermost reaches of space there will be no sanctuary. Few satellites, military or civilian, will be safe. Our own space shuttle will be at risk. So will the Soviet manned space stations.

The crux of the issue for us is that we Americans are far more dependent on the use of space — at least for military purposes — than the Soviets are. We depend greatly on space for military communications, for command and control, for navigation and precise position-finding. The high accuracy we assume for certain missiles systems in our nuclear deterrent is dependent on satellites.

Most important of all, we need satellites to know what is going on. The detailed pictures we can take from space afford an extraordinary overview of every activity within the vast Soviet land mass. Not at all incidentally, satellites can give us a similar overview of other areas of the world — in time, for example, to detect and avert preparations for South Africa's nuclear weapons testing in 1977.

Nor is this all. Satellites can "see" enormous portions of the earth's surface. Equipped with radar, or infrared detectors or listening receivers, they can supplement photography to fill in the whole picture. From

our intelligence perspective, we would be almost helpless without them, in this complex technological world.

From the standpoint of the Soviets, the situation is quite different. We are an open society. Vast amounts of military, political and industrial information are available to anyone — including the Soviets — for the price of subscription to a technical journal. Congressional testimony, official publications, contractors' brochures and newspaper stories are another rich lode of information.

The Soviets hardly need satellites to observe us. We "tell them all about it," so far as our own affairs are concerned. It's even difficult to imagine why they bother with satellite surveillance of us, except, possibly to attempt to track ships at sea — no easy task.

The development of anti-satellite weapons on both sides will, therefore, hurt us far more than it will hurt them.

We are not talking here about the administration's Strategic Defense Initiative (SDI) or "Star Wars" proposal. Although some of the technology is applicable to both ASAT and Star Wars, the problems posed in developing an anti-satellite system are infinitely simpler.

What are these "anti-satellite weapons?" The earliest were nuclear-tipped rockets, fired in the general direction of the target, and killing with a nuclear blast. Some others are simply satellites, maneuvered into a collision with the target satellite. The present Soviet ASAT is of this kind. Some are so-called space mines: companion satellites orbiting in close proximity to the target that can be blown up instantaneously on command, taking the victim with them. And some, far less developed, are laser or energy beams. The beams may be directed in space from one satellite against another, or from the ground to the target via a mirror in space.

The current Soviet anti-satellite weapon, which has been around for a while, is a dog. No doubt the Soviets can and will do better, if we reach no agreement with them. But an agreement that prevented the further development of satellite killers by either side would be so much in our own American interest that, if we can get it, we should grab it. The Soviets' operational capability is

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minimal. Ours, potentially much better, is not yet fully developed. Now is the time to make a deal.

Can we trust the Russians? How can we verify such an agreement, once it is signed? Here the situation looks pretty good.

A treaty stopping anti-satellite development would be readily verifiable. It's hard to hide activity in space. There's a cold black uncluttered background that makes detection easy. Satellite orbits are predictable, and orbital changes characteristic of anti-satellite tests stand out like a sore thumb. The characteristic dependence on specialized ground support is another giveaway.

Thus the very nature of space makes it unlikely that the Soviets would be able to develop a weapon clandestinely and then test it in space without our knowing about it. Moreover, even if they did develop an anti-satellite weapon, they would be unable to take out all our satellites simultaneously. So "breakout" of a significant ASAT capability, after clandestine development — that is, to be able to mount a surprise attack on a whole group of satellites — is totally unlikely.

Even if it made any sense to test our anti-satellite weapon, to do so in advance of the Geneva talks makes no sense when we have so much to lose and so little, relatively, to gain. Testing now won't compel the Soviets to shape up at Geneva to our liking; rather they will raise the ante. Those who have had experience negotiating with the Soviets know this is by far the likeliest outcome of an attempt to twist their arm publicly.

Then there are the civilian uses of space, growing in importance everyday. From exploration of the far universe, to unlocking the secrets of energy and matter, to assessing the resources of earth, space has become indispensable. Weather reporting, television, communications — all are dependent on it.

The practitioners in space from hard-headed administrators like James S. Beggs, administrator of NASA, and Roald Sagdeev of the Soviet Space Institute, dreamers like Isaac Asimov and Carl Sagan, cosmonauts and astronauts alike have spoken eloquently about the future of mankind in the cosmos. ASAT...Pg. 6-F

WASHINGTON POST

8 September 1985 (9) Pg.C-7

Joseph Kraft

PR and the Summit

En route to the Geneva summit the Russians are enjoying a propaganda hayride. The United States could spoil their fun with a solid, substantive proposal on arms control. But up to now, President Reagan has emphasized public relations over substance. For summit audiences are shifting, and the administration is more concerned with reassuring its own constituents than with challenging Gorbachev in his gallery.

The new Soviet leader, Mikhail Gorbachev, brings to the world two qualities not conspicuous in his recent predecessors. He is a youthful figure in the pink, who can expect to outlast his American opposite number. If he doesn't like what Reagan proposes, he can wait until a better offer comes along from the next president.

As a "communicator," moreover, Gorbachev rivals Reagan. He comes across as attractive, forceful and extremely well informed. He has a nice light touch, and a wife who buys diamonds at Cartier.

Months ago Gorbachev set in motion a publicity drive in the arms control area. Last week he slipped into higher gear with the publication of an interview by Time magazine, and in a meeting with eight visiting American senators.

In each case, Gorbachev intimated Russia was prepared to join the United States in making deep cuts (40 to 50 percent, some of his aides say) in the number of nuclear warheads. As a condition, however, he wants to limit to "fundamental research," Big Two efforts to develop a defense against ballistic missiles. That would leave, as the only obstacle to agreement, this country's Strategic Defense Initiative, or Star Wars program, for an antiballistic missile defense.

The general secretary's message has struck home with even some hard-boiled Americans. For instance, Sam Nunn of Georgia, the Democratic defense expert in the Senate, came away from the Moscow meeting impressed.

Far more impressed are the West Europeans—the truly crucial audience for Gorbachev. Many of them continue to regard Reagan as a trigger-happy cowboy. They are pleased to have a Soviet leader who, in the European tradition, is no pushover for the Americans. They are uncomfortable with Star Wars, which could remove the nuclear deterrent from their defense

arsenal.

"I can do business with Mr. Gorbachev," Prime Minister Thatcher said when he was a mere candidate leader. Since then he has registered well with socialist leaders from Italy and West Germany. On Oct. 3 and 4, he will be in Paris for meetings—certain to be highly publicized—with Francois Mitterrand.

On Sept. 19, the continuing Big Two arms control talks resume in Geneva. The U.S. delegation is being instructed to probe the Soviet diplomats on the offers unofficially held out by Gorbachev. In response, the United States could bring forth a public position with some numbers. Then it would be up to Gorbachev to back up his mouth with some money. If he were serious, an agreement would be in the works. If not, Soviet duplicity would be exposed again.

Several constraints work against that gambit, however. To test the Russians, SDI would have to be made subject to negotiations. But Reagan himself has repeatedly said he was with Star Wars for good, not as a bargaining chip. High officials at the Pentagon share that view. There is no sign that anybody can align the various factions inside Washington behind an arms control offer that would include limiting Star Wars.

In the past, to be sure, West European pressure fostered changes in U.S. bargaining positions. But in the past, especially when the issue was deploying modernized American weapons across the Atlantic, the Europeans were a crucial audience for the Reagan administration. No more. With the modernized missiles installed, the peace marchers have stopped marching in Britain and West Germany.

The important audience for the Reagan administration is in this country. But here, too, the antinuclear forces are spent. The pressure groups highly sensitive to what happens in Big Two relations are on the Right. As part of Reagan's original base, the right-wingers carry special weight with this administration. Now they are more than usually ready to blast any agreement with Russia. If only because of Gorbachev's facility in public relations, the Right has redoubled its suspicion that any deal with Moscow has to be a bad deal.

In these conditions the pressure on Reagan is to play to his own adher-

ASAT...from Pg.5-F

Surely we cannot wish to put all this at risk.

Nor is space the exclusive property of the Soviets and ourselves, or of East and West or even of the developed nations. It is the inheritance of all mankind. No one of us has an exclusive right to control it, and no one of us is likely to own the effective means to control it, however hard and recklessly we may try.

But there is a worse concern. Just as atomic weapons, once our sole possession, spread first to the Soviets and then to a dozen nations, so will the capability to shoot down satellites. And with each player the risks will increase exponentially.

If we will *look*, we can see two roads into the future: one road perilous to ourselves and all others, the other leading to the peaceful use of space for all mankind.

If we will *listen*, we can hear the voices of sanity here, in Russia and around the world saying, "Put an end to the arms race in space".

And if we will *stop* — we and the Soviets — we can set an example that will keep space free of threat. Now is the time. Geneva is the place. Leadership is the key.

Noel Gayler, a retired admiral who was commander-in-chief of U.S. forces in the Pacific, was director of the National Security Agency from 1969 to 1972.

ents. Hence the recent speech assuring them he was not out for "specific agreements" at the summit. Hence the decision to conduct tests of antisatellite weapons. Hence the demand for equal time to address the Soviet people on television during the Geneva meeting. Hence, so far at least, the lack of a substantive American program to test Gorbachev's good faith.

None of this means the summit will fail. Accords on air transport and new consulates are virtually ensured. An agreement on a follow-up summit seems certain. An arms race could be contained by extending for another year the Anti-Ballistic Missile treaty which expires on Jan. 1, 1986. But the little window of opportunity opened by the selection of a new Soviet leader seems to be closing.

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President Ronald Reagan

March 23, 1983

"Let me share with you a vision of the future which offers hope. It is that we embark on a program to counter the awesome Soviet missile threat with measures that are defensive . . . what if free people could live secure in the knowledge that their security did not rest upon the threat of instant U.S. retaliation to deter a Soviet attack; that we could intercept and destroy strategic ballistic missiles before they reached our own soil or that of our allies? . . .

Would it not be better to save lives than to avenge them? . . .

My fellow Americans, tonight we are launching an effort which holds the promise of changing the course of human history. There will be risks, and results take time. But with your support, I believe we can do it."

WE MUST DEFEND AMERICA

A New Strategy for National Survival

Daniel O. Graham, Project Director High Frontier



About the Author

Lt. Gen. Daniel O. Graham, U.S. Army (Ret.) is the Director of High Frontier, Inc., which conducted the research on which this book was based. After retiring as Director of the Defense Intelligence Agency in 1976, General Graham held a research professorship at the University of Miami from 1976 to 1978, and served as an advisor to Ronald Reagan in his 1976 and 1980 campaigns. General Graham has also served on the staff of the American Security Council and was Co-Chairman for the Coalition for Peace Through Strength from 1978 to 1981. A graduate of West Point and the U.S. Army War College, General Graham saw service in Germany, Korea, and Viet Nam. Other books by General Graham include *New Strategy for the West* and *Shall America Be Defended: Salt II and Beyond*.



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Strategic polling

Last February, a poll taken by Arthur Finkelstein, highly regarded pollster for conservative candidates, yielded 90 percent affirmative responses on whether the United States should defend itself against Soviet missiles. In May another polling organization, working for the Heritage Foundation, found that 69 percent of those asked supported a space defense system even if it required withdrawal from earlier arms treaties.

So, not to be bested, ABC News and *The Washington Post* went on the polling circuit and got a 53 percent margin *against* the Star Wars proposal. When conflict with the ABM treaty was mentioned, the approval rate dipped to only 26 percent. ABC confirms that the questions made no mention of Soviet violations of the ABM treaty or of current Soviet advances in strategic defense.

It is the open secret among pollsters that, on many questions, desired numbers can be obtained with reasonable precision merely

by adjusting the questions. Herewith, some tendentious but revealing questions for future SDI polls:

- Many scientists doubted that the steam engine, the electric light, and travel at speeds greater than 30 mph "would actually work." Today, some scientists doubt that Star Wars "would actually work." What do you think?

- The Anti-Ballistic Missile Treaty of 1972 forbids the U.S. and the U.S.S.R. to defend their civilian populations against nuclear attack. Some evidence suggests the Soviet Union is violating this treaty. Should the United States renegotiate it? Should the United States have entered into it in the first place?

- Supporters of Star Wars argue that it offers the prospect of security against nuclear attack without submission to nuclear blackmail. Would such a prospect not be worth investigating, even if the chances of success were less than in fact they are?

Soviets

that both sides would have permitted had the treaty gone effect. Nor have the Soviets agreed to the even lower level of that both sides were to reach the end of this year.

On the other hand, Moscow has destroyed some older land-based submarine-based missiles to within the 2,504 figure. All weapons destroyed were early ones, much less effective than newer ICBMs brought in to replace them.

In its part, the United States destroyed some Polaris missile-carrying submarines and old, land-based Titan missiles as newer U.S. missile systems came into operation. Both older systems, however, destroyed single-warhead missiles clearly were not considered viable under present U.S. nuclear strategy.

Washington may face a difficult choice this fall over whether to live up to the treaty's provisions or to put into service the USSA Trident submarine carrying 24 multi-warhead ICBMs. Alaska will put the United States 14 missiles over the treaty limit of 1,200 for land- and sea-based multi-warhead ICBMs.

An interagency group has been studying what can be done but, according to an administration official, "level" decisions have not been made with President Reagan. Though a strong critic of SALT II when taking office, Reagan has not indicated what he plans to do about its limits. He has focused his comments on alleged Soviet violations of some of the treaty provisions.

Some and other administration officials have privately suggested instead of destroying a Poseidon submarine, whose 16 missiles dismantled, would bring the total below the treaty limit, that should be taken out of service perhaps by placing it in dry-

Such a "gray area" approach would not, they say, be an open breach of the treaty but would still allow negotiations to take place. They compare such a step to Soviet actions toward other treaty provisions that U.S. officials say violate the spirit if not the letter of the agreement.

One group that reportedly has not taken a position on the treaty limit extension is the Joint Chiefs of Staff. In 1979, the chiefs supported the SALT II treaty and its limits on the ground that the provisions put a ceiling, albeit a high one, on the growth of Soviet nuclear forces and thus permitted future U.S. planning to take place to counteract those forces.

Recently, individual members, such as the Army chief of staff, Gen. John A. Wickham, have said they favor continuing the limits. Gen. Bennie L. Davis, head of the Strategic Air Command, has said the same thing to congressional committees. Last year, Lt. Gen. James A. Abrahamson, director of the Strategic Defense Initiative Office, told Congress that negotiated limits restricting the number of Soviet offensive weapons would be needed if the "Star Wars" defensive systems were to have a chance of working.

Rostow dismissed the views of these generals, saying, "that was the same old argument the Joint Chiefs made all along."

Members of Congress, Pentagon analysts and some Reagan administration officials, however, recognize that the chiefs are concerned with present Soviet capabilities to build up their forces rapidly if the treaty lapses.

Pentagon officials, viewing the recent congressional vote to cut the president's Star Wars research and limit MX deployment, do not believe the American public is willing to support a new strategic arms race with the Soviets.

"One answer," an official said last week, "is to have some interim weapons restraints." He added, however, that "this administration is trapped by its own rhetoric" that condemned SALT II and thus now seems to require something new.

'Star Wars' Team Seeks Countermeasure Flaws

Refutation of Space-Defense Critics Pursued

By Boyce Rensberger
Washington Post Staff Writer

LOS ANGELES, May 27—Officials responsible for President Reagan's Strategic Defense Initiative, popularly known as the "Star Wars" program, have begun to look for flaws in the various "countermeasures" that critics have said the Soviet Union could use to defeat United States anti-missile defenses.

Speaking before the annual meeting of the American Association for the Advancement of Science here yesterday, Gerold Yonas, SDI's chief scientist, said this effort had found reasons the Soviets might choose not to pursue at least one widely touted countermeasure: the fast-burn booster.

Star Wars critics have suggested that the Soviets could avoid having their missiles destroyed during launch by developing rockets that accelerated more quickly, escaping the atmosphere and releasing their warheads before there was time for U.S. beam weapons to attack.

Critics and supporters of SDI agree that if rockets cannot be destroyed before they release as many as 10 independently targeted warheads, it would be much harder to blunt a Soviet attack.

Yonas said preliminary analysis has shown that if the Soviets went to fast-burn boosters, they would sacrifice accuracy in aiming the warheads. This drawback, he suggested, might mean that the Soviets would be unlikely to employ such a countermeasure.

Much of the criticism of SDI has been based on assertions that it would be easy and cheap for the Soviets to penetrate a difficult-to-develop and costly defensive shield.

Yonas said the effort will examine Soviet political and social circum-

stances to decide "not what the can do but what they will do."

Star Wars' most prominent critic, Richard Garwin of IBM, brushed aside any optimism that such analyses might leave a potential missile-defense system looking invulnerable.

Speaking at the same session Garwin granted that although might be possible to develop space-based anti-missile systems in 20 to 30 years, there are so many different and inexpensive countermeasures that there is no way the system could overcome them all.

Garwin said those who support SDI on the basis of technological optimism should realize that similar optimism must underlie an analysis of the Soviets' ability to develop countermeasures.

Also on the panel was Donald Hafner, a political scientist at Boston College who specializes in the legal aspects of anti-satellite arms.

Although ASATs, as these devices are called, are not formally part of the SDI effort, Hafner warned that their development and deployment, which is not prohibited by treaty, could be used as a cover for development of outlawed anti-missile systems. The Antiballistic Missile treaty forbids development of anti-missile systems but not research on them. It is a foregone conclusion that, if SDI moves from pure research to weapons development, the ABM treaty would have to be abrogated.

The United States is developing an ASAT of the "smart rock" type. It is a small device carried on an air-launched missile that can home in on a satellite and destroy it by simply crashing into it.

SDI officials have suggested that a similar device could be used against incoming warheads.

ISRAEL'S POSITION ON S.D.I.

(Strategic Defense Initiative)

PRIME MINISTER SHIMON PERES

FBIS V. 19Apr 1985 I1
Tel Aviv BAMAHAHE in Hebrew
17 Apr 85 pp. 10,11,55

[Excerpt] Question: Why do you support Israel's participation in the U.S. "star wars" plan?

Answer: We have received an invitation the exact nature of which we have not determined. The invitation was extended in principle, and we accepted it in principle. I still do not know what the United States is offering us. In principle, however, star wars is not just another U.S. strategic move. It is a new dimension in the technological, scientific, and strategic spheres.

Perhaps toward 1992, which will mark 500 years since the discovery of America, we will discover a new America and a new world, different from the ones we have known.

It is not a matter of buying a ticket in order to fly from earth to space. This ticket is far more revolutionary in all possible areas: new metals, new communications, new movement, new computers, everything will be new, and in 10 years everything will be judged according to this new yardstick.

Question: Is this why Israel should join the project?

Answer: Yes. It is like joining a new era. Imagine if Columbus had invited an Israeli to join his ship. I, for one, would have supported this invitation, no matter what he was going to discover.

DEFENSE MINISTER RABIN

FBIS V. 8 Apr 85 I2
Tel Aviv MA'ARIV in Hebrew
7 Apr 85 pp. 1,11

[Report by Yosef Walter]

[Excerpts] Defense Minister Yitzhak Rabin is recommending that the U.S. invitation to take part in initial talks in preparation for the implementation of the "star wars" project be accepted.

A senior defense establishment source told MA'ARIV: "In principle, Rabin will accept the invitation, but Israel's participation in the project depends on approval by its inner Cabinet. The defense minister will bring the issue up for discussion by the Cabinet at one of its upcoming sessions."

