Scientists' Institute for Public Information

355 Lexington Avenue
New York, NY 10017
(212) 661-9110
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Media Resource Service

November 28, 1986

SDI

Max Green
Room 196
OEOB
White House
Washington, DC 20500

Dear Mr. Green:

I would like to express my gratitude for your help in securing William Tobey as a participant in our Madison symposium on "Reducing the Risk of Nuclear War: SDI and Alternatives." We at SIPI and the people at the University of Wisconsin both feel that the event was a rousing success. (See enclosed material for details.)

We had over 250 people at the symposium. It was covered by WKOW-TV, the local ABC affiliate, and aired as the lead story on their 10 o'clock news. Taylor and Maaranen taped a 12-minute segment on "Wisconsin Magazine," a WHA (Public) TV weekly news show and also went live on a WHA-Radio call-in news talk show that lasted an hour. And Tobey and Rathjens made an appearance on the local CBS (WISC-TV) news show, "Live at Five>" We will obtain copies of all these tapes. There was also considerable coverage by local publications and I will forward copies of these clips to you. (Some are enclosed.)

Soon we will have a full transcipt of the proceedings and will send Will Tobey and the other panelists copies for corrections. (If you are interested in a transcript, I would be happy to send one.) We may publish an edited version of the symposium in booklet form and also devote part of a SIPIscope to the event. We encourage the panelists' comments and suggestions.

Again, thank you for taking the time out to help make this symposium a success. I hope you'll be available to assist in future SIPI endeavors.

Sincerely,

Jay Letto

Jay Letto

UW news

From the University of Wisconsin-Madison / News Service, Bascom Hall, 500 Lincoln Drive, Madison 53706 / Telephone: 608/262-3571

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CONTACT: Sharon Dunwoody (608) 263-3389, Dick Ringler (608) 262-8087

REDUCING THE RISK OF NUCLEAR WAR: UW SYMPOSIUM LOOKS AT THE ALTERNATIVES

MADISON--Is the Strategic Defense Initiative (SDI) the answer to avoiding the risks of nuclear holocaust? Are there other viable alternatives such as arms limitation and reduction?

These and other questions will be addressed at a symposium, "Reducing the Risk of Nuclear War: SDI and Alternatives," Tuesday, Nov. 18 from 7-9 p.m. in the Lakeshore Room of the Wisconsin Center at University of Wisconsin-Madison.

The symposium will feature noted political scientist George W. Rathjens of the Massachusetts Institute of Technology; William Tobey, deputy director of defense programs for the National Security Council; Theodore B. Taylor, a physicist and former nuclear weapons designer now working for the elimination of nuclear arms; and Michael H. Mobbs, assistant director for strategic programs for the U.S. Arms Control and Disarmament Agency.

The free, public symposium is part of an ongoing series sponsored by the Scientists' Institute for Public Information, a non-profit organization dedicated to increasing public awareness and understanding of issues involving science, technology and public policy. Local sponsors include the UW-Madison School of Journalism and Mass Communication and the International Cooperation and Security Studies Program.

The symposium is made possible by grants from the H. Smith Richardson Charitable Trust, the Ploughshares Fund, the General Service Foundation and The Ford Foundation.

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-- Terry Devitt (608) 262-8282

'Star Wars' — shield or Achilles heel?

Pro: U.S. needs lever for honest arms talks

By William Tobey

"We are not dealing simply with a military or scientific problem, but with a problem in statecraft and the ways of the human spirit," concluded the first U.S. government panel to analyze control of atomic energy 40 years ago. The essence of the problem we face in strengthening peace in a world with nuclear weapons has not changed in four decades. It is challenging and success toward its solution difficult to measure.

Certainly, the threat we face from the Soviet Union has grown enormously, especially since the first Strategic Arms Limitation Treaty (SALT I) in 1972. Since then, the Soviets have fielded four new types of intercontinental ballistic missiles (ICBMs); a fifth is being tested. Since SALT II was signed in 1979, the Soviets have almost doubled the number of warheads aimed at us.

The Soviets also have a vigorous strategic defense program predating our own. They spend roughly as much on strategic defense as they do on strategic offense. Moscow is the only city in the world with defenses against ballistic missile attack. The Soviets are constructing a specialized radar near Krasnoyarsk, in direct violation of the ABM Treaty. The Soviet laser effort alone involves more than 10,000 scientists and engineers at a half-dozen sites.

These facts form a dangerous mosaic. Soviet strategic defense alone is not threatening; but it's combined with a unique and devastating first-strike capacity. Moreover, the Soviets seek a monopoly in defenses. President Reagan announced SDI in one of his most famous public speeches. But the Soviets continue to deny the existence of their strategic defense research — even while seeking to ban SDI. These long-term trends in Soviet offensive and defensive forces, together with his hope to strengthen deterrence by relying on defenses, led Reagan to conclude we must act or jeopardize our ability to build a more stable world.

Reagan's response has been three-fold: rebuilding our retaliatory forces to preserve deterrence over the near term; investigating strategic defenses to find a safer future form of deterrence; and seeking deep, equitable and verifiable arms reductions. Each of these steps is complementary. Over the near term we must rely on the threat of retaliation with nuclear arms to deter Soviet attack. We need SDI as a lever to achieve arms reductions and as an insurance policy to guard against Soviet cheating.

It would be premature to judge the ultimate effectiveness of these programs. But Reagan has succeeded in radically changing the terms of debate. Instead of negotiating rules for arms increases, such as SALT I and II, Reagan is proposing real arms cuts.

The overwhelmingly favorable response to Reagan's refusal to trade away SDI at Iceland demonstrates that Americans would prefer a doctrine based on defending ourselves. Reagan believes America and our allies must rise above a strategy based on deterring Soviet attack simply by threatening nuclear retaliation. If the Soviets are capable of equitable and verifiable reductions of nuclear arsenals, we have the opportunity to build a more stable peace.

William Tobey

Tobey has worked for the Defense Department and as an adviser to the U.S. delegation to the Geneva arms talks. He is presently deputy director of defense programs on the National Security Council staff.

Experts to discuss SDI at campus symposium

William Tobey and George Rathjens, whose pro and con positions on the Strategic Defense Initiative appear on this page, will be participants in a public symposium, "Reducing the risk of nuclear war: SDI and alternatives," from 7 to 9 p.m. Tuesday on the UW-Madison campus.

The symposium will be in the Lakeshore Room in the Wisconsin Center, 702 Langdon St. It is sponsored by the Scientists' Institute for Public Information, the UW-Madison School of Journalism and Mass Communications and the International Cooperation and Security Studies Program.

Tobey and Rathjens will appear on a panel of scientists and defense experts moderated by Robert March, a UW professor of physics and award-winning science writer. Also participating:

- Theodore Taylor, a physicist and former nuclear weapons designer who was involved in the building of the hydrogen bomb while working at the Los Alamos (N.M.) Laboratory from 1945-56. He is former deputy director of the Defense Nuclear Agency of the Defense Department and a former consultant to the Atomic Energy Commission.
- Michael Mobbs, assistant director of the U.S. Arms Control and Disarmament Agency. He is the third-ranking administrator at ACDA and is on the agency's strategic programs.

The symposium will include an introduction by March, a 15-minute presentation from each participant and an hour for audience questions. There is no admission charge.

Con: Nuclear arsenals provide real deterrence

By George Rathjens

In the aftermath of the Reagan-Gorbachev meeting in Reykjavik, and the subsequent foreign ministers meeting in Vienna, it is clear that the near-term prospects for major Soviet-American nuclear arms agreements are poor.