FBIS V. 1 May 85 I1

Rabin Comments on U.S. Space Defense Project
TA301653 Jerusalem Domestic Service in Hebrew
1605 GMT 30 Apr 85

[Text] The defense minister has addressed the U.S. invitation to Israel to join the star wars project, and said that at this stage no date has been set for Israel to give its response. Personally his approach is positive, but right now two Israeli scientists are being sent to examine the U.S. initiative. At any rate, the defense minister would recommend joining only those areas whose implementation would also be worthwhile for Israel.

SCIENCE MINISTER GIDEON PAT

FBIS V. 12 June 85 I2
Jerusalem Domestic Service in English
0400 GMT 11 June 85

[Text] Science and Technology Minister Gidon Pat has proposed that Israel's research institutes enter the primary stages of research in the U.S. space defense program. This is in order to take advantage of budgets that will be distributed as early as next year. Last night, the director general of the ministry convened a meeting with deputy presidents of research and senior researchers of institutes of higher learning at the Israeli Academy of Sciences.

[Jerusalem Domestic Service in Hebrew at 0500 GMT on 11 June carries a report in reaction to this disclosure, saying that "Science and Technology Minister Gidon Pat has said that a governmental forum will soon meet to discuss Israel's joining the U.S. defense program, known as the star wars program. The prime minister, defense minister, Minister Pat himself, and possibly some other ministers will take part in the discussion."]

M.K. EZER WEIZMAN

Jerusalem Post 8 Apr 85 p.1

Speaking at Haifa's Reali High School yesterday, Minister without Portfolio Ezer Weizman said that the "Star Wars" invitation should be given careful consideration. Weizman, a former defense minister and a former OC [Commanding Officer] Air Force, said the proposal should neither be "rejected out of hand," as some have urged, nor immediately accepted.

FBIS July 5, 1985 I4

Positive Reply to Space Defense Invitation Expected
TA040723 Jerusalem Domestic Service in Hebrew
0700 GMT 4 Jul 85

[Text] Israel will apparently respond positively to the U.S. initiative on participation in the star wars plan. The matter was discussed yesterday during a consultation with the prime minister. The meeting was also attended by the defense minister. The participants discussed the recommendations by the defense establishment delegation which negotiated on this matter in the United States. Our political correspondent Shim'on Schiffer reports that the prime minister and defense minister think Israel should give the United States a positive answer. They are now texting the formal reply and the fields Israel will ask to participate in.

Star Wars Made (Too) Simple

BY DAVID J. LYNCH

The problem with Robert Jastrow's new book is that it makes marvelously entertaining reading—unless you know anything about his subject, the strategic defense initiative. A reader acquainted only in passing with "Star Wars" will blush at how brazenly Jastrow glosses over the numberless complexities associated with the idea in *How To Make Nuclear Weapons Obsolete*.

Can the United States erect an effective anti-missile shield? Jastrow emphatically says yes. One could be in place today if we had started five years ago, he writes. Is it cheaper for us to build defenses than for the Soviets to overwhelm them? Yes again, says Jastrow. Would SDI spawn an uncontrollable offensive arms race? To the contrary, says Jastrow, it would lead to lower numbers of nuclear weapons—perhaps, he suggests, a *nuclear-free world*.

The folks in the Pentagon's Strategic Defense Initiative Organization who are busy spending billions trying to find the answers to exactly these questions will be happy to hear that they can stop working so hard.

But for opponents and supporters alike, the picture of the strategic defense initiative is not as clear as Jastrow would like people to believe. There is a need for a book on Star Wars that recognizes this fact and one other: that the debate over the wisdom of SDI turns not so much on whether it can be made to work as on whether making it work is such a hot idea.

Jastrow, however, spends his time in this thin volume worrying about unprovoked Soviet nuclear ambushes and the woefully inadequate state of the U.S. deterrent that has kept the peace for the last 40 years. Sadly, like so many others of the neo-conservative school of strategic thought, he is unconvincing on the imminence of the threat.

A professor of earth sciences at Dartmouth College and the founder of NASA's Institute for Space Studies, Jastrow apparently fears a Soviet first strike, describing in some detail how the massive Soviet arsenal could be employed to defeat the United States. The description is no doubt quite effective for the audience of laymen for which this book was meant. But, in the real world, no one expects—nor should the Pentagon waste much energy planning for—a Soviet "bolt from the blue."

Any nuclear attack is going to be preceded by a period, perhaps brief, perhaps somewhat extended, of heightened tension. A crisis, if you will. During that time, the U.S. president would no doubt have the brains to disperse the U.S. B-52s whose vulnerability apparently causes Jastrow so many sleepless nights and send the Tridents to sea where they would be safe. Facing that array of American nuclear might, Soviet leaders would no doubt find a nuclear strike somewhat less than attractive.

And, importantly, it is in dissuading the Soviets from launching a nuclear first strike that Jastrow thinks the SDI would be of the most use. "They are building a first strike force," he says flatly. "Such a defense, preserving the destructive power of our nuclear arsenal, will virtually foreclose the option of a first strike by Soviet leaders." Thus, Jastrow's goal is defense of the American missiles rather than the American people as originally envisioned by President Reagan. It may well be that defending missiles, such as the beleaguered MX, makes sense; but that could probably be done without spending \$33 billion on preliminary research, or rubbing up against any arms control treaties.

Jastrow's argument also rests on an unfair description of the state of the U.S. nuclear arsenal. In the space of a few pages, he dismisses our bombers and land-based missiles as next to useless. "For the present, the triad has been reduced to a monad," Jastrow says. And an impotent one at that, according to Jastrow, because submarine launched missiles are so terribly inaccurate that they aren't much of a deterrent. The radioactive mess they would make of Soviet society apparently doesn't count.

In writing a book obviously intended for the average American who wonders what all this Star Wars fuss is about, Jastrow has simplified things a bit. For example, he repeats an oft-quoted line that sounds ominous until examined a little more closely: that the Soviets have "the world's only operational ballistic missile defense system." This is true; it is also legal. Under the 1972 ABM Treaty, both the Soviets and the Americans are allowed to defend their national capital and one missile field. The Soviets took advantage of that provision; the United States ultimately chose not to.

On the question of whether computational ability would hamstring development of a defense, Jastrow employs an old dodge. He acts as if computing *speed*—not complexity—is at issue. And having set up his straw man, he merrily knocks him flat.

"...Computing speed is not expected to be a major problem for our defense," he writes. Maybe not, but Jastrow should know that writing error-free software will be.

As more and more Star Wars partisans publish books designed to win the hearts of Americans, they aren't about to let the facts stand in their way. But the real story is that the technical case has yet to be conclusively made either for or against Star Wars. Unfortunately, the partisans on either side of the debate think it has; they're now locked in the kind of attrition warfare into which every political issue in Washington eventually falls.

How To Make Nuclear Weapons Obsolete, by Robert Jastrow. Little, Brown and Company, Boston. \$15.95.

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SDI: A Logistical Revolution In Space

GAVIN HARVEY

Satellite constellations deployed as part of any strategic defense network would be far more diverse and numerous than the typical space systems operated today, challenging the capabilities of logisticians, an Air Force officer said recently.

"The world we see today and for the foreseeable future will be one of deployment of many new systems. Most of these systems will consist of not one to five similar satellites but from 10 to several hundred identical satellites," said Lt. Col. George Sawaya of the Air Force Space Division. "One representative Strategic Defense Initiative scenario consists of 100 kinetic kill interceptors, four to six boost surveillance, eight to ten space surveillance as well as ten communications platforms and 50 beam weapons being launched, positioned, maintained, serviced, spared, supplied, and replaced. All this must be accomplished without using the entire Gross National Product."

Sawaya spoke August 21 before an international gathering of logistics professionals in San Diego, California. Although the United States has the ability to field a strategic defense, according to Sawaya, tremendous research, development, technology, and procedural problems remain to be solved. As director of SDI Logistics Integration, Sawaya must assemble the immense foundation for space-based defense.

Ground support, on-orbit operations, and maintenance costs will far surpass those of launch and transportation, he said.

The space supply train received a formal nod on March 15th when SDI chief Lt. Gen. James Abrahamson signed the SDI space logistics directive, which defines the total space support infrastructure. The directive contains a work package which includes launch preparations; tracking, telemetry, and control; on-orbit assembly, maintenance, and repair; industrial development; and integrated logistics support for an operational strategic defense system. Sawaya's "loggies" will be in "everything from production line technique and high turn-around rates for vehicles to on-orbit debris management and satellite operations and mainten-

ance."

Sawaya asserted that radical changes in traditional space practices are needed if SDI is to fly. Today's space program can be characterized as a set of unique, vertically integrated, manpower intensive systems that are designed and operated by contractors without serious consideration of follow-on support needs. All of these conditions must be reversed.

In Sawaya's estimation the vertically integrated program has functioned well until now. Typically, a single contractor will manage a space system for its entire life, first designing and building a satellite, integrating it with a launch vehicle, and then maintaining the system. This structure is "no longer practical or possible," according to Sawaya—"not practical, because of the vast numbers of satellites to be built and the inherent requirements to start building and using standardized parts and subsystems to ensure producibility and minimize overall life cycle costs. Not possible, because of the high cost of sustaining a survivable system."

Consequently, standardization of the space industry must approach that of the commercial airline industry, beginning with components such as power packs, solar panel systems, and fuel. Through a joint industry-government task force similar to the Air Transport Association, Sawaya suggests, space contractors could be mobilized to set uniform specifications. "The net result of actions like these, of course, are lower life cycle costs as well as lower acquisition costs in many cases due to increased competition and longer production runs.... Standardization of subsystems would also give the space community the ability to acquire and launch systems faster if true off-the-shelf subsystems were available.... NASA has already demonstrated this interchangeability when they used an extra Landsat guidance system module to repair the Solar Max in April 1984."

Sawaya directs another critical salvo at the waste of human resources in space program operations and maintenance. Because

technology is being applied at the boundaries of science, the program is saddled with excessively delicate shuttles which require exhaustive testing and long turn around times. "We cannot continue to build right at the edge of technology. We don't have to. There is always pressure to push it a little further. But better is the enemy of good enough," Sawaya told *Defense Week*. The standing army of engineers presently tending to "dumb" satellites and frail shuttles will need to expand astronomically as SDI gets off the ground. Finding all the technicians necessary for the future space program will be difficult—paying them may be impossible.

The space command must demand greater self-sufficiency from future satellite systems with the ultimate goal of severely shrinking the cumbersome ground control infrastructure. Sawaya is confident that with available software, satellites can operate with vastly increased autonomy, linked to the ground only by light, simply managed, mobile control stations based on aircraft, trucks, ships or other satellites. And next-generation shuttles should be designed with turn-around times of hours, not weeks or months, he said.

Finally, Sawaya explained that contractors have designed systems without thorough consideration for follow-on costs. One dollar spent on designing the system's support could save \$100 in later operating costs, he said.

A report on operational requirements under initiation by Sawaya's office will address these concerns and what he called the number one near-term aim: beefing up the nation's launch capabilities. The million-pound Apollo boosters have been scuttled in favor of the shuttle's 60,000-pound boosters, and with them the capacity to lift the huge numbers and weights of satellites envisioned for strategic defense. "The laws of orbital physics rule the amount of thrust needed to move a mass from one place to another—even Congress cannot repeal these laws," Sawaya said. "If the nation is able to make the SDI happen, we must develop the capability to launch hundreds of tons dozens of times a year."

INTERNATIONAL

U.S. Tries End Run on Star Wars

By RICHARD L. HUDSON
And TIM CARRINGTON

Staff Reporters of THE WALL STREET JOURNAL

U.S. defense officials, undeterred by the lukewarm reception of European governments to the "Star Wars" research program, are pushing ahead with efforts to enlist individual European companies and scientists. The U.S. approach, however, could backfire.

In recent days, U.S. officials have been on the road discussing with European companies and university researchers the specific tasks they might perform in the \$26 billion, five-year program. So far, there have been "no final deals," in the words of program director, Lt. Gen. James A. Abrahamson. But the list of specific research projects in which Europe might work is growing.

It includes the establishment, Gen. Abrahamson said Saturday in London, of a "research facility" in Britain to study high-speed antimissile guns, so-called "electromagnetic rail guns" to shoot projectiles at fantastic speed. It also includes research in computer software by a London-based software company, Logica PLC. Matra S.A., a French arms and electronics maker, has expressed interest in work, and two West German aerospace companies, Dornier G.m.b.H. and Messerschmitt-Bölkow-Blohm, G.m.b.H. are discussing work with Washington.

Lack of Formal Endorsement

These discussions have been taking place, despite the lack of any formal endorsements from Europe's governments of the Strategic Defense Initiative, as the Star Wars program is formally called. Says Jean Francois-Poncet, French foreign minister from 1978 to 1981 and currently a French senator: "My feeling is the U.S. isn't looking for a collective European participation" in SDI, instead, it's pursuing "individual company participation."

The approach is risky for the U.S., as it tries to garner allied support for SDI. Mr. Francois-Poncet, says the U.S. pursuit of European companies, in the face of cool attitudes from European governments,

might seem like an end run. "At some point, there's going to be a reaction against the way they're proceeding," he predicts.

U.S. officials are aware of the diplomatic delicacies involved. During a briefing Saturday for reporters in London, Gen. Abrahamson said the possible British research projects aren't yet approved because "we don't want to do anything that isn't in consonance with what your (British) government does." (Whitehall, while likely to join SDI, is still planning its role in the program.) Nevertheless, the political sensitivity of SDI in many European countries has drawn enormous local publicity to any company or university said to be talking with the SDI office.

Ambivalent Europeans

The official European attitude toward SDI is ambivalent. The program, announced by President Reagan two years ago, aims to accelerate research in a broad range of technologies that any future space-defense system against Soviet missiles might need. On one hand, many European policy makers fear the research could touch off a costly space-arms race or foment war; on the other hand, many government officials are intrigued by the possible commercial spinoffs SDI research might have in computers, microelectronics and the aerospace industry.

The degree of European uncertainty was displayed Friday in Estoril, Portugal. At a meeting there of North Atlantic Treaty Organization members, foreign ministers split over a U.S. bid to get a NATO endorsement of Star Wars. In the end, the meeting's final communique omitted any mention of SDI. In separate discussions, officials from France, Norway and Denmark already have said they won't back SDI. Besides Britain, Italy is a likely participant. Most of the other countries, including West Germany, are still undecided whether to accept last March's U.S. invitation to join the U.S. in researching a defensive system to intercept and destroy nuclear missiles.

U.S. officials put the best possible face

on all this. Gen. Abrahamson on Saturday said the allied reaction to SDI so far has been "pretty good," and dismissed the development at Estoril as insignificant.

Companies Are Impatient

But to those European researchers eager to tap into the enormous Pentagon program, the government-to-government talks are moving too slowly, threatening to shut them out of business opportunities. London-based Logica, one company that has grown impatient, independently began negotiations with the Pentagon's SDI office about a \$200,000 grant to research the computer software systems the program needs.

"We couldn't afford to wait for the U.K. government's guidelines on the Star Wars program," says one Logica official.

In West Germany, the defense and research ministries have set up a government-industry advisory group that includes executives from aerospace and optics companies. The group plans to visit the U.S. later this summer.

In the meantime, companies

February, 1985

ment appears as a matter of record only.

Banque Kleinwort, Benson
(Geneva) SA
Deutsche Bank (Suisse) S.A.
Société Générale Alsacienne
de Banque
- Groupe Société Générale

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In the meantime, German companies such as Dornier and MBB are having continuing discussions with SDI officials. A Dornier official complains, however, that "the pace at the moment is a bit slow," owing mainly to the muddle over how formal European participation will be worked out.

In France, Matra has openly expressed interest in conducting Star Wars research, despite a lack of support from the French government. Companies from other parts of the world also may contribute: Tadiran Inc., an Israeli military electronics concern, says it has had preliminary discussions with the SDI office about what contracts it might bid for.

Political Motives

One issue perplexing potential European participants, however, is how much the Pentagon wants them for their know-how, and how much for the influence their involvement might have on their governments. The possible British rail-gun project is a case in point. Three research groups in the U.S. already are involved in such work, to develop a track enveloped, like a particle accelerator, in a high-power magnetic field and capable of shooting projectiles at speeds approaching 25 miles a second.

One senior U.S. rail-gun researcher says he isn't aware of any technical skill Britain has in such work that the U.S. doesn't already have. "My impression is the concern (in talking to Britain about rail guns) is to a great extent political," says the researcher, William Weldon, director of the University of Texas' Center for Electromechanics.

But Gen. Abrahamson, visiting London Saturday for one of the periodic meetings of U.S. ambassadors in Europe, cited the rail-gun work as an example of technical areas in which Britain has "a real capability." Other areas, he said, include artificial intelligence, special detectors for infrared light, and radiation-resistant computer chips. In these, and other fields, he said, his office is "now looking for brilliant teams of creative people" in Europe to receive SDI funds for their research.

'Star Wars' and *Economic* Power

U.S. Pays Too Little Attention to Possible Effects of Program

By ERNEST CONINE

Both sides in the debate over President Reagan's Strategic Defense Initiative spend most of their time quarreling over whether development of an effective defense against ballistic missiles is possible, and whether the effort to find out is a help or hindrance to arms-control efforts.

Too little public attention is being paid to another question that deeply concerns our European friends (and possibly our Soviet adversaries): What will be the effect of this potentially huge research-and-development program on the *economic* distribution of power in the world?

Some U.S. experts, including some well-placed insiders, worry privately that the quest for an effective strategic defense will soak up a disproportionate slice of America's scientific manpower, impairing this country's long-term ability to compete with the Japanese in other economically important areas of high technology.

The flip side of this argument is that SDI shapes up as the world's most exciting research effort; and that the technological spinoff could be of enormous benefit to America's economic competitiveness.

Top Reagan Administration officials do not appear to think much about the economic side effects of the planned \$26-billion investment in "Star Wars" research. Lt. Gen. James Abrahamson, who heads the SDI program, has been quoted as saying that technological fallout for the U.S. economy will be incidental to the military purpose of the research effort.

Allied political leaders make no effort to hide their concern that, in terms of European peace and security, the strategic defense program might cause more problems than it would solve. But it is the broader economic ramifications of the Star

foreign minister and a leader of the Free Democratic Party, warned that Europe could not afford to continue falling behind in the all-important new technologies involved in the information revolution.

Europeans are producing 64-kilobit memory chips, while the Japanese and Americans have been making 256-kilobit chips since 1982. European companies manufacture microprocessors only under American license, and account for only 5% of the world market in integrated circuits. U.S. companies dominate the European market in computers and data banks.

Genscher also expressed concern that Europe might fall hopelessly behind in such areas as genetic engineering, new materials and exotic energy technologies.

It was against this background that Reagan sprung his Star Wars proposal, which by nature involves large-scale research into futuristic technologies. The follow-up invitation for European participation has drawn mixed reactions.

European governments fear that SDI will goad the Soviets into responses that will threaten the military balance in Europe, and that enormous investments in the program will force reductions in U.S. and possibly European expenditures for more down-to-earth defensive systems.

Yet the Europeans dare not be left out of a project that is seen as comparable to the Manhattan Project of World War II and the lunar-landing program. With full European participation, a third of SDI funds might be spent overseas. But if America is

left to go it alone, the Europeans fear a damaging brain drain—and spinoffs into commercial technology that would leave them hopelessly behind.

The strategy of allied governments so far is to fend off formal participation in SDI while allowing individual companies to go after SDI business. Meanwhile, 17 European countries are moving to coordinate their research-and-development efforts in something called Eureka, which will seek to exploit Star Wars-type technologies for basically commercial purposes.

It remains to be seen what will come of it all. But it seems clear that Washington, by paying insufficient attention to the economic ramifications of the SDI program, runs the danger of creating the worst of possible worlds for America.

We may fail to enlist significant European participation in the Star Wars anti-missile program, but goad Europe into continentwide cooperation on futuristic technologies. And whereas we would be held back from commercial exploitation by national-security considerations, the Europeans would suffer no such encumbrance. Thus they might get more economic benefit from a much smaller program.

If the United States is to pursue a Star Wars program of the magnitude envisioned by the Administration, common sense dictates that the project be deliberately structured for maximum benefit to America's competitive position in the world.

Ernest Conine is a Times editorial writer.

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During the 1960s and 1970s Western Europe was on a roll. Unemployment was lower than in the United States. Economic growth and gains in productivity were higher. As a British economist puts it, "The common perception was that Europe was just better than America in every respect."

That perception has changed—not so much here, where intelligent Americans are appropriately worried about the massive and dangerous budget and trade deficits, as in Europe.

Economic growth in Europe has lagged in the 1980s. Unemployment went up, and stays high despite moderate economic recovery. Over the last decade the United States has created seven times as many jobs as all of Europe.

A lot of those U.S. jobs, of course, were in fast-food restaurants and similar enterprises having little to do with global competitiveness. The U.S. manufacturing sector is much less robust than its European counterparts, which have enjoyed an export boom at American expense.

What alarms thoughtful Europeans, however, is the specter of a technology gap between Europe on the one hand and the United States and Japan and the other.

Western Europe is hardly a high-tech basket case. In nuclear-reactor technology, commercial exploitation of space and transport aircraft, to mention but a few areas, the Europeans are holding their own. But in computer-related technologies they are not.

In an illuminating speech early this year, Hans-Dietrich Genscher, West German

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High-Tech Star Wars Program Is Challenged By Low-Tech Woes—Bureaucracy and Politics

By TIM CARRINGTON

Staff Reporter of THE WALL STREET JOURNAL

WASHINGTON—Some of the biggest challenges facing President Reagan's Star Wars program aren't scientific ones. Last Friday, for example, officials were scrambling to get Pentagon carpenters to complete wooden frames for miniature Italian and Dutch flags that were aboard a recent space shuttle trip.

The boss of Star Wars, Lt. Gen. James Abrahamson, plans to present the flags to Italian and Dutch officials on a visit aimed at easing fears among U.S. allies that erecting a leak-proof nuclear umbrella in space would disrupt global security. It is his eighth European "crusade" this year.

Mr. Abrahamson and his staff at the Strategic Defense Initiative Organization, as it's formally called, also find themselves making frequent fence-mending trips closer to home—to Capitol Hill. Congress has tentatively slashed next year's Star Wars budget to \$2.75 billion from the \$3.7 billion requested by the administration. Moreover, there are moves to bar certain research programs that lawmakers fear would erode the 1972 anti-ballistic missile treaty with the Soviet Union.

Managing the Politics

Supporters of Star Wars defenses increasingly fear that building political support here and abroad, for the controversial program is becoming as difficult as overcoming the scientific complexities. Mr. Abrahamson, his staff estimates, spends about 40% of his time managing the program's political aspects: soothing the Europeans, fending off congressional budget cuts and making speaking appearances before scientific and defense industry groups.

That political agenda is likely to grow. Peace groups in Europe are campaigning against the program, and domestic opponents, led by Common Cause, are gearing up for a fight against it similar to the one mounted against the MX missile. "There's going to be a crunch next year" in Congress, declares Mark Albrecht, an aide to GOP Sen. Pete Wilson of California.

What's more, the SDI organization that is running the research program has been plagued by contracting delays, understaffing and rivalries between the armed services.

Despite the high priority given to the program by President Reagan, as of June 30 the SDI organization had spent only 21% of the \$1.4 billion Congress appropriated for Star Wars in the fiscal year ending Sept. 30.

"The office isn't doing real well," says Robert Voyles, president of Digital Software Corp., a Santa Clara, Calif.-based

concern that is working on several Star Wars research projects. "It should be big enough to do all the things it's supposed to do, but it isn't. Contracts seem few and far between."

Even without the bureaucratic problems, the program faces daunting obstacles in reaching its goal of devising a defense against nuclear-tipped Soviet missiles. Dozens of technical problems on the edge of current technology must be solved before a U.S. president could be confident a defensive system could neutralize thousands of warheads and decoys raining down from space at blazing speeds.

Disorganized Office

The SDI office operates amid physical disorganization as well. Officials shuttle between the Pentagon and an aging government building in downtown Washington that the organization shares with several

is still doubling as the deputy director, a year after a search began for a full-time No. 2 official.

Some of the SDI organization's problems stem from the way it was created. When it was set up last year, the office wasn't given the authority to award contracts directly to the defense contractors and research laboratories that were to explore the prospects of missile defenses. Thus, the SDI office must depend upon at least seven separate arms of the Defense Department, as well as offices in the Energy Department and the National Aeronautics and Space Administration, to carry out the projects.

As a result, says a top executive with one major contractor, "they're getting bogged down." Like most other defense industry officials, he declined to be identified for this article, fearing his company's Star Wars business could suffer.

Defense Secretary Caspar Weinberger is preparing a directive that will grant the SDI office the authority to write contracts itself. However, the SDI office would still work through other arms of the Pentagon on many contracts, and contractors fear that delays will continue.

Some companies active in the Star Wars program are becoming worried about the organizational problems and the persistent political obstacles. Lockheed Corp., which is involved in dozens of Star Wars projects, is slowing its investment in Star Wars technology out of concern that the program may begin to unravel in Washington.

Kaman Corp., a Bloomfield, Conn., concern, has been waiting for three months for a large contract to carry out a complex experiment in pointing and tracking missiles through space. "We're sitting on our hands with our fingers crossed," a company official says.

Contracts that were expected to be signed this summer on boost-phase surveillance of missiles, ground-based lasers, and radar have yet to be completed. In addition, the SDI organization hasn't completed the second-phase awards for Mr. Abrahamson's much-publicized horse race among contractors that are exploring the overall architecture of a Star Wars system.

Some in Congress contend that the record shows the office can't effectively spend the increased funds it's seeking. But SDI officials assert that the spending rate for the current fiscal year is about the same as that for other military research, and fully 70% of this year's budget had been "obligated," or earmarked, even if not actually spent by June 30.

Star Wars Funding

Major Star Wars research areas (in millions of dollars)	Funds approved in fiscal 1985	Funds sought for fiscal 1986
Sensors	\$546	\$1,386
Directed Energy Weapons	\$376	\$ 866
Kinetic Energy Weapons	\$256	\$ 860
Survivability, Lethality	\$112	\$ 258
Battle Management	\$ 99	\$ 243

Source: Defense Department

unrelated bureaucracies, such as the Interior Department's branch of fish hatcheries. Cardboard boxes pile up in the halls, and paper signs taped to the walls point visitors toward such exotic-sounding specialty areas as "kinetic energy weapons."

The Pentagon plans to revamp a vacant office building in Arlington, Va., to house the Star Wars program. But for now the old structure must do.

Personnel shortages are another problem. Richard DeLauer, former undersecretary of defense, contends that the office needs 1,000 people, or 10 times the current number. At least one contract was held up recently because a scientist who needed to sign it was unable to get to such administrative details. "These guys are very overworked," says Robert Kinney, a vice president of Sparta Inc., the company whose contract was involved.

Even though Mr. Abrahamson often is preoccupied with shoring up support for the program, he lacks a full-time deputy. The office's chief scientist, Gerold Yonis,

THEFTS...from Pg.1

gate the theft of millions of dollars worth of parts. Several Filipino sailors are said to be involved.

(In Washington, Rep. Jim Bates, D-Calif., said he has been investigating the matter since mid-June, when a Navy auditor brought the matter to his attention. He said the House Armed Services seapower subcommittee is scheduled to hold a hearing Sept. 12 on the smuggling of F-14 spare parts from the Kitty Hawk.

(The congressman told The Washington Times he had been concerned that the Kitty Hawk was allowed to sail to Asian waters before the investigation was completed because the smugglers would have time to cover their tracks.

(The smugglers were believed to have mailed some of the critical spare parts under the guise of automobile parts or medical supplies to London via New York City and then on to Iran, said Mr. Bates, who is a member of the congressional Military Reform Caucus.)

The Kitty Hawk and its carrier group left the Indian Ocean two weeks ago for a "normal visit" to Subic Bay naval base, some 50 miles northwest of Manila, as part of its Western Pacific cruise. Normal visits usu-

ally involve replenishment of provisions for the crew and the ships, which include ammunition provided by the naval magazine at nearby Cubi Point.

The carrier group includes the cruisers England, Horne, and Fox, destroyers Fife and Hotel, fast frigates Badger and Cook, oiler Wichita, repair ships Mars and Shasta, and submarines code-named A and B.

Last month in a joint investigation by the Navy, the FBI, U.S. and British customs, two current U.S. Navy men and a businessman from the Philippines were arrested in San Diego. The businessman's brother, a retired Navy employee, was arrested in New York and an Iranian national was detained in London.

The sources from the Kitty Hawk said that besides the Filipinos arrested in San Diego and New York, aviation storekeeper Antonio Gatdula Rodriguez was arrested by the FBI aboard the USS Belleau Wood last month in Washington state. He was subsequently charged with involvement in the smuggling syndicate.

They were said to be a part of a plot to steal and smuggle spare parts for F-14 Tomcat fighter planes and Phoenix air-to-air missiles for shipment to Iran. Since the seizure of the U.S. embassy in Tehran, Iran has been cut off from replacement parts for its U.S. weapons lost in its 5-year-old war with Iraq.

The U.S. weapons systems had been bought in the 1970s under the rule of the shah, who was ousted in early 1979.

HIGH-TECH...from Pg.5

What's more, SDI officials say that some of the contracting delays stem from Pentagon efforts to curb waste or seek competitive bids. Last week, the Pentagon ordered that a \$62 million sensor-research program be canceled or pared back drastically because Aerojet Electro-Systems Co., the contractor, anticipated big cost overruns. Aerojet of Azusa, Calif., is a unit of GenCorp.

Still, despite SDI's high priority, the Star Wars officials "have to go through pretty much the same procedures as everybody else" at the Pentagon, says an official with the congressional Office of Technology Assessment. "Since the Manhattan project, nobody has ever been able to spend money with a free hand," he says.

Service Rivalries

The SDI office also is trying to tamp down institutional jealousies between the Army's ballistic missile defense operation in Huntsville, Ala., and the Air Force space command in Colorado Springs, to name just two of the major players. "The various armed services agencies are beginning to compete with each other" over which plays the leading role in developing Star Wars technology, says an SDI contractor who has worked with the Army and the Air Force on projects.

The Army had the main responsibility for missile defense in the low-profile, low-budget years before the White House discovered the issue. The only demonstration of a warhead being destroyed in flight was run by the Army. But, since 1983, Air Force officers, including Mr. Abrahamson, have been attracted to the program in droves and are pursuing more exotic technologies. There is some friction between the two services over the nature of the program and where the emphasis should lie.

But, even as he strives to achieve internal harmony, Mr. Abrahamson is likely to find himself parrying fiercer and fiercer political attacks. Common Cause and a consortium of other groups are beginning a grass-roots campaign seeking to hold down funding for the Star Wars program, which they think is doomed to go down as an expensive failure.

A similar campaign helped turn the

"The amount of the stuff smuggled by the syndicate could easily reach \$5 million dollars," said a Filipino source from the Kitty Hawk. He declined to be identified by name and gave his address simply as San Diego.

He said he and some of his colleagues on the carrier had "some knowledge that naval investigators" were with the flotilla when it was still in the Indian Ocean.

"But we are not sure if they were aboard the Kitty Hawk or the other ships, or if they came with us here to Subic," said the source.

A Subic Bay spokesman said he

WASHINGTON POST

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New Zealand Hints Shift

Reuter

WELLINGTON, New Zealand, Aug. 26—New Zealand indicated today it would make new proposals to the United States to break a six-month deadlock over Wellington's ban on nuclear-capable warships.

It was the second time in less than a week that Prime Minister David Lange suggested a way might be found to repair relations between the two allies in the ANZUS defense pact, which also includes Australia.

On Thursday, Lange said Deputy Prime Minister Geoffrey Palmer would go to Washington next month to discuss planned ship-ban legislation with Secretary of State George P. Shultz.

The legislation would enshrine New Zealand's antinuclear stance but probably hand responsibility for judging whether or not a warship was carrying nuclear weapons to a cabinet committee, Lange said today, indicating that Palmer's brief will also include consultations on the overall prospects of the resumption of ship visits.

Lange told reporters he wanted to avoid a rupture in relations with the United States, which canceled a

SHIFT...Pg.10

public tide against the MX missile program, which Congress capped this year at half the level sought by the administration. Michael Mawby, a Common Cause lobbyist, says that "Star Wars is going to be the next big game in town."

knew nothing about the investigators but added, "the case is still under investigation." U.S. officials in Manila referred all questions to the Pentagon in Washington.

The Filipino sources said U.S. agents are investigating "the disappearance of more than one million dollars in equipment and supplies from the Kitty Hawk." Among the missing items were several bars of silver that disappeared after the Navy supply system was said to have filled false orders for the bullion.

Staff writer Walter Andrews in Washington contributed to this report.

X: Cows

Most Polled Disapprove of SDI

Post-ABC Survey Finds 53% of Americans Against 'Star Wars'

By George Lardner Jr.
Washington Post Staff Writer

A majority of Americans interviewed in a Washington Post-ABC News poll say they disapprove of the Reagan administration's plan to develop a space-based missile defense in light of the criticisms lodged against it.

Support for the administration's Strategic Defense Initiative (SDI), which some call "Star Wars," would drop even more if its development should require the United States to violate or abandon the Antiballistic Missile Treaty with the Soviet Union, the survey found.

The nationwide poll of 1,506 people, conducted July 25 to July 29, showed that 53 percent disapproved of the program, 41 percent approved, and 5 percent said they were uncertain or had no opinion.

The response came in answer to a question that pitted the basic argument for "Star Wars"—protection from nuclear attack—against criticism that the system would be expensive, might not work and could escalate the arms race.

Those who said they approved were then asked whether they still would favor it if it meant violation or abandonment of the ABM treaty. Sixty-three percent of this group said they would still support it, 32 percent said they would not, and 5 percent didn't know or had no opinion.

Put another way, the survey found that 26 percent of all those polled said they supported development of a space-based missile defense even if it should conflict with the treaty.

The 1972 ABM treaty prohibits both the United States and the Soviet Union from developing, testing or deploying ABM systems or components "which are sea-based, air-based, space-based, or mobile land-based."

The SDI debate could turn into a potent political issue, the poll suggests.

Support for it was strongest among people who voted for President Reagan in 1984 (59 percent), those who call themselves Republicans (59 percent) and those who consider themselves conservatives (56 percent).

Opposition was strongest among those who voted for Walter F. Mondale (73 percent), those who disapprove of the Reagan presidency (70 percent) and those who call themselves Democrats (69 percent).

There is also evidence of a striking gender gap on the initial question. Men approved development of space-based weaponry to knock down Soviet missiles by 54 percent to 43 percent. But only 30 percent of the women approved, while 63 percent disapproved.

The findings contrast sharply with other, differently worded polls on the subject, such as a February 1985 survey by Arthur J. Finkelstein of New York and a May 1985 poll conducted by Sindlinger & Co. for the Heritage Foundation's Policy Review.

The Finkelstein poll said 90 percent responded yes when asked, "Do you want the United States to defend Americans against Soviet missiles?" It also said 83 percent answered no when asked, "Did you know that the United States has a treaty with the Soviet Union not to

protect Americans from a Soviet missile attack?"

The Sindlinger poll in May said current U.S. policy is "to deter a Soviet nuclear attack by threatening massive retaliation, while at the same time leaving the United States defenseless against a Soviet nuclear attack." It found that 74.4 percent felt that this strategy "needs to be changed."

The poll also said that 69.1 percent favored development and eventual deployment of a "Star Wars" defense system "even if it meant that the U.S. would have to renegotiate or withdraw from our existing arms control agreements with the Soviet Union."

The questions in the Post/ABC News poll and the results:

Q. Have you read or heard about plans by the Reagan administration to develop weapons in outer space that could destroy nuclear missiles fired at the United States by the Soviet Union or other countries? Reagan calls the research on these weapons SDI, for Strategic Defense Initiative, and some people refer to it as "Star Wars."

Yes, have read or heard	84 percent.
No, have not read or heard	16 percent.
Don't know or no opinion	1 percent.

Q. Supporters say such weapons could guarantee protection of the United States from nuclear attack and are worth whatever they cost. Opponents say such weapons will not work, will increase the arms race, and that the research will cost many billions of dollars. How about you: would you say you approve or disapprove of plans to develop such space-based weapons?

Approve	41 percent.
Disapprove	53 percent.
Don't know or no opinion	5 percent.

Q. (For those who approved) Currently the U.S. and the Soviet Union have an anti-ballistic missile treaty that prohibits both nations from developing certain weapons. Suppose the U.S. had to violate or abandon that treaty in order to develop the space-based weapons. Would you still favor development of those space-based weapons, or not?

Yes, would still favor	63 percent.
No, would not still favor	32 percent.
Don't know or no opinion	5 percent.

view sale

Computer Bugs Seen as Fatal Flaw in 'Star Wars'

WASH. POST: 10-30-85

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By Boyce Rensberger
Washington Post Staff Writer

President Reagan's dream of an effective "Star Wars" system of antimissile defenses is almost certainly doomed to failure, according to a growing number of top computer programming experts who say there is no conceivable way to write and test the software that would be needed to operate it with adequate reliability.

Officials of the Strategic Defense Initiative, as the program is properly called, have long cited computer software—the programs that instruct computers how to operate—as their biggest single technical obstacle, but they insist that with enough time and money, it can be overcome.

Some argue that a high degree of reliability is not necessary—that less-than-perfect reliability will be sufficient, since the Soviets would never have enough confidence to launch an attack against an America protected by Star Wars defenses, even if they knew there might be some bugs in the defense's computers.

Somewhat more tempered optimism is expressed by a panel of computer experts recruited to advise the Pentagon's SDI Organization (SDIO). Some members concede that while it is impossible to eliminate software bugs that could make the hardware malfunction, it may be possible to design systems that quickly isolate malfunctioning components, limiting the damage they can do. Others hold simply that SDI is a research program in its early stages, and that it is too soon to say it can't be done.

Outside SDIO, on the other hand, leading software engineers are mostly pessimistic. They say SDI officials underestimate the difficulty of the software problem and overestimate the capabilities of software engineering. Many say flatly that SDI's goals are impossible to achieve, given the current state of the software writing art and that no foreseeable advance within this century will change that.

While lasers and other beam weapons have dominated much of the public perception of the technical side of SDI, relatively little popular attention has focused on the fact that the entire system would have to operate completely automatically, under the control of a network of computer programs that would, all sides agree, comprise the longest, most complex piece of software ever created.

Because the Star Wars system would have to respond so fast and be so highly effective, there would be no time for human intervention, no time even to "wake the president," as one SDI official put it, before committing the United States to war.

The first engagement of a nuclear war—and perhaps the last—would have to be entirely under the control of a computer programmed in advance on the basis of assumptions about how the Soviets would attack and how the United States should respond.

Computers linked to orbiting sensors would have to be the first to detect an attack. Computers would have to discriminate between thousands of real weapons and tens of thousands of decoys meant to waste U.S. firepower. Computers would have to calculate the trajectories of all objects in the "threat cloud." Computers would have to determine the nature of the attack and select an appropriate strategy for responding, selecting the highest priority targets and assigning them to orbiting battle stations armed with lasers or other weapons. Computers would have to aim the weapons. Computers would have to verify that Soviet missiles and warheads had been destroyed. And the computers could not "go down" if the Soviets happened to blow up a hydrogen bomb in their vicinity.