The sticking point is Soviet unwillingness to conclude agreements on other weapons unless the Strategic Defense Initiative (SDI) is constrained, coupled with President Reagan's insistence that the program continue.

In the circumstances, many will argue the desirability of our at least foregoing SDI-related developments that would contravene the Anti-Ballistic Missile (ABM) Treaty of 1972 and of restraints on other programs — new nuclear delivery systems, anti-satellite systems and underground nuclear testing — at least for so long as there is reasonable reciprocity of restraint by the Soviet Union.

But better bet on Congress simply holding back on funding rather than counting on such restraint by the White House!

Desirable as they may be, no one should be misled that such limitations are likely to have much direct effect on reducing the risk of nuclear war, nor, for that matter, the damage should it occur. Nor would a "nuclear freeze" nor even the kinds of arms-reductions agreements that have been discussed in Geneva.

All must be seen as attempts to deal with the dual problem that inheres in having a difficult adversary in a world of nuclear weapons by tinkering around the edges.

George Rathjens

Within very broad limits, the nuclear postures of the two superpowers hardly matter. Each will surely be deterred from deliberately initiating conflict with the other by the fear that escalation, inevitably unpredictable, could lead to catastrophe.

And, when one considers more likely paths to war — most particularly, actions by third parties, over which the superpowers may have little control, and for which World War I is a better model than World War II — the superpowers' nuclear weapons are likely to be quite irrelevant.

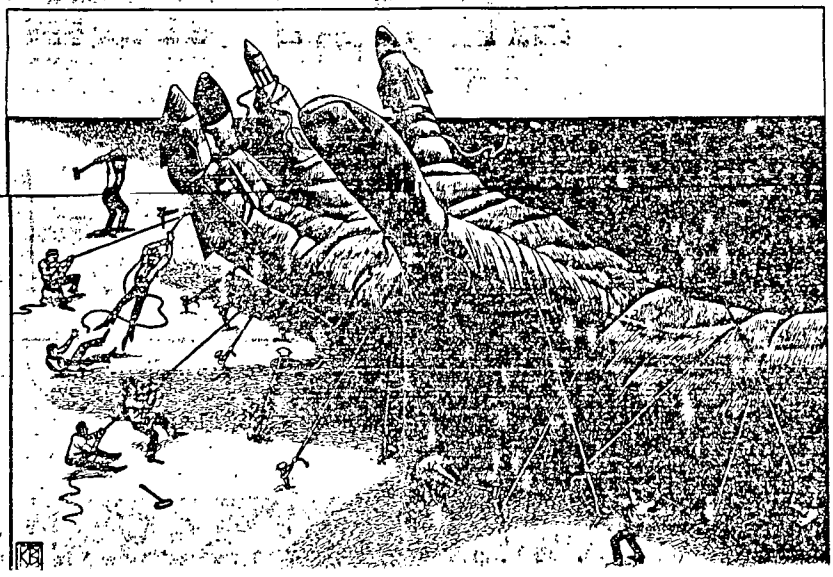
Can SDI make a difference? Not if all it can lead to is "enhancement of deterrence," for deterrence needs no enhancement. With or without our having defenses, the Soviets must expect that a direct attack against us will lead to an unacceptably high likelihood of totally devastating retaliation.

But what of Reagan's vision, not of just "enhancing deterrence," but of an Astrodome-type defense that would make nuclear weapons "impotent and obsolete"?

Although such a defense certainly would make a difference, both in the risk of war and in the damage should it occur, technical considerations will preclude our *ever being able* to deploy such a defense against a resourceful and reactive adversary. Also, it is unbelievable that if we were to deploy such a defense, should we so settle our differences with the Soviets, they would not react.

Even the vision, though, is important. It is an impediment to reducing the risk of nuclear war, for in offering an enticing "technical fix" to the problem of nuclear weapons and the Soviet Union, the president diverts attention from diplomatic and political paths that offer the only real hope of resolution of differences and avoidance of conflict that might engulf us.

Rathjens is a professor of political science at Massachusetts Institute of Technology, a part-time professor at Marquette University and the former deputy director of the Defense Advance Research Projects Agency of the Depart-



OTHER VIEWS

Options for peace

Is banning Star Wars a first step in arms control . . .

By THEODORE B. TAYLOR

PRESIDENT Reagan and Secretary Mikhail Gorbachev have repeatedly said their goal is worldwide elimination of all nuclear weapons.

Gorbachev proposes that this be done by the year 2000. Related Soviet action has included a 15-month unilateral moratorium on nuclear tests, while pressing for the United States to stop testing also and then join them in working out a comprehensive treaty banning all future tests. The Reagan administration has flatly refused to stop testing before strategic nuclear weapons have been eliminated.

Reagan wants to wait for Star Wars to "render nuclear weapons impotent and obsolete" and his insistence on continuing on this visionary path has brought all productive arms-control negotiations to a halt.

Waiting for Ronald Reagan's vision of an impenetrable, nationwide shield against all nuclear attacks means waiting forever or, more likely, until nuclear war leaves nothing to wait for. His shield is a technical impossibility. Developing a less ambitious version of Star Wars would still waste more tax dollars than have been spent on any project in history. Worst of all, it would stimulate an arms race beyond our wildest nightmares. Rather than rendering nuclear weapons obsolete, it will make them proliferate like rabbits. Any signs that SDI might be effective against intercontinental ballistic missiles will stimulate not only building nuclear countermeasures, but also new types of cruise missiles, bombers, intermediate-range submarine-launched missiles and other strategic weapons against which Star Wars offers no defense. Furthermore, SDI's vulnerability to nuclear explosions in space must be tested before full deployment. This means breaking the 25-year-old treaty banning above-ground nuclear tests; underground tests are inadequate for this purpose.

Congress should demand from the Reagan administration a thorough justification of claims that pursuit of Star Wars will decrease the likelihood of nuclear war, at a cost we can afford, as a condition for further funding of the program. I strongly doubt this condition can be met.

If the SDI logjam can be broken, the United States and the Soviet Union could then join the rest of the world in vigorous action against the most threatening common enemy — nuclear weaponry itself. Initial actions should include:

■ An immediate agreement by the United States to join the Soviet Union in its present moratorium on all nuclear tests, followed by joint pressure for a worldwide, enforceable treaty forbidding all future nuclear tests. This will keep closed the Pandora's Box containing countless generations of radically new types of nuclear weapons that, if developed, will greatly intensify the inherent dangers in a nuclear arms race.

■ Establishment of major public and private, national and international activities chartered to assess thoroughly the options for proceeding toward a stable world without nuclear weapons.

■ Serious worldwide consideration of non-violent alternatives to traditional military response to threats of aggression.

■ A verifiable worldwide freeze on production of nuclear weapons and delivery vehicles.

■ Internationally monitored demonstration tests of the specific steps needed for elimination of specific nuclear weapons.

■ Establishment of major cooperative projects, especially but not exclusively involving the United States and the Soviet Union, which, when accomplished, threaten no one and benefit everyone. Technological examples include water- and air-pollution abatement, development of economical renewable energy resources, joint exploration of space, and a host of others. Success of such projects could help shift from deterrence by threats of massive violence to deterrence by a desire to preserve the benefits of constructive cooperation. This shift could start now, independent of arms-control negotiations and disarmament agreements.

But we must move quickly. Time is running out.