In a matter of seconds or, at most, a few minutes, an antimissile system of the sort envisioned by President Reagan and SDI officials would have to make all the decisions that in a conventional war would be made by legions of reconnaissance experts, field commanders, generals, the Joint Chiefs of Staff and the commander-in-chief over a period of days, weeks and months.

"People just don't seem to understand that software isn't like most other engineering problems. There are some fundamental reasons why it can never be made reliable enough that you could have confidence Star Wars would really work," said David L. Parnas, one of the computer world's most respected authorities on large-scale programming. Parnas, a U.S. citizen, is a professor at the University of Victoria in British Columbia. "I'm not saying it's impossible. I'm saying you'll never know how reliable it is."

One reason for this uncertainty, SDI opponents say, is that it will not be possible to test the entire system under realistic conditions. Computer programs invariably contain errors, or bugs, that can be found only by debugging—running the program, trying to make it perform as intended, seeing where it goes wrong, rewriting the erroneous code and rerunning the program.

SDI advocates say it would not be necessary to test the software of a defensive system under realistic conditions, because programs can be debugged by running them on simulators.

Last June, Parnas was appointed by SDIO to its advisory committee on "battle management software." Parnas, who says he supports Reagan's goal of eliminating the threat of nuclear weapons and who has worked on military aircraft computing problems for many years, attended the panel's first session.

After meeting the other members and hearing SDIO's expectations, he quit in frustration.

"In March 1983," Parnas wrote in his letter of resignation, "the president asked us, as members of the scientific community, to provide the means of rendering nuclear weapons impotent and obsolete. I believe that it is our duty as scientists and engineers to reply that we have no technological magic that will accomplish that."

Parnas' resignation, accompanied by eight technical papers that he said explained why the software could not work as desired, galvanized the software engineering community and set the terms of a debate that continues to rage on campuses, where more and more software specialists are declaring their skepticism. The debate has become a prime topic on certain electronic "bulletin boards," by which many computer professionals communicate.

"I do believe, with Parnas and many others, that the software required simply cannot be produced to the degree of confidence without which it would be a meaningless exercise," Joseph Weizenbaum, a computer expert at the Massachusetts Institute of Technology, told his colleagues via the bulletin board.

"If the physics of the problem permits a good antimissile defense," countered John McCarthy of Stanford University's artificial-intelligence program, "the programs can be written and verified. However, it will be quite difficult and require dedicated work."

Larry Smarr, head of a new federally funded National Center for Supercomputing Applications at the University of Illinois, is among hundreds of physicists and growing numbers of other scientists—including software engineers—who have signed a petition refusing to work on SDI research because of its technical dubiousness.

"In my experience as a physicist who has written some pretty large computer codes," Smarr said, "there is no way you could produce a code large enough to handle the job and do it perfectly the first time, which is what you would need. I can't imagine any developments in computer technology that would make it possible in the foreseeable future."

It is generally agreed that the software required for the Star Wars system would consist of at least 10

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million lines of code, though some say it would be nearer 100 million. A line of code is an instruction, written in a programming language, telling the computer to carry out one in a series of data processing steps.

SDI advocates note that the space shuttle uses about 3 million lines of code, including the computers on the ground that control the launch and that control the flight from Houston. In the shuttle itself are about 100,000 lines.

"This is software that's evolved over many years of the space program. It's been tested on the ground many, many times. It's flown the shuttle successfully many times and yet we still have shuttle launches aborted because of software failures," Parnas said. "What happened is that in all the tests they never encountered the exact set of circumstances that revealed a bug that was in there all along."

"The SDI people say they will test all their software before deploying it, but what if they don't anticipate the exact set of circumstances that the software will encounter somewhere down the road when the Soviets decide to attack? You can't go back and fix the bug and start the nuclear war all over again."

Computer specialists know that all programs, even ones sold for commercial use, contain bugs—many of which are not discovered until years later.

Parnas said it is not unusual for debugging to continue long after new computerized weapons are deployed in the field. "Programmers are transported by helicopter to Navy ships. Debugging notes can be found on the walls of trucks carrying computers that were used in Vietnam," Parnas said. "It is only through such modification that software becomes reliable. Such opportunities will not be available in the 30-minute war to be fought by a strategic defense battle management system."

"The largest program I ever saw that was correct the first time it was run was five lines," Parnas said.

The reason computer programming is so hard is that a human mind must think through every function the computer must perform and break the task down into a complete and flawlessly logical set of small steps. At each step where alternative outcomes are possible, the programmer must anticipate each one and add to the program a full and flawlessly logical set of instructions on how to deal with each of these outcomes.

SDI's programs would be stored in digital form in several places, some in ground-based computers and some in computers aboard orbiting platforms carrying sensors or beam weapons. The components would communicate by radio—sending, for example, information on an enemy warhead's position from a sensor to a laser platform.

For every stage, or layer in the sequence of steps, at which alternative outcomes can occur, the program's complexity multiplies. Like

a tree whose trunk divides repeatedly into tens of thousands of branch tips, the sequence of steps a program executes can lead to any of several thousand alternative outcomes. Unlike a tree, computer programs also contain many "branches" that emerge from one "limb" only to arch sideways, reentering some other branch.

Programmers say it is impossible to keep all the pathways clearly in mind so that the rules of programming logic are not violated and that every branch is always prepared to deal properly with the data that may enter it from all other connected branches.

As programmers like to say, their software usually does exactly what they tell it to do, not what they want it to do.

Typical programs for word processing or spreadsheet analysis, usually no more than a few hundred lines long, contain scores or even hundreds of bugs when first written. Only repeated use, trying out every conceivable combination of maneuvers, can reveal the bugs. Bugs remain even after most software is put on the market—a situation that causes most manufacturers not only to deny their customers a warranty but to print a specific disclaimer of warranty.

For example, IBM's disk operating system software, the program without which no other program will run on an IBM-PC, carries the following disclaimer: "The program is provided 'as is' without warranty of any kind, either expressed or implied The entire risk as to the quality and performance of the program is with you. Should the program prove defective, you (and not IBM or an authorized personal computer dealer) assume the entire cost of all necessary servicing, repair or correction."

Top software engineers say bugs are not an indication of careless programming but a fact of life that even the best programmers must cope with. Moreover, they note, as programs grow larger, the incidence of bugs increases not in proportion, but much faster.

"You talk to people who write these big programs," Parnas said, "and you think you're talking to sociologists. They'll tell you that when they run their program it does 'funny things' that they can't predict. 'Sometimes it does this; sometimes it does that.' It's like they're trying to predict public opinion. You ask them what their program will do in such and such a situation and they say, 'I don't know. Let's try it.'"

SDIO's panel on computing, while conceding some of Parnas' points, insists that these concerns are not fatal to the long-range goal.

"Perfection is a bit overrated," said panel chairman Danny Cohen of the University of Southern California. "There will always be bugs and malfunctions. But that doesn't mean the thing won't work. You can design the software so that when bugs turn up, they are isolated in the system. You design the system to cope with malfunctions."

"Parnas keeps talking as if there is some fundamental law of nature that says it's impossible. But there isn't. This is not like perpetual motion, where you can show mathematically that it's impossible. It will be very hard to produce this software but as long as it isn't like perpetual motion, it isn't impossible."

A different problem for SDI software, according to the critics, lies in the fact that the program must embody assumptions about the characteristics of Soviet weapons.

For example, when a swarm of warheads is hurtling over the Arctic toward the United States, they are likely to be surrounded by perhaps 10 times as many decoys—objects designed to look like real warheads to the sensor. If the sensors cannot tell them apart, the beam weapons will have to spend precious time and energy destroying every object. If there are enough decoys, the beam weapons will not have time to destroy all the threatening objects and some warheads will slip through.

If the sensors and their computers are to distinguish the decoys, they must first be programmed to do so. "Unless the Soviets cooperate and tell us what characteristics to look for, the recognition algorithms written into the software could be wrong," Parnas said.

"If [the Soviets] come up with just one special trick to spoof the system and our people didn't happen to design the system to cope with that, it won't work," Sparr said. "It's going to be a Maginot Line in space."

"Parnas is putting his finger on some real technical problems," said Charles Seitz, a computer panel member from California Institute of Technology, "but these are things that SDI is researching. While Parnas is going around debating, we're studying the problems. The honest answer right now is that there is nothing today that assures us it can be done or that it can't be done. Existing software engineering practice has never encountered a problem quite like this before."

For all its optimism, the computer panel has concluded that there are limits to what software can do. The way out, as Seitz and Cohen described the panel's findings, is to rethink the nature of the hardware being considered for an antimissile system, limiting it to something that software could handle. In a formal report being prepared for SDIO, Seitz said, the panel will be "quite critical of the system architecture," the general configuration of the system's hardware that SDIO has been considering.

One change under consideration in the "system architecture" is decentralizing the battle management functions so that each orbiting battle station operates with some autonomy, said Air Force Maj. David Audley of SDIO's computer section.

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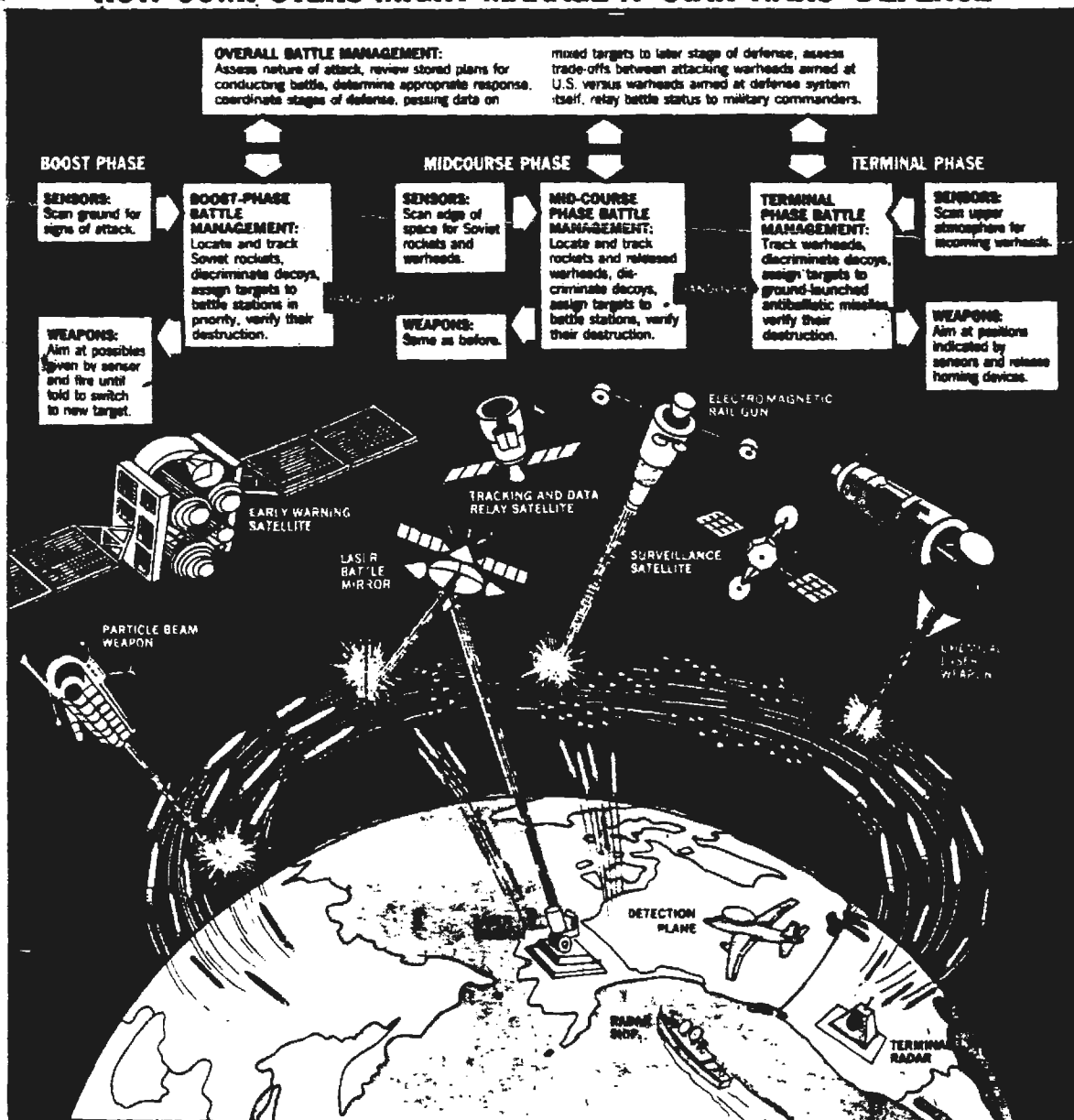
"Instead of having the whole system operated by one monolithic computer," Audley said, "we're thinking now about a loose federation of battle stations."

Audley said software limitations may force acceptance of a less efficient battle management. As a result, for example, a Star Wars system might end up with two or more battle stations shooting at the same target.

Critics say that while decentralization can overcome some barriers, each semiautonomous software module would still suffer from a lack of debugging under realistic conditions. Also, any bugs or wrong assumptions programmed into one module would be present in all.

For all their pessimism, most critics concede that if the government keeps spending money on SDI, someday there will be a huge computer program that SDIO calls battle management software. "But this software will not have the reliability that you or I would consider to be essential for such a system," said James J. Horning of Digital Systems Research Center in Palo Alto, Calif. "Nor will it be possible to retrofit reliability into it. The country will be faced with a cruel dilemma: deploy a system that cannot be trusted, or scrap it."

HOW COMPUTERS MIGHT MANAGE A 'STAR WARS' DEFENSE



FEATURES/COLUMNISTS

CHRISTIAN SCIENCE MONITOR
12 November 1985 Pg. 30

STAR WARS WILL IT WORK?

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The politics of space

By Peter Grier

In the US Capitol, a roomful of conservatives is cheering for missile defense, over dessert. "I'm for an arms race — in defensive systems!" cries activist Phyllis Schlafly. A block away, at 100 Maryland Avenue, liberal lobbyists meet every Thursday and plot against President Reagan's ballistic-missile defense initiative. "It's so big, we can't

"There may be something there," muses Rep. Les Aspin (D) of Wisconsin, influential chairman of the House Armed Services Committee.

The conservatives crammed into a Capitol room last September represent one pole of this debate.

They had gathered for a meeting of the Coalition for the Strategic Defense Initiative, a lobbying group whose members include the Moral Majority and Citizens for Reagan.

A series of speakers thumped home the message that America needs a shield against Soviet missiles — a broad effective shield, not just a demure little defense around Minuteman missile bases. Besides Phyllis Schlafly, longtime spokeswoman for conservative causes, hosts included Rep. Jack Kemp (R) of New York ("Whenever anyone asks, I say I'm a dove — a heavily armed dove") and Sen. Malcolm Wallop (R) of Wyoming, a laser-weapons champion who complained that the Pentagon is not pursuing missile defense with sufficient skill.

Underlying all the speeches, punctuated with the constant clatter of silverware, was the theme that the Soviets cannot be trusted, that defense and not arms treaties is the way to true security. Thus the coalition's purpose is to "raise

public awareness" in support of SDI and perhaps to save SDI from itself.

The liberal lobbyists and their weekly huddle show the other pole of the strategic-defense argument. Thursdays at 1:00 p.m., representatives from the Union of Concerned Scientists, the Council for a Livable World, and other self-styled peace groups meet to coordinate their anti-SDI tactics. This ad-hoc committee has dubbed itself the Space Policy Working Group.

For the most part its members believe that new weapons systems are dangerous because they goad the Soviets into building new systems of their own, leaving both nations in the same strategic situation, but poorer. They feel arms control agreements, not new technology, represent real protection.

Missile defense "is not going to end the arms race," says Union of Concerned Scientists lobbyist Charles Monfort. "You'd still spend billions on countermeasures, and counter-countermeasures."

Congress caught in the middle

Caught between these opposing camps, but so far paying little attention

MONDAY: RACE FOR THE HIGH GROUND
TUESDAY: CANNONS IN SPACE
WEDNESDAY: BATTLING WITH BEAMS
THURSDAY: THE CHALLENGE OF MISSION CONTROL
FRIDAY: THE SOVIET RESPONSE
TODAY: THE POLITICS OF SPACE

stop it. But we have to slow it down," says a participant in the meetings.

In Washington, a political fight is heating up over the President's proposed nuclear-missile shield.

The immediate battles will be over money for the Strategic Defense Initiative (SDI), popularly known as "star wars." But both sides know something far more fundamental is at stake: whether the US will reverse its nuclear strategy of the last 20 years and erect any sort of missile defense.

SDI, after all, is an ambitious package, involving billions of dollars for research on lasers, high-speed electric cannons, and other exotic weapons. Its stated goal is to see if an effective shield that eventually makes nuclear weapons unusable is possible.

Congress could reject SDI totally, embrace it, or simply redirect the program's broad approach. Members of Congress might vote to protect US intercontinental missile bases, for instance, with rings of rocket interceptors. They could decide to defend a mixture of some missile bases and cities.

to either, is Congress. Though legislators have sawed the occasional hunk out of SDI's budget, they have done nothing to change the fundamental thrust of the program.

The SDI, after all, is just the sort of thing that Congress has trouble understanding. It's big and it's highly technical. The Capitol is swarming with lawyers, not physicists.

"Congress's knowledge of technology? It's abysmally poor," says Sen. John Glenn (D) of Ohio.

Senator Glenn, a former astronaut, says colleagues often ask his opinion of SDI. After several grand tours of US missile defense labs, Glenn says the experiments are impressive, but he's not sure when or if a working system could be built. "This program is mind-boggling," he says.

Another reason Congress has yet to focus fully on SDI is that it has been fixated on another strategic-weapons acronym: MX.

The MX missile was first proposed by the Pentagon more than a decade ago. Larger and more accurate than the venerable Minuteman, the MX was supposed to strengthen US land-based nuclear forces.

But Congress and the Pentagon kept

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arguing about where this wonder weapon was to be kept — in silos clustered close together, on trains shuttling around vast tracts of land.

The argument went on so long that the MX became less proposed hardware and more a preeminent symbol of nuclear policy. Members had little attention for other strategic issues. But this year Congress voted to deploy 50 MXs in old Minuteman silos, and the issue appears closed.

"Many of the groups involved in the MX battle are now shifting to star wars," points out Kathleen Sheekey, a lobbyist for Common Cause, a public-interest lobby group.

Thus the SDI is entering a crucial period. In Geneva, it is one of the subjects on the table in arms control talks between the US and the Soviet Union. In Washington, it is beginning to gain prominence as an issue in Congress.

"The next year is going to be pivotal for SDI," says an aide to Sen. Pete Wilson (R) of California, who supports the program.

There is no chance that Congress will soon kill the program. Among members there is a consensus that the US should have some sort of missile defense research.

The question, as it often does on Capitol Hill, will come down to money: Should SDI receive \$26 billion over the next five years, as the Reagan administration has requested?

This year legislators waved their shears over the SDI budget and proclaimed victory. In an authorizing bill, \$900 million was trimmed from SDI's 1986 budget request — but the \$2.75 billion that remained represented an increase of almost 100 percent over 1985.

Future SDI budget battles are likely to center on what the money goes for, as much as its absolute level. In particular, critics worry that SDI, as it is now shaped, will eventually stretch or break the terms of the 1972 Antiballistic Missile (ABM) Treaty.

At issue here is the legality of 15 big experiments SDI plans to hold through the early 1990s. The ABM Treaty has traditionally been interpreted as banning "development" of "components" for other than land-based antiballistic missile systems, and critics contend some SDI demonstrations may violate this restriction. The Pentagon says the rest are allowable lab research, or involve "subcomponents," not "components."

"It's a rather ambiguous situation," says Rep. George Brown (D) of California, who complains that the Pentagon

has simply "defined away the problem."

So look for continued efforts in Congress to cut funds for major SDI tests. The Pentagon, for its part, is not just waiting to be cornered on this question: Officials recently floated a new interpretation of the ABM Treaty, saying it allows development of "exotic technologies."

To a certain extent, fights over language and budget lines are so dancing on the head of a Minuteman.

Focused on these narrow issues, SDI critics and supporters alike can forget the larger vision that Reagan held before the US public, and the political effect

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The SDI Debate

Two sides of the same coin: the pros and cons of the SDI program.

Proponents' case:	Opponents argue:	Proponents reply:
1. A defensive shield will make our air defenses obsolete.	Because a star wars system can't be perfect, it won't remove the threat of nuclear war entirely.	You don't need perfection. With even a few hundred interceptors, an opponent wouldn't know how many of his warheads will get through, so he'd be less likely to strike first. If he does strike first, a defense would destroy most of the attacking force.
2. Because SDI-type defenses would thwart the use of ICBMs, it will slow the US and USSR from further reducing their nuclear arsenals.	One way to beat a defense is to build more missiles to overwhelm it. This would lead to violations of arms treaties. So would testing and deployment of SDI-type weapons. All of this would pull the rug out from under the arms control process.	Deterrence is still steady. Despite some control treaties, I look at how many more missiles have been built since World War II.
3. SDI-type defenses could neutralize accidental or unauthorized launches or attacks by terrorists or other third parties.	There are cheaper ways to prevent accidents. Put command-destroy devices on missiles to destroy them if they're launched accidentally. As for terrorists, they're more likely to deliver a bomb in a suitcase or car trunk than on an ICBM.	Any system that can prevent the launching of a nuclear warhead is worth building.
4. SDI would enhance deterrence by helping US retaliatory forces survive a nuclear attack. This would discourage Soviet leaders from launching a first strike.	Put SDI might give the US confidence to strike first in a crisis. After all, it's easier for an imperfect defense to counter a ragged response than a coordinated first strike.	This is a defensive system. It is not designed to make aggression easier. Besides, when the US had clear nuclear superiority it didn't engage in nuclear blackmail.
5. SDI would help protect US allies in Europe against nuclear attack.	Maybe so, but it then leaves Western Europe open to conventional attack.	Conventional war is preferable to nuclear war — especially since conventional weapons can be recalled.
6. SDI takes advantage of the US technological lead over the Soviets.	That doesn't mean the Soviets won't respond. Since World War II, they've matched many US weapons developments.	A high-tech race works to the US's advantage. If the Soviets copy US technology, the US will be ahead in the race.
7. Technological spinoffs from SDI will help the rest of the US military and even find civilian uses.	The classified status of most SDI research will prevent quick use of spinoff technology. SDI may draw research money and manpower away from civilian work. It would be better just to spend the money for commercial R&D.	There plenty of examples of commercial technology that came from classified military programs. Take a look at jet engines and nuclear power.

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that vision has already had.

In calling for a world where nuclear weapons are "impotent and obsolete," the President employed the sort of Utopian rhetoric associated with theologians and antinuclear activists, not politicians. Whatever the merits of the SDI program, Reagan's words alone have given him a moral sheen in voters' eyes, say even some critics.

"The arms control and peace communities were taken by surprise. The Presi-

dent has grabbed the moral high ground, somewhat," says James Wetekam, a lobbyist for the United Church of Christ Office for Church in Society.

Mr. Wetekam, part of the anti-SDI coalition of lobbyists, says Reagan has "been effective to some extent" in capturing public opinion for missile defense.

Capitol Hill committee staff members of all political persuasions generally agree.

Public opinion? Few clear themes

Opponents' case:	Proponents argue:	Opponents reply:
1. SDI threatens to base weapons in space.	SDI offers a chance to negotiate treaties that nearly eliminate nuclear weapons.	The arms race wouldn't end. One way to counter a defense is to build more missiles. In fact you'd add two more races: one over defensive weapons and one over countermeasures.
2. SDI will undermine the ABM Treaty, which presumes that if there are no defenses the strategic balance will be more stable.	You assume a defense is deployed. SDI is a research program being conducted within the limits of the ABM Treaty. Besides, the Soviets have their own star wars program.	SDI may be research, but some of the demonstrations planned involve devices that could be seen as "components" under the ABM Treaty, hence testing them would be a violation.
3. Even if 55 percent effective — much higher than current estimates — its defense system will allow enough warheads to get through to inflict untold damage on the American society.	Without defenses, all of the warheads in a Soviet first strike could hit the US, destroying our ability to retaliate.	We can retaliate using submarine-based missiles. Even if a defense stops some Soviet warheads, it would still let enough through to destroy the US as a nation.
4. A star wars system will be destabilizing because its orbiting weapons will be vulnerable to attack and because the Soviets could build more offensive weapons to overwhelm it.	One object of SDI is to make it so expensive for the Soviets to overwhelm it that they give up that option. And because this reduces the utility of nuclear weapons, the Soviet should be more willing to negotiate arms reductions.	Possible countermeasures are numerous. They're already being explored by the US and the Soviets. While we put weapons into orbit, they'll put countermeasures on a new generation of ICBMs.
5. The US will have to convince the Soviets that relying on ballistic missile defenses is better than on the doctrine of mutually assured destruction.	The Soviets have always placed a high value on defenses, even if they're marginal. SDI merely shows that the US values defenses, too.	True, the Soviets value defenses. They are beefing up their air defense screen. But that doesn't mean it will be easy to ask them out of the ABM Treaty.
6. America's allies are concerned that SDI will speed the arms race between the US and USSR.	Perhaps. But the Europeans are also intrigued by the possibility that getting a share of the SDI pie will help their high-tech industries.	Given our efforts to halt the transfer of military sensitive technology, allied participation is likely to be quite limited.
7. The cost of a star wars system is likely to be prohibitive.	Cost estimates at this point are fuzzy. There is no clearly defined system on which to base them. Besides, Reagan administration officials have said that if research shows that a cost-effective defense can't be designed, it won't be pursued.	We do have spending targets for the SDI research program: \$26 billion by 1990. So much will have been spent by that time that the program will become self-perpetuating, even if it proves infeasible to deploy a defense.

Public opinion polls on the issue, however, show few clear themes. A recent roundup of star-wars surveys in Public Opinion magazine, published by the American Enterprise Institute, concludes that "responses bounce all over, depending on which nerve the pollsters touch."

Such movement, said the magazine, is typical when an issue is complicated and the public not well informed.

In general, the polls cited in the roundup show more people favor development of a star-wars system than oppose it. Opinions on what the system would actually do, however, skitter around like a cat on ice skates. Only one poll, a CBS News/New York Times effort, asked simply whether missile defense would work; 62 percent of respondents said that it could.

Building and keeping public support for missile defense is both necessary and difficult, admit administration officials.

The recognition of this fact has led pro- and anti-SDI groups outside the government to begin multimedia ad campaigns to try to build support for their positions.

"No one is going to write us a blank check and say, 'Go, come back in 15 years and build us something,'" says Gerald Yonas, SDI's chief scientist. To keep voters and Congress satisfied, SDI in the next few years will have to produce technical achievements that are the stuff of press releases, says Dr. Yonas.

SDI won't be able to produce these advances on its own. It will need help from defense-contractor friends. Such friends should not be hard to make, given that missile defense could be the biggest thing to hit the arms industry since the cost-plus contract.

SDI right now is just a research program, and thus still small change compared to such things as building Trident submarines. Boeing Aerospace is currently the No. 1 SDI contractor, with \$130 million worth of business.

But if a missile shield ever goes into production, it would mean immense amounts of business — rough estimates are that a full system would cost at least \$800 billion.

Companies are thus elbowing each other in a race to become SDI favorites. Ten contracts to study missile-defense architectures, let last year, were among the most hotly contested in Pentagon history. With contracts for such big programs as the B-1 and Stealth bombers basically awarded, companies are looking at SDI as the last mother lode of untapped defense spending this century, one industry official says.

"SDI offers you the chance to get in STAR WARS...Pg. 4-F

STAR WARS...from Pg. 3-F

on the ground floor of something really big," says Walter Edgington, GTE marketing vice-president.

Critics worry that this promise of money will make missile defense a pork barrel of the heavens, supported by Congress because of the jobs it provides, not because of its intrinsic virtue.

Seventy-seven percent of SDI research money has flowed to the districts of congressmen who sit on the key Armed Services or Appropriations Committees, according to an analysis released earlier this year by the Council on Economic Priorities.

But Mr. Reagan's words for missile defense have done more than argue morality and make corporate hearts beat faster. They have also launched a broad debate among university professors, think-tank scholars, and once and future government officials whose careers involve thinking about nuclear weapons. This debate is not so much about the President's vision as about whether a missile defense, however leaky, would be a good thing.

In concrete terms this means Congress could reject SDI's crash-program style and broad emphasis, yet still embrace the idea that defensive weapons could be a useful addition to America's offensive nuclear arsenal. A recent report from the Congressional Office of Technology Assessment identified four possible levels of defenses, from limited protection for US military forces to an extremely capable shield.

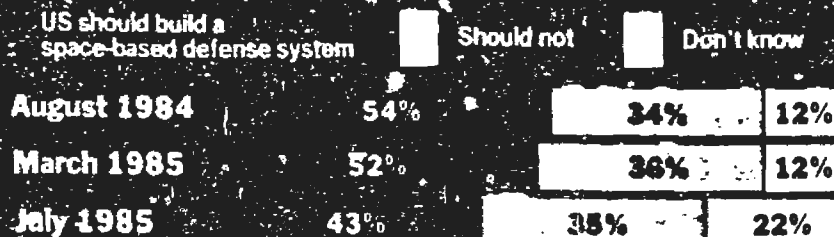
Arguments for strategic defense

Those in favor of defensive weapons usually begin their argument from the premise that US land-based nuclear missiles and control centers are dangerously vulnerable to Soviet attack. Furthermore, they add, US voters may grow faint in the face of today's assured nuclear destruction, and refuse to pay for new nuclear swords. "Democratic publics will sooner or later retreat to pacifism and unilateral disarmament," writes former Secretary of State Henry A. Kissinger.

Defensive weapons could be a politically attractive way to protect US forces, advocates say. If this is beginning to sound like a rerun from the 1960s, it is: The argument is similar to that put forward two dec-

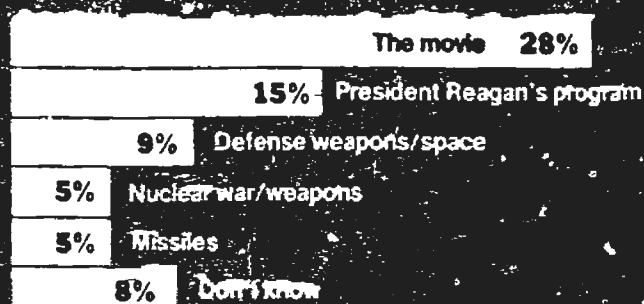
Public opinion and 'star wars'

QUESTION: President Reagan has proposed that the United States build a space-based defense system against incoming missiles. Many people think that this is a good idea because it would give us an advantage over the Russians in this area, which would help deter a Soviet attack. Many others feel that a space-based defense system is a bad idea because it would escalate the arms race and increase the risk of nuclear confrontation with Russia. How do you feel — do you think the United States should or should not build a space-based defense system?



Source: Roper Organization

QUESTION: What comes to mind when I say "star wars"?



Source: Survey by Arthur Finkelstein for Newsweek and D. Sellers, February 1985

QUESTION: Do you favor or oppose developing such defense weapons (which use lasers and particle beams to shoot down enemy missiles), or what?



Source: ABC News, January 1985

QUESTION: Would you like to see the United States go ahead with the development of such a system ("star wars") or space-based defense against nuclear attack, or what?



Source: Roper Organization, January 1985

QUESTION: From what you know about it, do you think that building the so-called "star wars" defense system in space is a good idea or a bad idea?



Source: Time magazine/Survey Research Center, 1985

ades ago when the US debated, but did not build more than a token antiballistic missile (ABM) force. The difference in the 1980s is that modern technology would enable an ABM system to actually work, according to proponents.

Light, mobile defender rockets could be shifted from base to base, in a sort of nuclear poker with the

USSR. Soviet military planners could never be sure what defensive forces were where, and therefore could never be sure a surprise nuclear strike would succeed, no matter their offensive strength, and therefore would never launch first.

"Defenses do not have to be nearly leakproof to be useful in de-

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terrifying Soviet attack," concludes Fred S. Hoffman, nuclear theorist and head of a 1983 presidential study of the strategic implications of missile defense.

Critics reply, first of all, that the case for limited strategic defense is based on the mistaken premise of US weakness. While US land-based missiles may theoretically be vulnerable to their Soviet counterparts, say critics, US submarines are not. A single Trident sub has enough nuclear missiles to devastate vast tracts of the USSR; while such firepower cruises safely beneath the seas, only a madman would launch a nuclear strike against the US, claim missile-defense critics.

"A threat to the US retaliatory capability does not exist today and is not likely to arise during this century," writes former Secretary of Defense Harold Brown.

Second, some critics complain that limited missile defenses would actually make the world a more dangerous place, because they would inflame Soviet distrust.

"Why? Because a leaky umbrella offers no protection in a downpour but is quite useful in a drizzle," says former Defense Secretary Robert S. McNamara. In other words, a small-scale missile defense could not cope with an all-out Soviet attack. But if the US hit the USSR with a first strike, limited defenses could mop up the ragged Soviet retaliation.

Kremlin leaders, who suspect that the US yearns to once again be the world's supreme nuclear power, might thus respond to US defenses with provocative moves of their own — perhaps an all-out offensive arms buildup, says Mr. McNamara.

Central security issue in Congress

Work on limited defenses and an SDI-type full-dress program are not mutually exclusive. Differences involve timing and emphasis. SDI officials see limited systems as the first step toward bigger things; small-scale-defense advocates see SDI as a Cecil B. DeMille production that could stand budget cuts.

What seems clear is that this multifaceted debate — big defense vs. small defense vs. no defense at all — is becoming the central security issue in Congress, if not the whole Western alliance. Its prominence alone has changed the super-

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IN THE NATION

Tom Wicker

The Great Turnabout

The Reagan Administration's curious decision to keep Casper Weinberger out of the summit conference in Geneva provides a backhanded reminder of a different Defense Secretary, a different summit and a remarkable turnabout.

In January 1967, President Johnson announced in his annual budget message that the U.S. would "continue intensive development" of an antiballistic missile system; but, he said, he would take no action to deploy the defense, pending the outcome of an overture to the Soviet Union for talks on limiting ABM deployments.

Here was a classic Johnsonian compromise. Intelligence suggested that the Russians were beginning deployment of an ABM defense around Moscow, but continuing U.S. ABM development would temporarily placate the Joint Chiefs of Staff, Congressional hawks and Republican criticism. The delay in deployment, plus the overture to Moscow, reflected the opposition of Robert S. McNamara, the Secretary of Defense, to ABM defense, and both his and the President's desire for strategic arms talks.

Moscow, apparently suspecting that the U.S. wanted to limit Soviet defenses while retaining what were then its own offensive advantages, hedged on entering such talks. And in February, Prime Minister Aleksei Kosygin, at a news conference in London, stoutly defended ABM's. More than 18 years later, in a speech to the U.N., President Reagan quoted Mr. Kosygin: "I believe that defensive weapons, which prevent attack, are not the cause of the arms race but constitute a factor preventing the death of people ..."

In June, however, Mr. Johnson and Mr. Kosygin unexpectedly agreed to meet at Glassboro, N.J. The President brought Secretary McNamara along — and, over lunch, Mr. McNamara argued the case against ABM defense directly to the Soviet Prime Minister. Mr. Kosygin appeared unimpressed and still refused to agree to arms talks; L.B.J. wrote in his Presidential memoirs that "the

point did not get across — or Kosygin chose not to understand it."

In a speech in San Francisco that September, Mr. McNamara made the point publicly:

"[An ABM system] can rather obviously be defeated by an enemy simply sending more offensive warheads, or dummy warheads, than there are defensive missiles capable of disposing of them ... Were we to deploy a heavy ABM system ... the Soviets would clearly be strongly motivated to so increase their offensive capability as to cancel out our defensive advantage ..." The U.S., he made clear, would respond in the same way to the same challenge.

That remains the crux of the case against ABM's of far more advanced technology, including Mr. Reagan's proposed Strategic Defense Initiative; and apparently "the point" had had more effect on Aleksei Kosygin than L.B.J. had realized.

Mr. McNamara concluded the San Francisco speech with an extraordinary "yes, but" when he announced that the U.S. would deploy a limited defense against the possibility of a missile attack from China — a step owing less to strategic necessity than to the internal politics of the Johnson Administration. Members of Congress and the military made it clear — though Mr. McNamara opposed the idea — that they considered this the first step in a "heavy" ABM defense against Soviet attack.

That prospect apparently convinced the Russians to heed Robert McNamara's Glassboro warning that a missile defense on one side would inevitably stimulate an increase in offensive missiles on the other, and vice versa. In June 1968, Moscow agreed to enter arms control talks; and Mr. Johnson — who had by then refused to seek re-election — was ready to announce on Aug. 21 that he would go to Moscow to begin such talks in October. The Soviet invasion of Czechoslovakia on Aug. 20 scuttled the arrangement.

When what became known as the SALT talks finally began in November 1969, not just President Nixon — who had embraced the McNamara arguments and persuaded the Joint Chiefs to go along — but the Russians too were pressing for a limitation on ABM's. It was ultimately reached in the treaty of May 26, 1972.

Moscow's willingness to enter that treaty represented one of the great turnabouts in Soviet-American relations — but no greater, unfortunately, than the turnabout of the Reagan Administration in becoming the new champion of the old ABM fallacy. □

powers' relationship. It may distract the US from other matters worthy of attention. "People always want to talk about SDI," grumbles Dr. Freeman Dyson, physicist and author of two acclaimed books on nuclear weapons. "The Soviet offer of a comprehensive test-ban treaty, get-

ting NATO to adopt a 'no first use' nuclear strategy — those things are a hundred times more important than SDI."

Last of six articles. Preceding installments ran Nov. 4-8.

STAR WARS

WILL IT WORK?

3

Battling with beams

By Scott Armstrong

About a dozen people, mainly military brass, were crowded into a control bunker three stories beneath the New Mexico desert here. Peering anxiously at a bank of

monitors and computer screens, they watched as a laser beam the diameter of a Hula-Hoop flashed a half-mile across the desert floor, glanced off a focusing mirror,

Beam weapons are gaining prominence. Once confined to Buck Rogers fantasy, these "death rays" consist mainly of particle beams, which hurl streams of atoms or atomic particles, and lasers. These technologies have been elevated to new visibility under President Reagan's Strategic Defense Initiative (SDI), popularly known as the "star wars" program.

Indeed, they are one of the reasons that the United States has revived the idea of building defenses against inter-continental ballistic missiles (ICBMs) after scotching it in 1970s.

Earlier it was thought that there was no way to deal with tens of thousands of warheads and decoys that might be launched against the US in a full-scale nuclear assault. There still may not be.