Theodore B. Taylor, a physicist and former nuclear weapons designer is now working for the elimination of nuclear arms. He is president of NOVA, INC., a renewable energy company, and a board member of the Nuclear Control Institute.

Arms-control program

A free, public symposium, "Reducing the Risk of Nuclear War: SDI and Alternatives," will be held Tuesday, Nov. 18, from 7 to 9 p.m. in the Lakeshore Room of the Wisconsin Center at the University of Wisconsin — Madison. It will be structured so that members of the audience can question the experts. Both Michael H. Mobbs and Theodore B. Taylor will be included among the panelists. A reception will follow in the Memorial Union at which the panelists will be available for informal discussion.

. . . or is SDI our only hope for security, Soviet compliance?

By MICHAEL H. MOBBS

SINCE the Iceland meeting between President Reagan and General Secretary Mikhail Gorbachev, the United States has sought to build on the important results achieved there. Recently, Secretary of State George Shultz met with Foreign Minister Eduard Shevardnadze in Vienna to discuss — along with human-rights issues, regional issues and bilateral affairs — arms-control issues. The United States brought its top experts in order to have the kind of intensive discussions that have brought progress over the past few months. In arms control, we sought to narrow areas of disagreement in strategic-arms reductions, in intermediate-range nuclear forces, and in defense and space issues.

Unfortunately, the negotiations did not move ahead as we had hoped. But these issues will continue to be pursued by our negotiators at the nuclear and space talks in Geneva. Moreover, to maintain momentum, the US has proposed that experts from both countries meet before the next round of negotiations begins to see if further progress can be made.

Understanding the situation today requires going back, at the very least, to the Reykjavik meeting of a month ago.

That meeting resulted in reduced differences in virtually every major aspect of nuclear arms control. These postive results have been formally incorporated into the US negotiation position in Geneva, where we now hope to build upon them.

At Reykjavik, the US offered a proposal for agreement that was both sweeping in scope and generous in content. In exchange for the US commitment not to deploy the Strategic Defense Initiative for 10 years, we offered the complete elimination of all ballistic missiles — Soviet and American — by 1996. Unfortunately, the Soviets coupled acceptance of this proposal with a condition that was unacceptable: The US must confine research to the laboratory, which is more restrictive than what the Anti-Ballistic Missile Treaty now permits. In effect, the Soviets demanded that we kill SDI.

> "Does the Soviet Union merely want protection for itself? If so, then it should be eager to move with us toward a world in which mutual security would be enhanced as offensive weapons are reduced...."
>
> —Michael H. Mobbs

Yes, SDI was critical to the plan to eliminate ballistic missiles; without it, such a plan would be unworkable. SDI would serve as the necessary insurance policy for such a plan. It would help ensure that the Soviet Union kept its commitments, and it would be America's security guarantee were the Soviets, as they have done too often in the past, fail to comply with their solemn commitments. At this very moment, in fact, the Soviet Union is violating, among other things, the ABM Treaty, and is in a position to break out of the treaty quickly to establish a nationwide defense of its territory.

What do you think?

The Journal welcomes your views on the issues. Letters and In My Opinions must bear the writer's signature and name, full address and telephone number. Send them to: Letters to the Editor, The Milwaukee Journal, Box 661, Milwaukee, Wis. 53201.

Because of limited space, we routinely condense letters (preferred length is 300 words or fewer) and In My Opinions (600 words or fewer). We publish only original material. We don't publish poetry, open letters, or copies of letters sent elsewhere. To ensure diversity, we limit each writer to one published letter every two months, one published In My Opinion every six months.

It would be a mistake to believe that SDI itself was the main stumbling block at Reykjavik, just as it would be a mistake to view it as the main obstacle to progress today. More accurately, the problem lies with the Soviet allegation that SDI is an offensive program. Our SDI research to date clearly shows that the technologies we are investigating are not suited for offensive use. We have made this clear to the Soviets. And we have urged the Soviet Union to accept our proposal to join with us in opening research facilities to each other's inspection. This confidence-building measure should answer any questions about the strategic defense efforts of either side.

The Soviet Union is also pursuing defenses against ballistic missile attack. The Soviet laser program, to take one important example, is much larger than the US effort. It involves more than 10,000 scientists and engineers and more than a half-dozen major research and development facilities and test ranges.

ULTIMATELY, of course, progress in arms control depends not simply on the fairness of our proposals, but on the Soviet Union. Does the Soviet Union merely want protection for itself? If so, then it should be eager to move with us toward a world in which mutual security would be enhanced as offensive systems are reduced and defenses play a greater role. But if the Soviet Union wishes not merely to protect itself, but to threaten others as well, then the chances for meaningful reductions and lessening the risk of war through arms-control agreements are bleak indeed.

They do not have to be, however, and we believe the agreements we have proposed are fair to both sides and would represent a dramatic step forward. We continue to hope that the Soviets will show a willingness to take that step with us. But that's a decision the Soviets must make.

Michael H. Mobbs is the assistant director of the United States Arms Control and Disarmament Agency for Strategic Programs.

'Star Wars' program takes criticism, praise

By Susan Lampert Smith
Of The State Journal

In a Tuesday night debate on the UW-Madison campus, President Reagan's "Star Wars" program was compared with the fake cancer drug Laetrile — and praised as the way "toward a more secure, less risky world."

The advocates of the Strategic Defense Initiative (SDI) were both young, blond and methodical in their approach to the debate. They were William Tobey, deputy director of defense programs on the National Security Council staff, and Steven Maaranen, chief of the defense and space division in the U.S. Arms Control and Disarmament Agency.

The opponents of SDI were graying and passionate. They were George Rathjens, a Massachusetts Institute of Technology professor, and Theodore Taylor, a former hydrogen bomb scientist who now heads an alternative energy company.

About 250 spectators jammed the Lakeshore Room of the Wisconsin Center. Judging from applause and questions, most agreed with anti-Star Wars perspective.

Here are a few of the things they heard, for and against the space-based defense system.

Pro-Star Wars: Tobey said the SDI is not primarily designed to shield the entire country from a nuclear attack.

"Its fundamental purpose is deterrence," he said, "to make sure nuclear weapons are never launched."

Tobey said SDI has already proved useful by bringing the Soviets back to the bargaining table and by allowing the United States to propose reducing its arsenal of weapons.

"By proposing SDI," he said, "President Reagan has changed the tone of the arms control debate from ever-increasing weapons to reducing them."

Tobey and Maaranen both countered technical criticism of SDI by saying it is still in the research phase and will be evaluated, and perhaps scrapped, if it is shown not to work. Maaranen said SDI will be judged on whether it can survive a nuclear attack and whether it will convince enemies not to attack.

"The question is: 'How well do you need to do?,' " Maaranen asked. "SDI technology doesn't have to be perfect to work."

Maaranen said SDI could be part of a several "layers" of defense, which would attack incoming missiles at various stages in their flight. He said SDI will "move us toward a more secure, less risky world."

Anti-Star Wars: Rathjens said Reagan has sold SDI as "a shield that protects (people) from nuclear weapons as a roof protects a family from rain" because the public won't support a space-based system designed mainly to protect weapons.

Rathjens said a perfect shield is impossible. He said satellite-based systems could be shot down easily because satellites move in predictable orbits.

"I think that no matter how you look at reducing the risk (of nuclear war), SDI flunks on all counts," he said. "SDI is spherically symmetrical — it looks like a lemon, no matter how you view it."