But a defender's job would be easier if a system could knock out as many missiles as possible within the first few minutes of launching, before they had a chance to release their many decoys and warheads. Beam weapons flashing through space at or near the speed of light are prime candidates for the job.

Conceptually, they make captivating weapons: beams of pinpoint precision able to zap mankind's most destructive armament. But translating that vision into reality will be difficult.

Physicists have been toiling for more than a quarter of a century to fashion directed-energy weapons, as they are called. The Pentagon launched its first particle-beam research program, the

Seasaw project, in 1958 at Lawrence Livermore National Laboratory. The aim: to build a particle-beam accelerator and study its potential for thwarting missiles.

Interest in laser weapons surfaced shortly after that. In the years since, enthusiasm for these exotic weapons has vacillated. Hopes raised by advances in technology were often dashed when people began to look at the cost and other problems tied to building a practical weapons system.

The military is still keen on beam weapons for everything from air-defense to zapping enemy satellites. The SDI program, however, focuses attention on the far more difficult task of destroying enemy missiles and warheads, for which \$1 billion is being sought next year alone (about one-fourth the SDI budget).

Given the hurdles that remain, particularly the defensive tricks the Soviets may try (such as spinning a booster so a laser cannot dwell on one spot), even SDI officials do not see a practical and affordable beam-weapon system this century. Divining what the Soviets might do is like a chess game, says Louis Marquet, head of SDI's directed-energy programs. "Unfortunately, the Soviets are very good at chess."

Infrared chemical lasers

Light from a normal lamp is a disor-

MONDAY: RACE FOR THE HIGH COMMAND
YESTERDAY: CANNONS IN SPACE
TODAY: BATTLING WITH BEAMS
THURSDAY: THE CHALLENGE OF MISSION CONTROL
FRIDAY: THE SOVIET RESPONSE
TUESDAY: THE FUTURE

and lit on a section of a Titan missile. Seconds later, the rocket stage suddenly blew up, scattering shards of metal hundreds of feet amid the mesquite and piñon.

"I've been in this business for 12 years," says Capt. Arthur Schroeder, head of the Navy's work here, who watched the demonstration in September. "It was the most dramatic damage and vulnerability test I've ever seen."

Impressive as it was, it does not prove that lasers can be used to defend the United States against nuclear annihilation. The test was simply one more small step in a long and arduous quest to see if directed-energy, or beam, weapons ever may be suitable for knocking down Soviet missiles.

derly jumble of frequencies. Lasers generate concentrated beams of light that are almost perfectly parallel, identical in frequency, and the light waves move in phase with each other. This gives lasers their punch. In theory, they could be focused over thousands of miles of space to burn a hole in the skin of a missile or, in the case of lasers that emit pulses, thump the target like a sledgehammer.

The most powerful lasers now in existence are chemical. They draw their energy from the combustion of gases. Because they do not require huge power plants, chemical lasers are mainly being considered for parking in space, where they would be free from the distorting effects of the earth's atmosphere.

These lasers pack a punch. Ones far less powerful than that tested here at White Sands — a 2.2-megawatt device that is the "brightest" in the West — have already knocked down planes. But space-weapons lasers will have to be brighter (probably 10 times or more).

Such infrared chemical lasers also have a long wavelength. Because their beams spread out over great distances, they would need to linger on the same spot on a fast-moving missile for several seconds. They also would require exquisitely fabricated mirrors of up to 50 feet in diameter to keep them focused. This has caused them to fall from grace with some in the SDI community.

Any orbiting constellation of chemical-laser battle stations will have to meet
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several criteria: be reliable, be cheap enough to hoist into orbit and maintain, and be able to survive a direct attack — for instance, from exploding satellites (space mines) the Soviets may park next to the weapons platforms.

"The difference between putting something up in space that can fire once or twice and something that will keep missiles from landing on top of you is a big one," says Jeff Hecht, author of the widely respected book "Beam Weapons."

Free-electron and excimer lasers

The alternative is to use shorter-wavelength lasers, such as the free-electron and excimer lasers. These are now the fair-haired beams among SDI researchers. A free-electron laser uses a huge particle accelerator to generate the electrons that, when passed through a series of wiggling magnets, are the source of the device's ultraviolet light.

These lasers have been developing the quickest. "They've come along in not many years from a scientific curiosity to reality," says Gerald Yonas, SDI's chief scientist.

In theory, a free-electron laser can be tuned to different wavelengths to allow its beam to slip through Earth's atmosphere. They also can be scaled to large powers and operated at high efficiencies. But for now, they exist only in early-stage laboratory models. Because the free-electron laser's accelerator requires a jumbo power source, it is a better bet for basing on the ground.

Prodigious electrical requirements are likely to keep the excimer earth-bound as well. The excimer does not require a particle accelerator, but it does use a lot of power in producing an ultraviolet beam from rare gases.

Ground-basing is not necessarily a woe. It makes the complex devices simpler to tinker with, easier to defend, and, as Dr. Marquet likes to point out, "You could plug them into Hoover Dam, turn off the lights when the war starts, and deliver all the electricity into the devices." Which you may have to do: By one estimate, powering enough of these lasers to hit 2,000 targets may gobble up as much energy in a few minutes as New York City uses in several hours.

One scheme calls for placing the lasers on mountaintops and firing them high into space, where their beams bounce off huge relay mirrors and then off smaller aiming mirrors in lower orbits. Or the beams might simply be bounced off of "catch and transmit" mirrors in low-earth orbit. Either way,

these devices will need mirrors of gem-like quality larger than any built to date.

To meet this requirement, scientists are considering using mirrors made up of many small segments, like a mosaic, all computer controlled. The same general principle (adaptive optics) is aiding scientists in overcoming another problem with ground-based lasers: atmospheric distortion. So far, however, experiments have only been carried out with low-power beams.

The other snag with short-wavelength lasers is that they can be self-destructive. An excimer laser may be able to disable a booster in two seconds, which would negate the effect of spinning it to counteract the beam. But the excimer could also buckle its own mirrors.

New mirror coatings are being developed, but this is considered one of the more intractable SDI technologies. At a conference this spring, James Stanford of the Naval Weapons Center in California noted that only 2 percent of the coatings now available meet even currently known requirements.

Pop-up X-ray lasers

Of course, defenders could alleviate many of the problems with ground- or space-based systems by simply popping lasers into orbit at the first hint of a Soviet strike. This is where the nuclear-pumped X-ray laser comes in. This weapon appears to be advancing technically but losing ground politically.

The idea sounds simple: Explode a nuclear bomb in a small chamber ringed with rods and pointed at a target. When the explosion's radiant energy hits the rods, it produces a pulse of highly lethal X-rays, spraying them out in the instant before the device vaporizes.

Snags exist, however. Even though work on the secret devices at Lawrence Livermore has been moving quickly, scientists still have to invent more efficient "third generation" nuclear devices that will convert more of their energy into X-rays instead of explosions. Researchers will also have to control and aim the pulses to hit quick-moving targets.

X-ray lasers, too, have put the Reagan administration in the uncomfortable position of pursuing a weapon driven by a nuclear bomb (albeit theoretically a small one) to help make nuclear weapons "obsolete." In theory, hundreds of such lasers could be orbited. But SDI officials now go to great pains to say that will not be done.

The pop-up scheme involves putting X-ray lasers atop missiles safely stored beneath the sea on submarines or on land-based launchers and lofting them into space at the first sign of a Soviet

strike — the pet idea of Dr. Edward Teller, inventor of the hydrogen bomb and an inveterate SDI booster.

To get the weapons into space quickly enough, however, they would require extremely fast launchers and perhaps the submarines would have to be parked vulnerably close to Soviet shores.

"The practicality of a global scheme involving pop-up X-ray lasers of this type is doubtful," said a recent Congressional Office of Technology Assessment study.

X-rays also do not penetrate Earth's atmosphere well. Thus if the Soviets were to use "fast-burn" boosters — which would complete their flight within 100 seconds, while still in the atmosphere — the weapon may not be effective for knocking out ICBMs in the all-critical boost phase, when warheads and decoys are in one package and the missile is easy to detect. Currently, the boost phase lasts from 3 to 5 minutes.

Livermore scientists are not ready to concede lasers cannot be made bright enough to eat part way into the atmosphere. "It doesn't violate any laws of physics to do so," says George Miller, Livermore's deputy associate director for nuclear design.

But X-ray lasers are considered more likely for post-boost duty, when the missile is just beginning to cast off its warheads and is still somewhat easy to find. In addition, the X-ray lasers could be used during the midcourse phase, when the warheads and swarms of decoys are floating through space. However, because the X-ray laser is basically a one-shot device, some critics think it will be able to wipe out only a limited number of decoys and warheads.

The chief concern, however, seems to be that detonating a series of nuclear bombs in space might damage America's own battle stations and satellites. This point bothers even many in the SDI community.

"I don't find it to be a credible weapons system, even if it does work," says Stephen Rockwood, head of SDI work at the Los Alamos National Laboratory in New Mexico.

X-ray-laser proponents say they believe battle stations could be hardened against the effects of nuclear explosions. They also say the device holds such potential, either as a defensive weapon or one to take out Soviet satellites, that the US can't afford to give up studying it.

Neutral and charged particle beams

The particle beam — a stream of atomic particles or atoms — is the Ar-

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Army working on new rifle to make soldiers better shots

By BRUCE BAILEY

A "next generation" rifle is being developed by the Army at its research center in Morris County to increase the odds of a soldier under stress hitting a target by 100 percent.

Almost a science-fiction weapon the Army hopes the new Advanced Combat Rifle (ACR) will be on line in the early 1990s to replace the M16 series rifle that has been the basic weapon of American soldiers for the last 20 years.

Specifications and designs for the ACR, which will be characterized by its shotgun effect, is the property of the Army Research and Development Center in Rockaway Township, while prototypes for the new weapon are

being manufactured privately.

In 1982, the Army awarded contracts to the AAI Corp. of Baltimore and Heckler & Koch Inc. of West Germany to move ahead with prototypes of the rifle, which the government wants to field test next fall.

"While we coordinate all the work on the ACR, the Army also would like to see more private manufacturers enter into the development of prototypes so that the best assault weapon possible will result," said Vernon Shisler, project officer in the Joint Services Small Arms Program office (JSSAP) at Picatinny Arsenal.

Shisler and Army Capt. Rudy Schatke, a liaison officer for the project, said the Army's present M16A2 rifle is an excellent weapon, but that

under the stress of combat the soldier firing it has a low probability of hitting a target, particularly a moving target, while quickly exhausting ammunition.

"The Army felt the answer was to develop a weapon that is easy to point and at the same time increase the probability of hitting the target when aiming errors are large," Schatke said.

"Under ideal conditions a soldier would like the luxury of having time to properly aim his weapon and consider all factors," Schatke said; "but in combat this opportunity is rare. On the rifle range you aim and shoot. In combat you point and shoot."

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nold Schwarzenegger of directed-energy weapons: It comes in a large package and packs a potent punch. The beam penetrates a missile's skin and sizzle the insides, unlike most lasers, which deposit their energy on the surface.

This means particle beams could disable a target quickly. It also means they would be tough for Soviet scientists to foil, either by shielding the missile or spinning it. The particle beam's penetrating character, however, has its drawbacks: Because the beam immobilizes the internal electronics, it might take some time to verify that a target had been destroyed or disabled. Thus a particle-beam weapon may continue to fire at a target long after it had actually been "killed." In the meantime, other warheads zip past.

The most likely candidate for a missile-zapper would be a neutral-particle beam, which, because it can't penetrate the atmosphere, would have to be parked in space. The particle beam's bulk is not endearing. Scientists figure a neutral-beam battle station might be 80 feet long and weigh 50 to 100 tons (the shuttle carries 33 tons). Up to 100 may be required. "The problem for particle beams is one of packaging and engineering," says Dr. Rockwood. "They will have to be compact, lightweight, and fully remote controlled."

Blunted by Earth's atmosphere, neutral particle beams would be of little use for boost-phase kills. But they look more suitable for post-boost and midcourse phases.

One type of charged-particle beam — the electron beam — can operate in the atmosphere. Indeed, it has to: Its interaction with the surrounding atmosphere

helps hold it together. If shot in space, the beam would almost immediately disperse as its electrons repelled each other. Even if the electrons remained in a narrow stream, it would be bent uncontrollably by Earth's magnetic field (neutral beams are immune to such mischief). Thus, the electron beam is being looked at for use on the ground to zap warheads dropping from space. The idea would be to use them to defend ships or US missile silos and command posts.

The perfect weapon? Not quite. As yet, researchers have only been able to control the beams over very short distances in the atmosphere. One possible solution: Use a laser to "tunnel" a path for the particle beam through the air. Scientists at Sandia National Laboratory have tested this technique in a special gas-filled chamber. For now, however, the trick looks more like a coup for science than anything to make the Soviets nervous: The gas used in the tests doesn't exist in Earth's atmosphere.

At Livermore, meanwhile, researchers are enthusiastic about work they are doing with the Advanced Test Accelerator, a device nearly the length of a football field bunkered in the flaxen hills east of San Francisco. With something greater than the sound of cracking helmets, it propels pulses of electrons up to 50 million electron-volts of energy — in effect creating synthetic lightning.

When technicians fire the beam into the air for the first time within the next several months, they're hoping to keep it controlled for some 75 feet — something that would be a leap forward but would still fall shy of the several miles that will be needed for a weapon. "You're talking about a long row to hoe," says physicist William Barletta, head of the beam re-

search program at Livermore. "We're still working on the basic physics."

If and when scientists work out the physics, they'll also have to be mindful of the cost. "For terminal defense, if we can't keep the costs down to \$100 [million] to \$200 million a copy, it won't be worth looking at," says Dr. Barletta.

Beyond this, star-wars officials are exploring even more exotic concepts to thwart missiles, though most of these ideas are not much more than theories now. Two examples: gamma-ray lasers and "plasmoids."

Like the X-ray laser, gamma-ray lasers would be pumped by a nuclear bomb. Because gamma rays are more lethal than X-rays, one SDI booster says such a device would be the "ultimate directed-energy weapon." Plasmoids are clouds of energized atomic nuclei and electrons that scientists would like to hurl at warheads. But first they will have to find a way to make the cloud stick together in space.

Given the work to be done, it's perhaps not surprising that beam weapons in general are not envisioned as part of a first-generation defense. Their first role would probably be a supporting one — doing such things as helping discriminate decoys from warheads.

Even if beam weapons can be made to shoot down missiles, they, along with kinetic-energy weapons, will have to be knit together in a reliable system, which means some way to point and aim them and manage the battle itself. Most experts agree that developing technologies to run the battle will be far harder than developing the weapons.

Third of six articles.

SPECIAL REPORTS

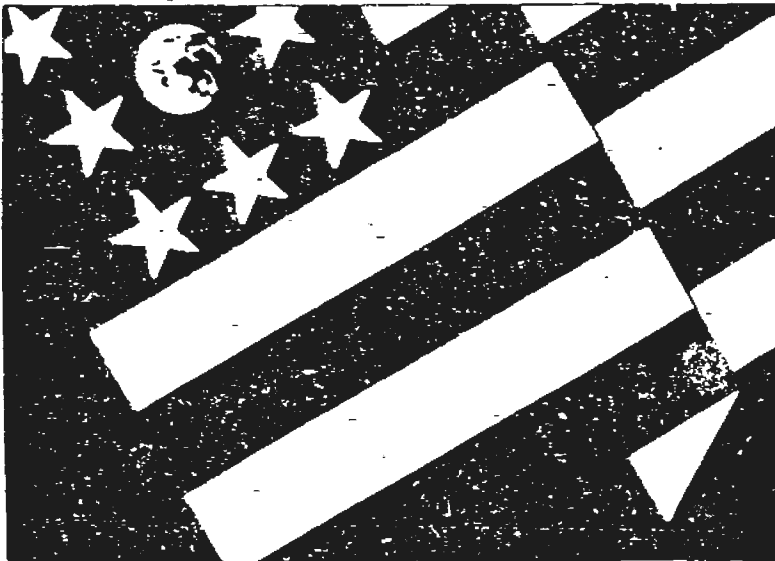
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SDI The Hidden Opportunity

DR. JOSEPH D. DOUGLASS, JR.
DR. SAMUEL T. COHEN

President Reagan's Strategic Defense Initiative (SDI) is an attempt to break out of the mutual assured destruction (MAD) logic that has dominated US strategic thinking for more than two decades. This type of thinking may have been acceptable when the United States ruled the strategic balance. However, the United States no longer rules the balance, and the major limitations of MAD as a vehicle for guiding force development have become increasingly clear. Accordingly, on March 23, 1983, the President proposed a way out—SDI.

Now, after two years of SDI planning, the program appears headed for trouble as Congress begins to cut deeply into the SDI budget. In a sense, this should not be much of a surprise. The vast majority of the Pentagon bureaucracy has opposed the concept since its introduction, because all correctly see the SDI cost coming out of "their" budgets. The prior leadership oppose the concept, because it represents a negation of their assured destruction policies. And, the present leadership beneath the President has short-changed the concept by couching their sup-



The co-authors have extensive background in military technology. Dr. Douglass is a former deputy director of DARPA's tactical technology office. Dr. Cohen developed the technical military neutron bomb concept in 1958.

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port mainly in well-intentioned but currently unattainable objectives. For example, SDI will make nuclear missiles obsolete and SDI will protect the population. Congress, to its credit, is rightfully skeptical.

How SDI should be judged, depends on its role. Unfortunately, its "role" has not yet been adequately defined in operationally meaningful or strategic terms. This problem is exacerbated in the current development process because SDI is being developed and evaluated mainly as defense against ballistic missiles and as defense in isolation.

But the operation of SDI depends on the operation of other elements of the strategic forces. All the forces need to operate together as part of an integrated strategy. This brings up what may be the most central part of the problem: US nuclear war strategy. SDI needs to fit into the strategy. Accordingly, and practically by definition, the US strategy needs to be redefined. The reason is obvious. The current strategy does not allow for defense. It is an offense-only strategy that was developed under a policy of mutual vulnerability, that is, of defenselessness.

SDI'S ROLE

The essence of successful strategy is to defeat the enemy without war, as ancient Chinese military philosopher Sun Tzu counseled centuries ago. One's strategy should seek to defeat the enemy's strategy.

The dominant US nuclear goal is to prevent or deter war. To do this, it is essential to understand the Soviet strategy in going to war and to defeat that strategy. The issue is not retaliation or assured destruction. The issue is what is the Soviet strategy and how do we defeat it. This is most important now because for the first time we face the possibility of defeating Soviet strategy without needlessly resorting to such artifacts as mutual annihilation.

Soviet strategy for war calls for the execution of a surprise first strike. The Soviet view of first strike is one in which the enemy, the United States, is caught unaware. Their objective is to destroy the majority of our forces before we can successfully mount an organized and powerful counterstrike. Aside from responding to a perceived US first strike, a most unlikely event, it is extremely doubtful that they would initiate a nuclear attack unless they believed they had an extremely good chance of executing a successful surprise first strike. This is not only nuclear common sense; this is Soviet strategy.

To deny the Soviets confidence in being able to achieve a first strike capability would be a highly significant contribution to deterrence. So much so that it probably should be regarded as the *sine qua non* of US deterrent strategy. It

would be nice to be able to ride out a Soviet attack and respond at our leisure in the aftermath. However, Soviet strategy and capabilities have made such a responsive strategy unrealistic and impossible, unless one is advocating de facto capitulation.

Accordingly, the minimum (but most important) US requirement is for a highly effective SDI optimized first to ensure the ability of the United States to launch a deliberate, organized, powerful counterstrike while under attack or, more precisely, at the beginning of the Soviet first strike.