Rathjens said SDI, like Laetrile, offers "false hope" of a technical solution to nuclear war. He said a "World War I" scenario, in which nuclear war begins with a political tiff in a smaller country, is more likely than the two superpowers attacking each other. He said SDI may stop the U.S. from looking for political solutions.

Taylor said SDI research will open a "Pandora's box" of new, more deadly space-based weapons. Speaking as a former bomb researcher, he said major laboratories are "addicted to nuclear weapons."

Taylor said he is especially worried about more nations developing nuclear and space-based weapons.

"As everyone gets on the bandwagon," he said, "the mistakes, the things that nobody imagined, will happen."

Tuesday's event was one of a national series of campus debates on SDI sponsored by the Scientists' Institute for Public Information. UW sponsors included the School of Journalism and Mass Communication and the International Cooperation and Security Studies Program.

Two seminars will focus on war, peace, Star Wars

CT . 11/12/86 By UNS Reporter Terry Devitt

If you are interested in arms control or the Strategic Defense Initiative (Star Wars), the next week in Madison should offer you plenty of insights, perspectives and discussion on contemporary nuclear issues.

Two conferences — one linked to Madison via satellite — will take place.

On Saturday, a "satellite summit" will link panelists in Washington, D.C., and Hamburg, West Germany. The discussion will be shown on a big-screen television at Union South from 1 to 3 p.m. Check the bulletin board or call 266-2543 to find the room number.

On Tuesday, a symposium on "Reducing the Risk of Nuclear War" will take place in the Lakeshore Room of the Wisconsin Center, 702 Langdon St, from 7 to 9 p.m.

The "satellite summit," co-sponsored by the Union of Concerned Scientists and the International Scientists' Peace Congress, features scientists from the Soviet Union, Germany and the United Kingdom discussing SDI, its role in arms control and its impact on East-West relations.

Participants in Washington will include Paul Warnke, chief negotiator for the SALT II treaty; Jan Martensen, undersecretary of the United Nations; and Allan Mense of the SDI office. Panelists in Hamburg include Lord Alun Chalfont of the United Kingdom House of Lords; Hans Dietrich Genscher, West Germany's foreign minister; Dr. Richard Garwin of the IBM T.J. Watson Research Center; and Dr. Evgeny Velikhov of the Soviet Academy of Sciences. It will be moderated by Hodding Carter, host of the PBS television program "Capitol Journal."

During the second hour, panelists — including Linus Pauling, Nobel laureate for peace and chemistry — will discuss informally the role of scientist and citizen in arms control.

The "Reducing the Risk of Nuclear War" symposium, sponsored by the Scientists' Institute for Public Information, the UW School of Journalism and the International Cooperation and Security Studies Program, features four panelists, with an opportunity for audience questions.

Participants in the event are George Rathjens, professor of political science at Massachusetts Institute of Technology; William Tobey, deputy director of defense programs for the National Security Council; Theodore Taylor, who formerly designed nuclear weapons and now is writing a book called "A World Without Nuclear Weapons"; and Michael Moobs, assistant director of the U.S. Arms Control and Disarmament Agency. Physics professor Robert March is the moderator.

'Star Wars' topic of symposium

by Terry Devitt

Is the Strategic Defense Initiative (SDI) the answer to avoiding the risks of nuclear holocaust?

Or are there other viable alternatives such as arms limitation and reduction?

These and other questions will be addressed at a symposium, "Reducing the Risk of Nuclear War: SDI and Alternatives," Tuesday, Nov. 18 from 7–9 p.m. in the Lakeshore Room of the Wisconsin Center on the UW–Madison campus.

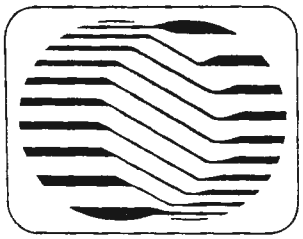
The symposium will feature noted political scientist George W. Rathjens of the Massachusetts Institute of Technology; William Tobey, deputy director of defense programs for the National Security Council; Theodore B. Taylor, a physicist and former nuclear weapons designer now working for the elimination of nuclear arms; and Michael H. Mobbs, assistant director for strategic programs for the U.S. Arms Control and Disarmament Agency.

Free and open to the public, the symposium is part of an ongoing series sponsored by the Scientists' Institute for Public Information (SIPI). SIPI is a non-profit organization dedicated to increasing public awareness and understanding of issues involving science, technology and public policy.

Local sponsors include the UW–Madison School of Journalism and Mass Communication and the International Cooperation and Security Studies Program.

The symposium is funded by grants to SIPI from the H. Smith Richardson Charitable Trust, the Ploughshares Fund, the General Service Foundation and the Ford Foundation. ■

University of
Wisconsin-Madison



Perspectives on War and Peace

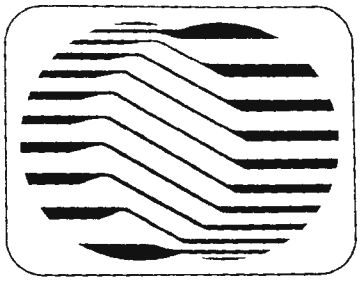
Vol. 4, No. 2 Oct. 1986

A Publication of the International Cooperation and Security Studies Program

Tuesday, November 18, 7:00-9:00 p.m.
Room to be announced
"Reducing the Risk of Nuclear War"
A panel discussion of the nuclear arms race and arms control possibilities. Panelists will include George W. Rathjens, Professor of Political Science, Massachusetts Institute of Technology; Theodore B. Taylor, Independent Consulting Physicist (and former Deputy Director of the Defense Nuclear Agency, Department of Defense); and others.
Co-sponsored by ICSS, Scientists' Institute for Public Information (NY), and the UW-Madison School of Journalism

EVENTS this week

Reducing the Risk of Nuclear War SDI and other alternatives will be discussed by a panel including Michael Mobbs, assistant director of the U.S. Arms Control and Disarmament Agency; George Rathjens, professor of political science, Massachusetts Institute of Technology; Theodore Taylor, independant consulting physicist, former deputy director of Defense Nuclear Agency, Department of Defense; William Tobey, deputy director of Defense Programs. The event will take place at 7 p.m. in the Lakeshore Room, Wisconsin Center, 702 Langdon St.



International Cooperation
and Security Studies

REDUCING THE RISK OF NUCLEAR WAR: SDI AND OTHER ALTERNATIVES

Panelists:

MICHAEL MOBBS, Assistant Director (in Charge of Strategic Programs) of the U.S. Arms Control and Disarmament Agency

GEORGE W. RATHJENS, Professor of Political Science, Massachusetts Institute of Technology

THEODORE B. TAYLOR, Independent Consulting Physicist, Former Deputy Director of Defense Nuclear Agency, Department of Defense

WILLIAM TOBEY, Deputy Director of Defense Programs, National Security Council

Moderator:

ROBERT H. MARCH, Professor of Physics, UW–Madison

TUESDAY, NOVEMBER 18, 7:00 p.m.

LAKESHORE ROOM, WISCONSIN CENTER (702 Langdon Street)

Sponsored by:

Scientists' Institute for Public Information (NY),

International Cooperation and Security Studies (UW–Madison)

and the School of Journalism and Mass Communication (UW–Madison)

University News Service

19 Bascom Hall
500 Lincoln Drive
Madison, Wisconsin 53706

November 11, 1986

Dear Wisconsin Editorial Writer:

I am writing to inform you of a rare opportunity to learn, first hand, about one of the most pressing issues of our time: the Strategic Defense Initiative and other, non-technological, strategies for reducing the risk of nuclear holocaust.