Further, in this context, the need to consider all defensive measures in addition to ballistic missile defenses during the SDI development and evaluation process becomes increasingly clear. Even an extremely effective SDI against ballistic missiles will not suffice by itself if the Soviet first strike can be achieved by other methods—for example, cruise missiles or bombers. Similarly, implicit in the need for SDI is the need for greatly improved US internal security capabilities to guard against sabotage.

SECONDARY ROLES

There are two secondary roles for SDI: *help* preserve US residual forces, or strategic reserves, that is, those not designed and developed to be the initial US counterattack response, and *help* limit damage to the United States in the event of war. The emphasis is on the word "help" because SDI can contribute to both objectives, preserve residuals and limit damage, but in both cases, the major contribution—certainly in the near- and mid-term—has to come from other means, specifically, from the manner in which the offensive reserves are designed and from other defensive measures.

The problem with the US offensive "reserves," is that most were not developed as reserves, as that term is traditionally used, and did not foresee the manner in which the Soviet threat would develop. This is obvious in the case of the land-based forces and less obvious, but also true, of the sea-based force. Reserves do not suddenly become reserves simply because someone such as the Secretary of Defense decides some elements of the force are now "reserves." Reserves have to be designed as reserves from the ground up. Fixed site, vulnerable missiles dependent on electric power that may disappear after a day or a week, submarines with communications likely to rapidly disappear, and bombers devoid of covert recovery bases do not constitute effective reserves. It makes little sense, a

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In Defense Of SDI

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GEORGE F. CHAPLINE

While the President's speech in March, 1983, was a surprise, the reaction to it was not. The intellectual community, did not take lightly a non-intellectual intruding into one of their sacred domains—namely, basic strategic doctrine.

The scientific branch of the intellectual establishment was quick to respond. The Union of Concerned Scientists pointed out that "no reputable scientist" supported the President's position. One man said the president's proposals would destroy the arms control process. Two others said it wouldn't work and another said the president made his speech at a particularly inauspicious time.

Since I long ago gave up dreams of becoming a respectable scientist, it does me no harm to confess that I am intrigued with the president's proposals, and I am unimpressed with the arguments of the critics, particularly those critics who claim that a defense against ballistic missiles is not technologically feasible.

History teaches us that when it comes to predicting the

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priori, to look for defensive forces to eliminate obvious offensive vulnerabilities that can be corrected more cheaply and dependably in other ways.

Similar problems are even more evident in the case of limiting damage to the United States in the event of war. SDI can and would contribute, but the major tasks lie elsewhere. As the situation currently exists, in the event of a Soviet nuclear attack, there would be tens of millions of casualties. And most of them would be collateral casualties—that is, casualties that are the indirect effects of attacks on other targets. The most obvious way to save lives cheaply is through a well thought-out, reasonable civil defense and recovery program, one that is based on a careful analysis of Soviet strategy. The concept of building an SDI to "protect the population," without recognizing and acting on the fact that the major contribution has to come from other measures, simply does not make strategic sense.

THE SDI OPPORTUNITY

SDI has been touted as the way to make nuclear weapons obsolete. To better "sell" SDI, it has been proclaimed that SDI reduces our need for offense, that in SDI,

George F. Chapline, an X-ray laser expert who works at Lawrence Livermore National Laboratory, didn't take seriously the idea that "X-ray lasers might have military application" until President Reagan proposed an SDI program.

offense is being traded for defense, and so forth. It is important not to let long-term political goals interfere with current, near-term and foreseeable future realities or to let catch phrases interfere with intelligent national security planning.

The basis of SDI as put forth by the president in March of 1983 is the belief that the US strategy and policy—the mutual assured destruction, mutual assured vulnerability, offensive retaliation only, and so forth—is no longer valid and needs to be revamped.

This is the essence and opportunity of SDI. It is a mechanism for challenging the way business is being done, or not being done, by all those elements that should contribute as a team to US national security—beginning with strategy and including offensive forces, internal security, civil defense, and active defenses against planes as well as missiles. All these elements need to be reassessed and placed in an integrated context in the process of bringing in SDI.

This is necessary if the president's objectives are to be achieved. This also may be an effective way to convince Congress and the public that SDI is not just another flight of fancy.

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technological future the experts are often wrong. It is a curious fact that ideas for new technologies often meet with extreme hostility from the experts. For example, the Wright brothers had to build the engine for their first airplane themselves because no engine manufacturer wanted to expose himself to the ridicule of being involved in a project experts had declared impossible.

Indeed, in the 19th century it was widely believed in academic circles that manned flight was impossible. Theodore von Karman mentions in his history of aerodynamics that the famous Helmholtz once failed a student because he was unable in the course of an examination to prove that human flight would never be possible.

One would think that physics professors in the 20th century would be less dogmatic and more aware of the follies of trying to predict the technological future. Unfortunately this does not seem to be the case.

In 1937, a well-known theoretical physicist published a theorem that stated an absolute upper bound to the energy which a cyclotron could produce. In the preprint it was claimed that, as a consequence of relativistic effects and practical limitations of radio frequency voltages, it would be impossible to produce protons with energies greater than 5.5 Mev (million electron-volts). However, after the preprint appeared, the authors received a call from Berkeley pointing out something must be wrong with their arguments because a cyclotron in Berkeley already had produced 8-Mev protons. The phone call resulted in the authors adding a footnote, raising the absolute upper limit to 12-Mev. They let stand the remarkable admonition that "... it seems useless to build cyclotrons of larger proportions than the existing ones." The cyclotron builders in Berkeley, including at this time one Robert R. Wilson, apparently did not let this advice deter them because they went on to build in the next year a 60-inch cyclotron which spit out 16-Mev deuterons.

In 1939, E. O. Lawrence announced plans for a 100-Mev cyclotron. In arguing the case for this cyclotron before the Rockefeller Foundation, Lawrence claimed that such a machine could produce the mesotrons of Yukawa, and thereby unlock the secrets of the nuclear force. The 184-inch cyclotron was, with the hiatus of World War II, finished in 1946 and produced 400-Mev α -particles. In 1947 a search for π -mesons was begun, and in 1948 artificial production of π -mesons finally was demonstrated. Thus began the enterprise of doing elementary particle physics with large accelerators that has its culmination at Fermil National Accelerator Laboratory.

This story illustrates that even brilliant physicists can be wrong when they say something can't be done. Unabashed, though.

Professor Hans Bethe still seems anxious to share his views of what can't be done.

Together with three other professors, he recently assured the readers of *Scientific American* that a defense against ballistic missiles is a technological mirage.

I disagree.

Actually, I do agree with those authors on one basic point. Unlike previous technological challenges, like the airplane or the hydrogen bomb, one is not just trying to defeat nature, so to speak, but a determined and possibly clever human adversary. Consequently, I agree that a flexible offense is probably always superior to any fixed defense. But I strongly disagree with Professor Bethe and his colleagues about their contention that a defense against ballistic missiles could never work well enough to make some contribution to our national security.

There are two basic issues involved here: technological feasibility of a ballistic missile defense and whether such a defense system would contribute to national security.

TECHNOLOGICAL FEASIBILITY

There are really two questions of interest. First, is it possible to build a defense against the offensive ballistic missiles already deployed? Second, what could the offense do to defeat such a defensive system? The answer to the first question is quite important in itself because of the large proportion of Soviet ballistic missiles used as first-strike weapons.

With technologies already invented and under development, one could build a defense against existing ballistic missiles that would be at least 99.9 percent effective. The key technologies that make this possible are the nuclear explosive-pumped X-ray laser, high-power XeCl or free-electron lasers, laser-guided projectiles and electron beams, and supercomputers on a wafer.

The first two technologies provide the ability to project large amounts of energy over long distances at the speed of light. When people say traditional defensive systems are not very effective, keep in mind that traditional defensive systems use projectiles not moving

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much faster than the objects being shot at. Projectiles moving at the speed of light are moving 40,000 times faster than the speed of ballistic missiles. Of course, there is the well-known problem of providing a line of sight to the target. With the possible exception of putting nuclear-pumped X-ray lasers into Earth orbit, the current limitations on putting large amounts of mass into orbit probably means that defensive systems must be deployed on the ground.

This presents certain problems if one wants to attack ballistic missiles during their boost phase. Contrary to what some critics suggest, though, there is no insurmountable time problem in doing this. With a 10-g acceleration rocket, one could reach the required line-of-sight altitude, approximately 500 kilometers in about 100 seconds. This leaves about three minutes before the current generation of ballistic missiles begin to unload their re-entry vehicles. This should be plenty of time to respond; if the Soviets simultaneously launched 1,000 missiles, one should respond instantly. If the attack were spread out, the warning time is correspondingly increased, while the missiles launched initially could be attacked either in midcourse or over the US.

The general scheme for a strategic defense is to provide a first line of defense with nuclear-pumped X-ray lasers either popped up from submarines, or placed in high earth orbits, a second line of defense by high-power, ground-based lasers, perhaps bouncing their beams off mirrors popped up into orbit, and a third line of defense by X-ray lasers shooting downward and rocket- or electromagnetically launched projectiles shooting upward.

The operation of a strategic defense system obviously will require enormous data-processing capabilities. Fortunately, extrapolation of current technological trends suggests that the needed capabilities will be well in hand by the end of the century. A company in Israel already makes a machine that can scan a printed circuit board in a microsecond and, using artificial intelligence techniques, spot any defects. In addition special-purpose, pattern-recognition CMOS computers for robotics applications are already on the drawing board. The computers capable of 10^{11} VAX-equivalent operations per second. Pattern recognition computers, two orders of magnitude faster, on a wafer using bipolar logic are just around the corner.

Critics may point to the failure of Trilogy. However, new techniques such as laser pantography have appeared that promise to overcome the difficulties Trilogy faced. By the end of the century, we comfortably can expect wafer-sized, fifth-generation supercomputers, capable of directing an attack against hundreds of thousands of warheads and decoys, to be available.

COUNTERMEASURES

Bethe and Richard Garwin claim that a strategic defense is unworkable because there are simple things the offense can do to defeat the defense. This may be so, but nothing Bethe and Garwin have suggested fits into this category. The countermeasure most often mentioned is fast-burn boosters. There is little doubt that on the time scale that a defensive system could be built that the current rocket boosters which burn out well above the atmosphere could be replaced with boosters that burn out at much lower altitudes. However, because of atmospheric drag neither re-entry vehicles nor decoys could be deployed below an altitude of 100 kilometers.

Because the buses carrying the re-entry vehicles and decoys are vulnerable to attack, this mode of operation does not prevent one from destroying the re-entry vehicles before they and their decoys are separated. In fact, the payload may be even more vulnerable to attack in the case of a fast-burn booster since a bus traveling at high speed through the upper atmosphere has a unique UV signature. Because the time available for attacking the buses is relatively short (approximately 100 seconds), the payload of a fast-burn booster would be most easily attacked from orbit. However, a pop-up system using a high acceleration rocket also may be useful under some circumstances.

Another countermeasure often cited is the use of foils or aerosols to protect the re-entry vehicle against X-ray laser attack. Unfortunately for the offense, the weight of such a shield would be prohibitive if the direction of the incoming laser beam is unknown. Because an intense X-ray beam can ionize atoms in its path the propagation of an X-ray laser beam is fundamentally limited only by Compton scattering. Hence, it would take 10 tons of mass to provide a 4π Compton shield. Even if the X-ray laser beam were not bright enough to penetrate the shield, one has a scenario in which a sizable explosion goes off next to the re-entry vehicle. At the very least this might deflect the warhead off course.

A more clever countermeasure has been suggested by Sidney-Drell. He proposed setting off nuclear explosions in the atmosphere to push part of the atmosphere into the line of sight of an X-ray laser beam. Although this might be of some efficacy against pop-up X-ray lasers, it is not useful against orbitally based X-ray lasers.

Time delays between the launches of offensive missiles provide another possible countermeasure. The cost effectiveness of nuclear-pumped X-ray lasers is largely due to their ability to attack many targets at once. One could deny the defense this advantage by

What If The SDI Works?

US Military Space Policy In 2110

BARRY R. SCHNEIDER

What if it really works? What if Ronald Reagan's vision of a fully defended United States becomes possible by the year 2110?

What are the strategic implications of a fully defended US homeland? Well, we still need such a large bomber and missile force? Will nuclear weapons become obsolete? Will the world be safer or more dangerous for those who do not live in the heavily defended zones? What do we gain and what did we give up to secure our defensive shield?

These are important questions being asked today about President Reagan's Strategic Defense Initiative (SDI) program, dubbed by critics and the press as "Star Wars."

First, if future technical, political and budgetary obstacles do not block the SDI program, what will a fully mature strategic defense architecture look like in 2110?

As presently envisioned, the defense will set up at various points along the path an enemy ballistic missile would take en route to a target in the US. The first three lines of defense will be in space in the boost phase, post-boost phase, and mid-course phase of missile's flight path. The fourth and final defense would engage the enemy force as the re-entry vehicles bearing nuclear warheads began to descend toward the target through the earth's atmosphere.

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Barry R. Schneider is
a senior defense

analyst for the National
Institute for
Public Policy.

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spacing out in time the launches. However, the price an attacker would pay for this is the loss of surprise and fewer targets for the defense to deal with at any given time. This would be a disaster for the offense if the defense had sufficient reserve capabilities.

What about the issue of decoys? It is true it would be difficult to deal with thousands of decoys. However, it is not physically possible to begin deploying lightweight decoys at a sufficiently low altitude such that the vehicle deploying the decoys is not vulnerable to attack. Thus, by attacking the vehicles carrying the decoys to the top of the atmosphere, one could reduce the number of decoys substantially and thereby perhaps make it possible to attack nuclear warheads in midcourse. Even if this does not prove feasible, it is possible to distinguish lightweight decoys from warheads when they re-enter the atmosphere. In fact, there is approximately a 10-second window where the warheads would be clearly distinguished from decoys yet vulnerable to attack from space-based weapons. Ten seconds may seem to be a short time, but it—for the kind of technologies we are envisioning—10 seconds is as good as a

century. This 10-second window is very important because it permits defense of cities.

The critics of strategic defense, and even some bureaucrats in the Reagan administration, often have insinuated that it is not possible to defend cities, but only missile silos. However, the so-called terminal defenses for missile silos almost certainly would be useful only if the attack were previously thinned out, either initially or in midcourse. In any case, the marginal benefits of terminal defense probably are cancelled by having the warheads aimed at a particular place. Many seem to prefer defending missiles rather than people, but I believe either an entire nation can be defended against nuclear attack or nothing can be defended.

Although the existence of an effective countermeasure to a strategic defense system cannot be ruled out, no one has yet demonstrated that the president's original proposal to make ballistic missiles "impotent and obsolete" is out of reach. In particular, a strategic defense system utilizing both orbitally based and pop-up X-ray lasers as a first line of defense seems hard to beat.

Would a defense against ballistic missiles really contribute to national security? A number of people have questioned whether a defense against ballistic missiles should be built even if it should prove technologically feasible. Whether or not these arguments are correct, it is interesting that the Soviet Union has admitted publicly that the Strategic Defense Initiative induced them to resume arms control negotiations. Therefore, it seems to me that the possibility of providing a strategic defense already has proved to be of political value.

As to whether it is desirable to replace the current strategy of mutual assured destruction with a new strategy, I agree that one can have legitimate doubts as to whether a successful strategy should be replaced with an untried strategy. On the other hand, I can visualize circumstances where the current strategy would fail. For example, suppose there was an accidental launch, or a launch that the Soviet Union or some other country claimed was accidental. In the absence of a defense against ballistic missiles, what should the president do?

Another situation in which the present strategy would fail: an insane political leader comes to power and doesn't care about starting a war in which half the world's population dies. This particular situation is not unknown to history.

A most important consideration is the meaning of a civilized society. I am not thrilled with the idea of killing millions of innocent people for no better reason than perhaps the Soviet leadership is stubborn or incompetent. It seems much better to strike back at the forces or weapons that are directly threatening us. A

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The four-layered defense system to be deployed by the US in 2110 will consist of a mix of 1) kinetic kill vehicles to ram oncoming Soviet missiles, 2) laser- or particle-beam weapons that can kill with deadly speed-of-light, directed-energy charges, or 3) electromagnetic rail guns that can fire projectiles through space or the earth's atmosphere at velocities well in excess of a bullet from a gun. These weapons will be supported by battle management computers to guide the fight and by numerous space-, air- and ground-based sensors for SATKA (surveillance, acquisition, tracking and kill assessment).

When this "astrodome" defense is completed, each layer of defensive weapons takes its toll on the attack force, thinning it out and making it easier for the subsequent defensive layers to stop enemy "leakers" through the previous defenses.

Assume an enemy attack by 10,000 missile warheads in 2110. If each layer of the astrodome defense were 90 percent effective, the boost-phase first layer would destroy 9,000 warheads, leaving 1,000 for the second layer of defense to handle. Post-boost phase battle stations in space would then thin the attack from 1,000 to 100 "leakers" that would challenge mid-course US defenses in space. These mid-course defenses might be permanent space assets in orbit or ground-based interceptors designed to "pop-up" into space to meet the attack.

If 90 percent effective, the mid-course defense would reduce the 100 Soviet nuclear re-entry vehicles to just 10 that leak through and enter the earth's atmosphere falling toward US cities or military targets below. The mid-course defenders hand the problem over to US terminal defenses—ground-based or air-based kill vehicles that intercept and destroy nine of the remaining 10 re-entry vehicles. One enemy warhead would detonate somewhere on the continental United States out of a total of 10,000 initially launched.

At 80 percent efficiency, 16 enemy warheads will detonate on US soil; at 70 percent, 81 will detonate; at 60 percent, there will be 256

leakers; and at 50 percent, 625.

Clearly, what President Reagan had in mind when he launched the Strategic Defense Initiative on March 23, 1983 was a comprehensive defense, approaching the 80-90 percent efficiency level in each of the four intercept phases.

COMPETITION OR COOPERATION?

Getting to the point where defenses can achieve an 80-90 percent effectiveness against a full-scale nuclear missile attack would be much easier if the United States and Soviet Union could agree to limit and reduce offensive forces while building up strategic defenses. While the Soviet government shows little visible inclination to cooperate in such a transition to a defended world, a number of factors are working to push them toward such cooperation. Their own longstanding defensive tradition shows their interest in defenses. After all, the USSR is the only country with an operational BMD system. The Soviets have the world's foremost air defense network and a civil defense program more advanced than that of the United States.

Other reasons why General Secretary Mikhail Gorbachev and his Politburo colleagues may opt for cooperation with an offensive-limited defensive transition are the huge costs involved in trying to keep up in offense and defense with the world's most productive economy, that of the United States. Kremlin leaders also may see cooperation as a means to limit homeland damage, a goal they could accomplish in wartime today only by offensive, pre-emptive attack. Soviet leaders also might eventually realize the value of defending against lightly armed third parties such as the People's Republic of China, France, the United Kingdom, Pakistan, India or Israel. Further, the Politburo masters may choose the path of a defended world because they fear the counterforce capability of US Peacekeeper and Trident II missiles. They may opt to restrain offensive forces and build ballistic missile defenses to further protect Soviet leadership bunkers, C.I. assets, their political and military KGB chains of command, as well as their strategic nuclear forces.

Should the Soviets cooperate for these or other reasons, it may be possible to erect the comprehensive defenses envisioned by President Reagan when he set the goals for SDI.

The Soviets have been consistently in opposition to the SDI since its inception. Their opposition may be derived from their judgment that the USSR could not effectively compete with the United States in an unorganized BMD development race. And, in their point of view, they may be trying to kill the "child" before it grows into a strategic "monster."