In conjunction with the New York-based Scientists' Institute for Public Information, the University of Wisconsin-Madison School of Journalism and Mass Communication and the UW International Cooperation and Security Studies Program are sponsoring the symposium "Reducing the Risk of Nuclear War: SDI and Alternatives."

The symposium's panel of experts consists of two high-ranking administration officials, Michael H. Mobbs, assistant director for strategic programs for the U.S. Arms Control and Disarmament Agency, and William Tobey, deputy director of defense programs for the National Security Council. Both are responsible for aspects of the Strategic Defense Initiative. The panel will also consist of two nationally-known critics of the president's "Star Wars" program, MIT political scientist George Rathjens, and physicist and author Ted Taylor. Biographical sketches are enclosed.

One of the principal aims of the program is to provide Wisconsin editorial writers with an opportunity to become more familiar with the ramifications of a national policy of almost unprecedented scope. The symposium, to be held Tuesday (Nov. 18) from 7 p.m. to 9 p.m. in the Lakeshore Room of the University of Wisconsin-Madison's Wisconsin Center, will be structured so that audience members will have an opportunity to question the experts. A reception will follow in the UW-Madison Memorial Union.

Our hope is that you will take advantage of this opportunity to learn more about this issue in order to better inform your audiences. If you would like more information, or if there is anything we can do to facilitate a visit to the University of Wisconsin-Madison campus, feel free to contact me at your convenience.

Sincerely,

Terry Devitt
Science Editor

Enc.

REDUCING THE RISK OF NUCLEAR WAR: SDI AND ALTERNATIVES

PARTICIPANTS

*William Tobey -- A native of Decatur, Ill., Tobey holds degrees from Northwestern and Harvard Universities. He has been a staff member on several political campaigns and has worked for the National Republican Senatorial Committee. He subsequently served in the office of the secretary of defense and as an advisor to the U.S. delegation to the negotiations on nuclear and space arms in Geneva. He is presently deputy director of defense programs for the National Security Council. His primary responsibilities are in the areas of strategic defense and related arms control policy.

*Theodore B. Taylor -- An independent consulting physicist, Taylor is a former nuclear weapons designer now working for the elimination of nuclear arms. He is a board member of the Nuclear Control Institute and president and chairman of NOVA, Inc., a renewable energy company. A noted author, Taylor is now working on a book entitled "A World Without Nuclear Weapons." He received degrees in physics from the California Institute of Technology and Cornell University. In 1965, he received the Ernest O. Lawrence Award from the Atomic Energy Commission for work on nuclear weapons and the Triga research reactor. In 1966, he was awarded the Secretary of Defense Meritorious Civilian Service Medal.

*Michael H. Mobbs -- Mobbs is an assistant director of the U.S. Arms Control and Disarmament Agency. He is responsible for formulating and executing U.S. policy on the control of strategic and intermediate-range nuclear arms, space arms and strategic defense systems. Prior to his work at ACDA, Mobbs served as special counsel to the head of the U.S. delegation and as the representative of the secretary of defense to the negotiations on nuclear and space arms in Geneva. A native of Florence, Ala., Mobbs has degrees from Yale and the University of Chicago Law School.

*George W. Rathjens -- A native of Alaska, Rathjens is a professor of political science at the Massachusetts Institute of Technology. He holds degrees in chemistry from Yale and the University of California at Berkeley. His current interest is in the role of nuclear weapons in Soviet-American relations and on nuclear arms control. During a 15-year career with the federal government, Rathjens served as chief scientist and deputy director of the Advanced Research Projects Agency of the Department of Defense, special assistant to the director of the U.S. Arms Control and Disarmament Agency and director of the Systems Evaluation Division of the Institute for Defense Analyses. His recent work includes examinations of the feasibility of the Strategic Defense Initiative and the likelihood and implications of nuclear winter.

"WE ARE LIVING IN A TRULY REVOLUTIONARY AGE— in one generation we have entered three new eras: the Space Age, the Atomic Age, and the Computer Age. Understanding any one of these requires more information than any one of us can possibly have. We are in a crisis because of this—how do we inform the electorate? —because a democracy cannot survive without an informed electorate. So what do we do? We don't want to rely on the government for all our information. The Scientists' Institute for Public Information has the answer...a pool of scientists and specialists to whom journalists can turn. And it's an objective organization, without bias."

WALTER CRONKITE
Honorary Chairman, Media Resource Service

The Media Resource Service is a program of the
Scientists' Institute for Public Information
355 Lexington Avenue, New York, NY 10017
Toll-free: 800/223-1730 In New York State: 212/661-9110

MEDIA SPONSOR COUNCIL

The Media Sponsor Council consists of the following media companies and media-related foundations that have demonstrated their confidence in the Media Resource Service with financial contributions:

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IN 1980, WHEN THE SCIENTISTS' INSTITUTE FOR PUBLIC INFORMATION LAUNCHED THE MEDIA RESOURCE SERVICE, several Wise Old Observers declared it would never work. Journalists, they said, don't have the time or the interest to call a referral service for expert sources. Journalists, they said, are happy to dash off half-baked, unchecked stories that make headlines. And besides, they said, scientists are too wrapped up in their own work to volunteer time to talk to the press.

Today the MRS includes more than 20,000 participating experts in science, technology, and medicine. The MRS staff fields upwards of 50 calls a week from print and broadcast journalists across the country. During the week following the space shuttle disaster, for example, nearly 100 journalists called the MRS for referral to expert sources.

Why, despite the predictions of the nay-sayers, has the MRS emerged in just a few years as such a vital bridge between the scientific community and the media?

The answer lies partly in the fact that science and technology have become so pervasive in modern society. Science has become crucial to decisions we make every day about what to eat and drink, where to live and work, and how to raise our families. Science plays a major role in the decisions our elected government makes on policies ranging from health, transportation, and consumer affairs to space exploration and national defense. Reporters, even those experienced at covering science, cannot possibly have enough sources at their fingertips or in their notebooks to cover all the fast-breaking developments.

But the answer lies also in the fact that not all, but many journalists *do* care enough about accuracy to seek expert sources, to get second and third opinions, to check their facts; and that not all, but many scientists *do* care enough about public understanding to spend the time and effort it takes to talk to the press.

To those journalists and those scientists, we dedicate this report.

WHY SIPI ESTABLISHED THE MEDIA RESOURCE SERVICE

☐ An area medical center has received government funds to conduct cancer research using Interleukin-2. Who can offer a critical perspective of this cancer therapy?

☐ It's been one year since the disastrous chemical leak in Bhopal, India. What advances in computer safety systems have chemical companies made to prevent a recurrence of a lethal spill?

☐ Surgery has just been completed on the first woman to receive an artificial heart implant. How expensive is this procedure?

☐ There's been an accident at the Three Mile Island nuclear power plant in Pennsylvania. What went wrong? What are the dangers involved?

The first three questions were asked by journalists who called the MRS in 1985. But the last question, of course, dates back to March, 1979. At that time, SIPI was besieged with calls from journalists needing to talk with experts who could explain the events at Three Mile Island. Realizing the need for a referral service for journalists who deal with scientific issues on a daily basis, SIPI established the MRS in 1980, with about 5,000 scientists in its files by the end of the year.

Today, there are more than 20,000 experts in the MRS resource base, all of whom have agreed to answer questions from journalists—who often need these answers immediately. Deadlines for the queries above, in fact, were "ASAP." In each case, we were able to get back to the journalist with names of experts within 30 minutes.

WHEN A JOURNALIST CALLS THE MRS...

Any member of the working press can call SIPI's toll-free number—800/223-1730 (212/661-9110 in New York state)—and describe the information or specialist needed.

The MRS staff then searches its computer data base to find the appropriate experts, examining any special criteria that the journalist has requested, such as geographic location, field of expertise, or position on a particular issue. If the journalist's story is on a controversial topic, representatives of diverse points of view are provided.

Deadlines permitting, the MRS staff calls each scientist to ascertain his or her availability, to alert the scientist that the journalist will be calling, and to explain the journalist's needs.

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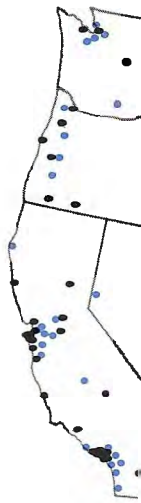

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WHERE THE CALLS COME FROM...

MRS CALLS BY TYPES OF MEDIA, 1985-86

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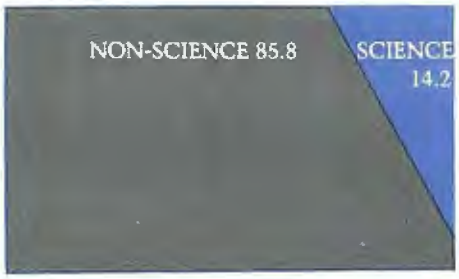
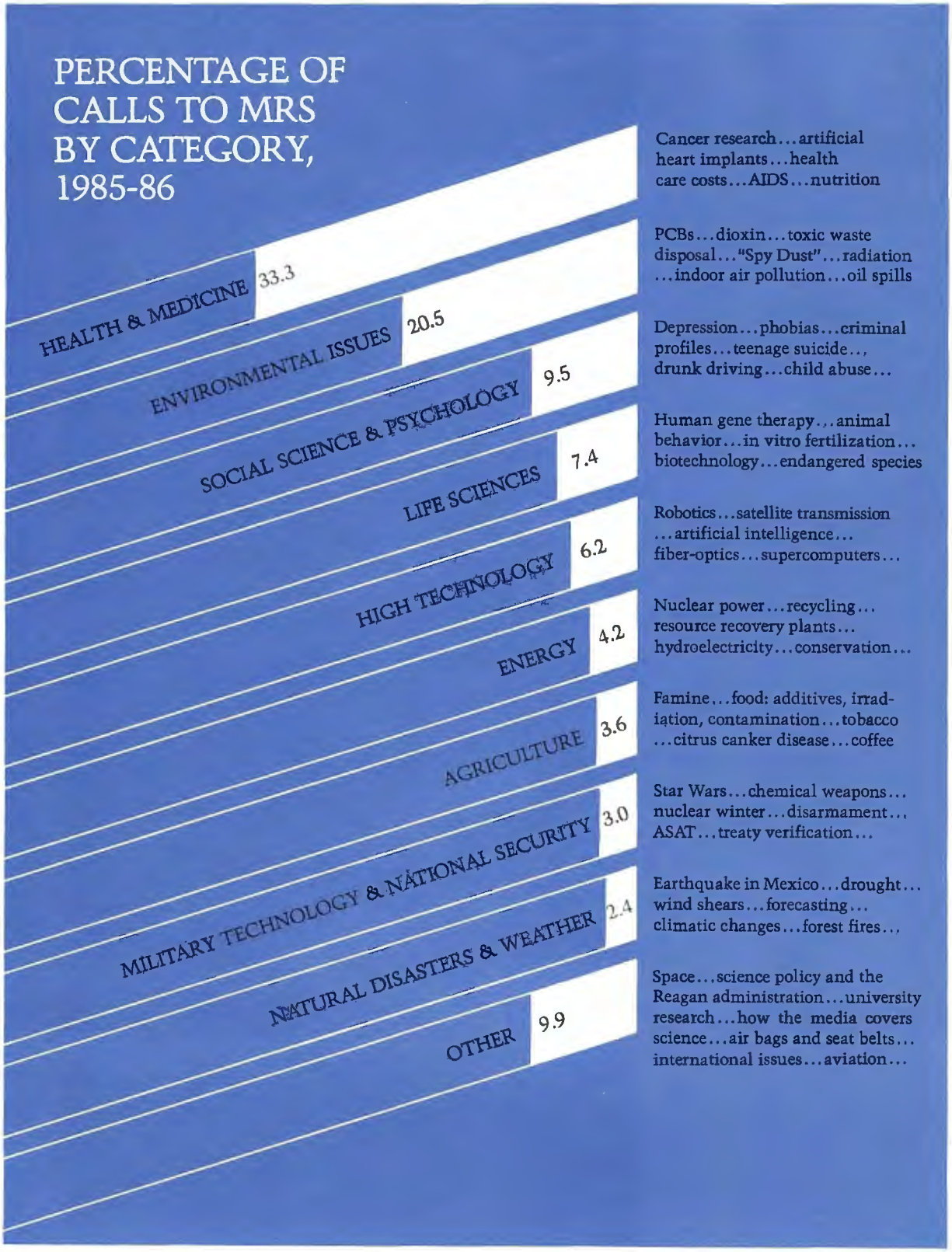


*Includes news services and syndicates, publishing and production companies.



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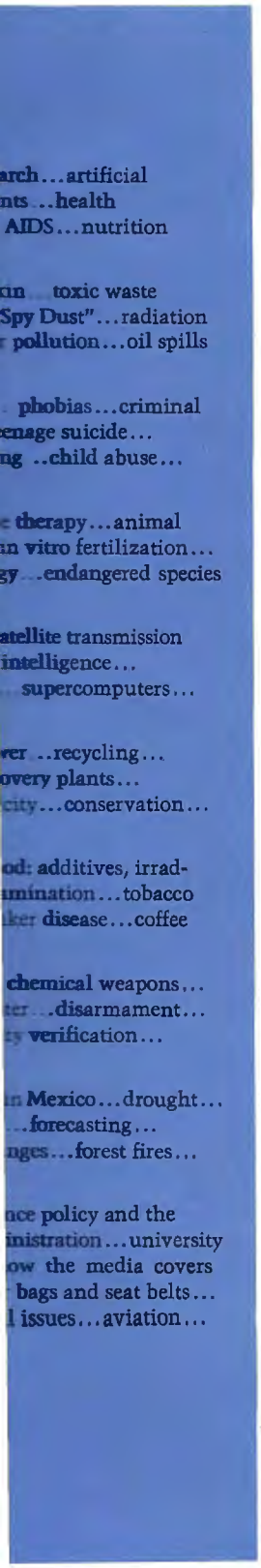


FOUR FREQUENTLY ASKED QUESTIONS ABOUT THE MRS

Who funds the MRS?

The MRS is funded by foundations (60%), media sponsors (20%), and non-media corporations (20%). Funders for 1985-86 are listed on the inside front and back covers of this report.

How do you compile your list of experts?

Since SIPI began compiling its resource base of MRS experts back in 1980, it has relied heavily on assistance from the nation's leading research institutions and scientific societies. Letters of invitation and questionnaires are sent to experts on the basis of recommendations from these institutions and from other scientists, and by surveying the current scientific literature.

How do you decide which scientists should answer a journalist's query?