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little-known corollary of the Pershing II deployment in Europe is that it gives us the capability of insuring that the Soviet leadership will not survive a nuclear war. I applaud this, but as an adjunct we should also destroy the weapons that have been sent to kill us.

Can we save the world in the last 10 seconds? Yes. Not by wishful thinking—but by using our inventive capabilities to develop the means of destroying all missiles before they reach us. □

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Other factors that may spur Soviet competition rather than cooperation with the attempt at a defensive transition are a fear of losing their war deterrent capability against the United States and the fact that US defenses could deny to Soviet strategic rocket forces the ability to carry out assigned missions. In addition, a US BMD shield could deny the Soviet Union any plausible possibility of victory, as it would define the term.

Another part of the Soviet incentive and condemnation of the SDI undoubtedly springs from the current bitter political relationship between the superpowers and the extreme distrust that permeates each party's view of the other's motives. Later, as strategic defenses become more formidable, Soviet leaders may be influenced by their perceptions of the relative ease or difficulty of erecting strategic defenses instead of upgrading offenses to counter them. The Kremlin elite also may be influenced by their perceptions of the chance for reaching at a comprehensive arms control agreement that limits asymmetrical offenses simultaneously while permitting the upgrading of very different types of defenses in a manner ensuring equal security.

The bottom line on how the Soviet Union responds to the defensive transition depends on whether the Soviets cooperate, at least partially. The goals of the SDI may never be fully realized and virtually leak-proof defenses may remain a gleam in the eye rather than a reality.

ASTRODOME IMPLICATIONS

Assuming, somewhat heroically, the US and the Soviet Union possess virtually leak-proof astrodomes by 2110, how is US national security changed? What are the implications of a strategic world where both of the present superpowers are almost invulnerable to a nuclear attack?

Early, as the Soviet strategic defenses move through a ballistic missile defense system on top of their air defense "walls," defense "cellars" and superhard silos in cellars," US missiles and bombers have much less deterrence leverage.

US presently is defenseless against a ballistic missile attack, as is the Soviet Union—except in the case of a very light attack on Moscow. Both hold the other hostage. Soviet strategic defenses are effectively invulnerable; the US offensive forces will not be as effective in targeting the highest values of the Soviet leaders. This means the US strategy of minimizing pressure on the Kremlin by using counterforce weapons to target hardened leadership bunkers, ICBM silos, command and control centers and ICBM silos may be undermined by the Soviet BMD program, as well as deep-basing and superhardening of

shelters.

Ironically, if US deterrence policy and posture fails, the offensive strategy embraced by the Reagan administration to prevent war may need to be sacrificed on the altar of the goal of protecting US citizens.

Crisis stability is probably more threatened during the transition to astrodome defenses than during the present period in which no defense exists at all. The Soviet leaders may, in a crisis, be tempted to strike first through imperfect US defenses to disorganize and shatter US retaliatory forces. Then, they may calculate that their own modest defenses could stop the weakened US force. However, the incentive to strike first and escalate an acute international crisis will be far less when the defensive transition is completed and a comprehensive multi-layer US defense is effectively in place. At that point, first strikes become means of effectively disarming oneself to no good effect.

In the transition to strategic defenses the United States and the USSR are likely to pass through at least four stages. ■ **PHASE 1:** Full BMD deployment within the ABM Treaty limits (100 interceptors/launchers and agreed upon radars to defend one site). ■ **PHASE 2:** Defense of the offensive forces, leadership and C'I assets. ■ **PHASE 3:** Defense of all mentioned in Phase 2 plus some defense for "soft" military bases and ports, as well as key industrial sites and mobilization zones. ■ **PHASE 4:** Defense of the entire homeland: the four-layer "astrodome."

Once Phase 4 defenses are in place, the situation favors improved crisis stability and a more credible extended deterrence pledge. At present, US and NATO military doctrine threatens the USSR and Warsaw Pact with nuclear escalation all the way up to homeland attacks. This pledge lacks credibility so long as a US strike against the USSR is an act of US national suicide. Without very effective defenses, it would be just that. Therefore, the present US nuclear pledge on behalf of Europe has a hollow ring to it. With the US astrodome in place, such deterrent threats would acquire credibility once more. Of course, this threat could still be muted when and if the Soviet Union acquires a similar hard-shell defense.

The optimum situation for defending US allies with a nuclear threat to aggressors obviously is that time when the US acquires the astrodome first and still retains a potent offensive threat. During such a period, US strategic influence would be maximized.

More importantly, the phase four defenses will have returned to the American people the kind of security they have not enjoyed since the invention of the nuclear warhead, the ballistic missile and the long-range bomber. Urban-industrial defenses could once more prevent a

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FIRST STRIKE!

The Soviets' massive nuclear inventory far surpasses what is needed for defensive purposes. The USSR may now have the potential to cripple the United States with one swift, unprovoked missile attack.

By Dr. Robert Jastrow

THE SOVIET UNION has created a massive nuclear stockpile that seems to be designed for the destruction of the United States, rather than as a deterrent to an attack on the Soviet Union. It consists of many thousands of highly accurate nuclear warheads, any one of which can deposit the equivalent of a half a million pounds of TNT within a 250-yard radius of a target.

Warheads as accurate as this can land close enough to hardened military sites to cave them in and demolish them. These highly accurate Soviet warheads have only one purpose—to destroy the missile silos and other military installations of the United States and cripple our power to retaliate against a Soviet attack.

For many years the safety of the

United States has rested on the assumption that if the Soviet Union attacked, we would be able to destroy the Soviet homeland in retaliation. Of course, the Soviets could also destroy us if we attacked them. This is called security through Mutual Assured Destruction, or MAD. An important part of MAD is the Anti-Ballistic Missile (ABM) treaty, which says that the United States and Soviet Union both guarantee to keep themselves defenseless against a nuclear attack by the other country. The ABM treaty is supposed to further discourage an attack by ensuring that the retaliation will be devastating.

Because of the Soviet missile buildup and the resultant threat to our retaliatory forces, the whole theory of MAD is collapsing like a house of cards. If the Soviets have a sufficient number of accurate missiles to wipe out our own nuclear force in a surprise attack, they will not be deterred by the fear of retaliation, because we will

not be able to retaliate.

That is just what has happened. As a result, this nation faces the greatest peril it has ever known.

There is no doubt about the deadly purpose of those Soviet missiles. Their accuracy reveals the intent. If the Soviets had built their missiles mainly to prevent the United States from attacking them, they would have done what we did and placed most of the missiles on submarines. A missile launched from a submarine is too inaccurate to destroy a hardened military target made of reinforced concrete and buried under tons of earth. That requires a nearly direct hit. (The reason for the inaccuracy of submarine-launched missiles is simple. The submarine does not know exactly where it is in the ocean, and therefore cannot tell exactly where its warheads will land. Missiles that correct for these errors in mid-flight are being developed, but they will not be available in substantial numbers until the next decade.)

A submarine missile can flatten a city because that does not require pinpoint accuracy; you do not have to explode a nuclear warhead within 250 yards of Times Square to destroy New York. So, if you want to threaten to destroy the enemy's cities to keep him from attacking you, submarine

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program work. Indeed, one could say that the SDI is no more about beam weapons than the Normandy invasion was about howitzers. Of critical importance are such tasks as tracking the missiles, identifying warheads amidst a cloud of decoys, and verifying their destruction. Half the SDI budget for the rest of the decade will go toward computer and communications research for what defense planners call battle management.

Even in the most optimistic projections, a fully functioning defense system will not be achieved for decades. "We're well aware that current technology can't do the job," says SDI chief scientist Gerold Yonas. Accordingly, the next five years or so will be dedicated to research; the goal is to gain enough knowledge on a variety of technologies to allow an informed deci-

sion in the early 1990s on whether defense against nuclear attack is feasible.

If the answer is yes, building and demonstrating prototypes of defense systems would likely occupy the remainder of the century. Finally there would come a decision on whether to deploy. But although research on defense systems is permitted by the 1972 Anti-Ballistic Missile treaty, deployment is not.

Thus critics point out that SDI would violate an important treaty. Moreover, they say, it would have to be 100% effective—a virtually impossible goal—and it would be destabilizing. The superpowers could respond to each other's defense efforts by building more and better offensive arsenals; or, in response to U.S. plans for deployment of a defense system, the Soviets might be

tempted to attack before their missiles became useless.

SDI officials insist that the defensive shield need not be leakproof to fulfill its purpose, which is to deter attack. Thus an imperfect defense could still be effective if it made the requisite offensive buildup by the Soviets prohibitively expensive. SDI proponents also argue that after the admittedly tricky period of transition, strategic defense would relieve the hair-trigger sensitivity of nuclear deterrence. If there is a major crisis and someone pushes the nuclear button, the world might be destroyed. But if anyone pushes the laser button, even in error, the worst result would be beams dissipating harmlessly in the atmosphere. □

T. A. Heppenheimer, a writer in Fountain Valley, Cal., has a PhD in aerospace engineering.

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missiles are very useful. But if you want to build a first-strike force, you put your missiles on the land, where they can be aimed accurately. That is what the Soviets did.

THE UNITED STATES also has some land missiles, with warheads about as accurate and destructive as the best Soviet warheads. These are the Minuteman III missiles with Mark 12A warheads. However, we only have 900 of them. That is not enough to place at risk more than a tiny fraction of the 4000 or so top-priority Soviet targets. Targeting two warheads on each hardened site, 900 warheads could take out at most 10 percent of the important Soviet military sites. Our first-strike missiles would hardly make a dent in the Soviet power to retaliate.

In other words, our Minuteman missiles are not a first-strike force. They have the accuracy, but not the necessary numbers, to cripple Soviet military power.

But the situation is even worse than that because the Soviet missile buildup has placed our land-based missiles in jeopardy, to the point where up to 95 percent of the American missiles would be destroyed in their silos by a Soviet first strike, according to defense experts. The few missiles that escaped, which would carry less than 100 warheads, would be unable to inflict any significant damage on Soviet military sites.

The Soviet nuclear missile force, on the other hand, includes more than 8,000 accurate and destructive warheads.

With two warheads targeted on each important military site in the United States, these Soviet missiles could destroy every one of the 4,000 critical U.S. military sites. The Soviet nuclear arsenal is a true first-strike force.

Our nuclear arsenal does contain other accurate weapons—the nuclear bombs carried by B-52 bombers and cruise missiles. But according to Defense Secretary Caspar W. Weinberger, the B-52 can no longer penetrate Soviet air defenses, which are the most massive in the world. The new B-1B bombers, just going into production, are designed to penetrate the latest Soviet air defenses. But Congress has only approved funding for 100 B-1Bs, and even this small force will not be fully available until late in this decade. At the present time our bombers cannot be counted on as an important deterrent to a Soviet attack.

As for the cruise missile, it is my

THE LEGION'S POSITION ON SDI

THE American Legion demonstrated its support for the Strategic Defense Initiative with Resolution 229, adopted in September 1984 at the 66th National Convention in Salt Lake City:

"Resolved, That we applaud the President's change in the national strategy of deterrence from one of mutually assured destruction wherein populations are held hostage to the threat of destruction from nuclear weapons, to a strategy of protecting our population

through defensive measures; and, be it further

"Resolved, That we urge Congress to support the President's initiatives in re-establishing our anti-missile system effort using all latitudes available including the existing ABM treaties; and,

"Resolved, That vigorous research and development be undertaken to increase our anti-ballistic missile capability using all techniques, including space, as these techniques can be developed."

impression that its effectiveness is overrated. The current generation of American cruise missiles is vulnerable to the new look-down, shoot-down Soviet Foxhound fighters. In Soviet tests, a Foxhound at an altitude of 20,000 feet destroyed drone aircraft, imitating American cruise missiles, that were hugging the ground at 200 feet. These Soviet advances in air defense may explain why the Defense Department recently cut its order of air-launched cruise missiles from 4,348 to 1,499.

Improved cruise missiles with stealth technology are under development, but will not be available in large numbers before the 1990s. Until then, the air-launched cruise missile also cannot be counted on as a major deterrent to Soviet attacks.

With our land-based missiles, bombers and cruise missiles vulnerable to Soviet forces, what is left? The answer is—submarines. The American fleet of submarines has become our principal protection against a Soviet nuclear attack. Each ballistic missile submarine carries enough missiles to destroy all the large cities in the Soviet Union. Relying on these submarines as our main deterrent does not seem like a bad idea, because the newest submarines have very quiet engines and are hard to find, so the Soviets cannot count on eliminating most of them in the first wave of their attack, as they can with our land-based missiles.

The bottom line is that at the present time the security of the United States is suspended by a single thread—our fleet of ballistic missile submarines. If these submarines were ever to lose their undersea cloak of invisibility, that thread would snap.

Several lines of research indicate that this may happen at some point in the 1990s. For example, a submarine churns up cold water from below depths, creating a cold-water "wake" that is invisible to the eye but can be

seen clearly by heat-sensitive instruments on satellites. Heat from the nuclear reactor on the submarine also creates warm water, which rises to the surface and produces another kind of temperature disturbance over the submerged sub. The two effects don't cancel each other. The result is a thermal "wake" that can be picked up by instruments in satellites.

Submerged submarines also create a surface signal in the form of changes in the "sea-state"—the irregular pattern of waves and wavelets that continually crosses the ocean surface. Details of the sea-state can be measured from satellites with a new type of radar. This line of submarine detection is particularly promising and the USSR is reportedly pursuing it with vigor.

In our present defenseless state—dictated by the ABM treaty—the loss of invisibility for our submarines will be a catastrophe, for we will then have lost our most important means of retaliation against Soviet attacks. The Soviet Union, with its huge first-strike force of land-based missiles, will then have achieved a true nuclear superiority for the first time.

In the years from 1945 to about 1975, when the United States first had a nuclear monopoly and then had nuclear superiority, we did not make use of our nuclear weapons to conquer the world, although we could have done so if we had wished. But a world dominated by Soviet nuclear weapons will be another matter. Prudence requires that we take the strongest measures to protect ourselves against this eventuality.

That is the main reason why we need SDI—the American defense against Soviet nuclear missiles. As soon as we have that defense, even if it is not perfect, our days of peril will be ended. Suppose the defense is only 80 percent effective—a very low estimate, according to defense experts.

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That means we can shoot down four out of five Soviet warheads in a mass attack. With such a defense in place the Soviets will know that the bulk of our nuclear missile forces will survive their attack. They will know that if they attack us, we will be able to strike back with our nuclear weapons and reduce all the major Soviet cities to rubble in 30 minutes. Our defense only has to be good enough to guaran-

tee the survival of most of our retaliatory forces—the key missile silos, Trident submarine pens, air bases—and most important of all, the chain of command beginning with the President, that would actually order a nuclear counterattack against the Soviet Union.

Such a defense, preserving the destructive power of our nuclear arsenal, will virtually foreclose the option of a first strike by the Soviet leaders. That

fact will deter the Soviet leaders from planning an attack. By deterring the Soviet leaders from an attack, our defense will protect the people of America from destruction.

There are other reasons why we need SDI. The biggest one is the size of the Soviets own "Star Wars" effort. Dr. James Fletcher, former head of NASA, who chaired a panel of experts in a thorough study of missile defense,

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'STAR WARS' DEFENSE: FACT OR SCIENCE FICTION?

HOW would a space-based defense system against a Soviet missile attack on the United States work? Or would it work at all?

To get at the answers to these crucial questions, you have to think in terms of two different systems—one using presently available technology and the other relying on "far out" approaches. Here's how Dr. Robert Jastrow, author of the foregoing article, puts it:

"An advanced defense against Soviet missiles, using exotic technologies such as the laser and the neutral particle beam, may become a reality by the end of the century. Americans will rest easier when that defense is in place, for it will mean that the prospect of a Soviet first strike is essentially nil.

"Meanwhile, the technologies that are already in hand will allow us to put into place in the early 1990s a simple but highly effective defense at a cost of roughly \$60 billion. A conservative estimate of the effectiveness of this defense is 90 percent, which means that only one Soviet warhead in 10 will reach its target. This is more than sufficient to guarantee devastating U.S. retaliation and discourage Soviet leaders from any thought of achieving a successful strike.

"This limited defense will be based on the off-the-shelf technology of the smart bullet. That technology is mature and unexotic and its deployment around the end of the decade involves no further research, but only a relatively modest degree of engineering development of existing hardware."

These quotes are from Jastrow's new book, "How to Make Nuclear Weapons Obsolete" (Little, Brown and Company). Providing needed insights into the technologies behind all the "Star Wars" talk, Jastrow points out that a first-step missile defense system would consist of two layers—a boost-phase defense that tackles

Soviet missiles as they rise above the atmosphere, and a terminal defense that intercepts the warheads at the end of their trajectories, as they descend toward their targets in the United States.

The essential element in this system is the "smart bullet"—a projectile that homes in on its target using radar or heat waves and destroys it on impact. The interceptor rocket for this phase is seen as an advanced version of the air defense interceptors that are in operational use in our Air Force today. These weigh about 500 pounds, and the smart bullets they carry (which are non-nuclear) weigh 10 pounds.

Jastrow estimates a need for a space-based force of 100 satellites, each holding 150 interceptors, or enough to counter a mass attack from all 1,400 Soviet missile silos. Also needed would be four early-warning satellites in geosynchronous or stationary orbits and 10 lower-altitude satellites dedicated to surveillance and tracking, plus ground control communications and battle management. He sees the system working like this:

"The rockets with their smart bullets would be stored in pods on satellites and fired from space. The tracking information needed to guide them would be acquired from satellites orbiting over the Soviet missile fields.

"Heat-sensitive eyes on the satellites look for the tell-tale flames of the missile launch, follow the course of the missile as it rises, and pass their information on to computers which calculate the probable path of the missiles.

"The high-altitude satellites flash their information to the fleet of satellites at lower altitudes—the battle-management satellites and those that carry the weapons to be used against the Soviet missiles. These satellites begin to track the moving missiles. In a few more seconds, they fire."

The technology used for terminal defense would be based mainly on

what Jastrow describes as "a small homing interceptor, also non-nuclear, with a heat-seeking sensor, launched by a rocket." Such interceptors, he wrote, could be ready for deployment in five years if a decision were reached to follow this course.

Farther out "Star Wars" concepts envision a fleet of satellites similarly orbiting over the Soviet Union, each containing a powerful laser and a large concave mirror to reflect the laser beam toward the missile, focusing it on the skin until it softens or melts. Beyond the laser are still more exotic weapons possibilities, such as the Neutral Particle Beam. As Jastrow explained, a laser beam is absorbed at a missile's surface but a NPB beam passes right through and enters the brains of the missile—the electronic computer that guides it on its course—driving the missile off its proper path so that it begins to tumble and destroy itself.

Then there's the Electromagnetic Railgun which uses an intense magnetic field to propel smart bullets at "much higher speeds than a rocket," enabling them to intercept and destroy missiles far more readily than at present.

Also being researched are other deadly devices known as the X-Ray Laser, Excimer Lasers and the Electron Beam. Trouble is, as Jastrow concludes, "the potential of the new technologies will not be clear for another three to five years, and some years beyond that may be needed to shape the best of them into practical defenses against missiles, which means that these new technologies may not come into use before the mid or late 1990s."

Meanwhile, according to Jastrow, the Russians are going all out to develop their own military capabilities in space—with the aim of stopping a U.S. missile counter-attack in its tracks. If the United States then had no comparable space defense system, the USSR would be able to launch a first-strike nuclear attack with little fear of retaliation. It's this kind of nightmare scenario that lends urgency to U.S. "Star Wars" planning. □