When scientists agree to be part of the MRS resource base, they fill out a questionnaire that asks for their backgrounds, qualifications, and perspectives on their particular areas of expertise. Because the MRS staff calls most scientists before making a referral to a journalist, there is additional opportunity to ascertain the expert's appropriateness. If the journalist needs information on a controversial issue, every effort is made to ensure that the scientists referred represent diverse points of view.

No one is excluded from the MRS files, because SIPI does not believe it has the authority to decide who qualifies as a scientific expert and who does not. However, the MRS questionnaires ask for detailed descriptions of educational background, positions held, areas of specialization, society and committee memberships, and recent publications. This information usually speaks for itself.

MRS staff inform querying journalists of each scientist's qualifications, including whether he or she is chair of a university department, head of a research committee, a member of the National Academy of Sciences, the author of recent scientific publications, etc. Journalists usually express a greater interest in speaking with those scientists who have strong credentials.

How many calls do you receive a week?

As of early 1986, the MRS received an average of 50 calls a week.

JOURNALISTS CALL THE MRS ON:

Medicine & Health

May 2, 1985/11:05 a.m.

Journalist:
Wendy Greenfield
Staten Island Advance

Query:
Has a link between nutrition/ diet and cancer actually been established?

Referrals:
Dr. Michael Pariza
Dr. John Weisburger
Dr. Lawrence Garfinkel
Dr. Susma Palmer

From the News Story:

DIET AND CANCER:
FOOD FOR THOUGHT

What foods cause cancer, which ones help prevent it, and how strong a link exists between diet and cancer are currently questions of heated debate among the public, physicians, scientists, and dietitians....

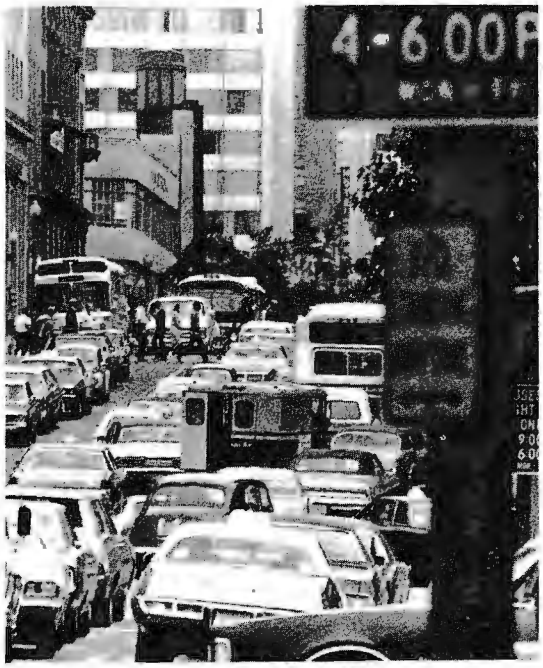
Michael W. Pariza, a 42-year-old Ph.D., professor and chairman of the University of Wisconsin's Department of Food Microbiology and Toxicology...said in a telephone interview, referring to how much of an influence diet has on cancer, "The issue is still unresolved ...I think that one can certainly conclude that there is a lot of evidence that diet and lifestyle play a role in whether you are going to get cancer. The problem comes in when you talk about specific dietary factors.

"For example, try to separate high-fat diets and problems associated with obesity. There is a very real question of whether a high-fat diet by itself is all that big of a factor in terms of cancer. People who want to reduce fat should do it. But certainly the studies to date haven't proved that that is going to reduce your risk of cancer."...

Dr. John H. Weisburger, a biochemist with an honorary M.D. degree, director of the Naylor Dana Institute for Disease Prevention in Valhalla, N.Y., disagrees with Pariza, advocating a low-fat, high-fiber diet.

Weisburger pointed out that studies have shown that the Japanese have a lower incidence of heart attacks, cancers of the colon, breast, and endometrium than do Americans. When studying what they eat, it was found that most of their fat intake comes from unsaturated oils from fish and vegetables, while in America, where there is heavy consumption of beef and dairy products, most of our fat intake comes from saturated oils, Weisburger explained.

Environmental Issues



March 4, 1985/1:55 p.m.

Journalist:
Debra Baer, KLON-FM
Longbeach, Calif.

Query:
Has anyone studied the health effects of leaded gasoline on people who live in heavy traffic areas?

Referrals:
Dr. Herbert Needleman
Robert Percival
Dr. Jerome Cole

From the News Story:

LEAD GAS RULING

Gasoline producers must make the first stage of reductions by July 1. The current allowable lead content level is 1.1 grams per gallon of gasoline. In July the level will go down to 0.5 grams per gallon, and by January of next year to 0.1....

Roberta Williams is the spokeswoman for Texaco Oil Refinery in Willington..."What the lead enables you to do is get a higher octane level, and when you remove the lead you have to do something to raise the octane —whether it's a different refinery process or, again, something like adding alcohol to up your octane level."

The EPA based its ruling on numerous studies on the effects of leaded gasoline on children. **Herbert Needleman** is the chief of psychiatry at Children's Hospital in Philadelphia and a leading researcher on lead poisoning. He says his studies, as well as those from Europe, have confirmed links between leaded gasoline and lead levels found in children.

"We showed that the decrease in lead in newborn babies is highly correlated with the decrease in sales of leaded gasoline in Massachusetts. The same thing has been shown by the Centers for Disease Control in young children — that lead has no known function in the human body. And the evidence is that at almost any dose, it's bad for you."

An EPA spokesman says the agency is still considering a ban on any lead in gasoline.

JOURNALISTS CALL THE MRS ON:

Child Health & Development

December 11, 1985/4:45 p.m.

Journalist:
Kathy Carlin
Kansas City Star

Query:
What are the benefits or drawbacks of Infant Stimulation, a series of techniques designed to arouse the senses of newborns?

Referrals:
Dr. Robert B. McCall
Dr. Lewis Lipsitt

From the News Story:

STIMULATING THE UNBORN, NEWBORN

Arthur and Teddy Samuel of Fairway are just two of hundreds of people in the metropolitan area who are being taught through a program called Infant Stimulation that their children are never too young to learn.

In addition to talking to the fetus, methods of stimulation recommended in the program range from selecting black-and-white toys and classical music for the newborn to rubbing him or her with lambskin blankets....

However, some critics say extra stimulation may not be necessary for a normal baby with loving parents.

"Most babies who are tended to, played with, get quite enough (stimulation)," said **Robert B. McCall,** a senior scientist and science writer at Father Flanagan's Boys' Town near Omaha, Neb.

"More stimulation probably doesn't hurt unless it's extreme or it's forced on the baby. You don't want to hang so much stuff above the crib that you have to take a machete to hack through it."

Others cite a need for long-term studies of some of the research used as the foundation for the program.

"I believe it's an open issue as to whether the program is effective over the long term," said **Lewis P. Lipsitt,** professor of psychology and medical science and director of the Child Study Center at Brown University.

"All of these infant stimulation programs need long-term study. So many allegations are made about the importance of certain types of stimulation and the non-importance of other types of stimulation that one can only come to the conclusion that we don't have enough data."

Milita & Na

January 1,

Journalist:
Robert Duc
U.S. News

Query:
What is th
the Soviet
on space-b
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need only

Referrals:
Stephen M
Dr. Ashton
Dr. David

Military Technology & National Security

January 1, 1985/3:00 p.m.

Journalist:
Robert Dudney
U.S. News & World Report

Query:
What is the current status of the Soviet Union's research on space-based weapons?
(On extremely tight deadline; need only one referral)

Referrals:
Stephen M. Meyer
Dr. Ashton Carter
Dr. David Holloway

From the News Story:

STAR WARS:
THE SOVIET THRUST

The United States is not alone in its controversial search for a system to defend against nuclear-missile attack.

What emerges from a close examination of Soviet military plans is evidence that the U.S.S.R. is pursuing its own version of President Reagan's so-called Star Wars scheme....

Myriad obstacles must be overcome before the Soviet's perfect a laser weapon that is both dependable and practical. When it comes to putting such a weapon into space, Moscow could run into problems achieving the desired economy of size and automation.

"The Soviets have always had great trouble with the reliability of their space systems," says **Stephen M. Meyer** of the Massachusetts Institute of Technology, a leading expert on Soviet defense programs. "They could—on a static, ground-testing basis—beat us to the punch with a laser. But it wouldn't be very good or very useful."...

Impressive as the Soviet program is, expert opinion is far from unanimous on the question of whether it surpasses—or even matches—America's capabilities. One area where the U.S.S.R. clearly lags is in technologies for spotting and tracking small objects in space....

Still, even those skeptical of Moscow's current Star Wars prospects have no doubt that the Soviet Union can eventually catch up with the advances made by the U.S. "If we have a race in space, it will take the Russians longer," says MIT's Meyer. "But they surely will get up there with us. It is all a function of time."

THE SCIENTISTS' INSTITUTE FOR PUBLIC INFORMATION

is a national, nonprofit organization working to improve public understanding of science and technology. Recognizing that most Americans get nearly all their information by turning on their TVs or radios, or opening the pages of a newspaper or magazine, SIPI seeks to bridge the gap between scientists and the media.

In addition to the MRS, SIPI has initiated a media outreach strategy designed to bring scientists and journalists together to discuss specific issues. These efforts include a series of roundtables held since 1983 on such topics as the use of animals in laboratory research, nuclear waste disposal, military technology and budget priorities, and AIDS.

In an effort to broaden this outreach, SIPI has developed similar programs with state and regional press associations, the Radio-Television News Directors Association, and the nation's journalism schools.

In 1985, a new series of media roundtables on issues in university research was launched under the co-sponsorship of SIPI, the American Association for the Advancement of Science and the Association of American Universities. Topics have included: National Security and Scientific Inquiry, Supercomputers and the Direction of American Science, and Human Gene Therapy.

SIPI's bimonthly publication, *SIPIscope*, serves as a forum for discussion of current issues in science policy, as well as a review of media coverage of science and technology. SIPI's other publications include a review of all MRS queries on chemical substances received from journalists over the past two years.

For more information on SIPI programs or to obtain copies of SIPI publications, call 212/661-9110 or write SIPI at 355 Lexington Avenue, New York, NY 10017.

SIPI is a nonprofit organization and contributions are tax-deductible.
Copies of SIPI's 1985 audited financial reports are available on request.

Media
Resource
Service

The Media Resource Service is a program of the
Scientists' Institute for Public Information
355 Lexington Avenue, New York, NY 10017
Toll-free: 800/223-1730 In New York State: 212/661-9110

The New York Times Magazine / AUGUST 24, 1986

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THE STAR WARS SPINOFF

The controversial defense system is yielding technologies that seem sure to change the world.

By Malcolm W. Browne

THE LANDSCAPED INDUSTRIAL park that flanks San Diego's Balboa Avenue hints of well-appointed board rooms, robotic assembly lines and healthy workers bronzed by weekends on the nearby beaches. The street is only a few minutes' drive from Sea World and other tourist magnets, and to the casual visitor it seems as far removed as an American suburb could be from any hint of war or weaponry. But the peaceful mien of the neighborhood is disturbed several times a week by the blast of a stunningly powerful cannon that sends flocks of startled birds into the air and sets off burglar alarms in parked cars over a wide area.

The source of the noise is one of the world's first rail guns, a new breed of electromagnetic artillery potentially capable of piercing the most heavily armored tanks, of picking off intercontinental missiles and battle satellites, and even of hurling projectiles to distant planets.

The rail gun, built by Maxwell Laboratories Inc., and named Checmate (an acronym for Compact High Energy Capacitor Module Advanced Technology Experiment), is about the size of a large merry-go-round and stands in a hangarlike building. One recent morning, flashing red lights and insistent loudspeakers warned nonessential personnel away while technicians sealed off the test building and retreated to the safety of a control shack. As the countdown progressed, pictures and computer data flowed across monitor screens, and workers readied the lasers, X-ray flash cameras and diagnostic sensors used for assessing each shot. The whine of high-power electrical equipment rose to a scream, a supervisor nodded to a controller, and the rail gun fired, sending a shudder through the factory compound, slapping clothing against the legs of passers-by and leaving ears ringing.

Hastily donning gas masks, technicians swarmed into the smoke-filled rail-gun building to look for equipment damage and check the target. Incredibly, a metal projectile scarcely larger than a household nail had been driven into a sandwich of thick steel plates to a depth of several inches. "Nice clean shot," someone observed. "We're moving right along."

In fact, experts say, American efforts to develop an electromagnetic rail-gun launcher — a gadget conceived by weapons makers as long ago as World War I — have achieved in the last two years alone what Defense Department planners had once predicted would take a decade. And credit for the project's impressive progress goes to what may be the most costly and intensive military research program in history: the Strategic Defense Initiative. Together with hundreds of other arcane, high-technology devices, ideas and systems, the rail gun has been selected for grooming and development as part of President Reagan's controversial vision of a defense shield capable of defending the United States against a Soviet ballistic-missile attack.

The merits of the President's plan — promptly dubbed "Star Wars" by advocates and opponents alike — have become a matter of intense worldwide debate. Supporters see it as a means of ending the threat of nuclear devastation. Opponents charge that the program is an exorbitant boondoggle whose stated objective is ruled out by the limitations of technology. Worse, these critics contend, Star Wars defenses might so upset the fragile balance of forces between East and West that war might become more rather than less likely.

Yet even as the debate has raged, Star Wars re-

Malcolm W. Browne is a science reporter for The Times.

CONT NEXT PAG

search has moved ahead quickly, consuming more than $3 billion in the last year alone, and giving unprecedented momentum to a broad range of advanced scientific programs.

The exotic new materials and technologies produced or encouraged by Star Wars research promises to have particular importance for conventional warfare, fostering changes in land combat as radical as those wrought by the introduction of gunpowder in the Middle Ages. But spinoffs from the President's initiative are also finding their way into a myriad of civilian fields, including energy production, transportation, communications and medicine. Meanwhile, science itself is gaining new research tools from S.D.I. projects.

Critics of S.D.I. point out that the technological side benefits of Star Wars research could be had much more cheaply and efficiently if they were pursued directly rather than as the unintended offshoots of an extravagant military spending program. But S.D.I. proponents assert that in the absence of such a visionary scheme, it is unlikely that such research would have taken place at all. Weapons research, they say, has been a key element in technological progress throughout history, and has nearly always produced byproducts of immense value to mankind. Costly though World War II was in human suffering and destruction, for example, wartime research bequeathed a cornucopia of consolation prizes to the survivors, including plastics, synthetic textiles, antibiotics, jet aircraft and nuclear energy.

How far the President's vision of a space-based strategic defense will ultimately be carried is an open question. Spurred by concern over Federal budget deficits, Congress has already voted significant cuts in S.D.I. funds, and even the program's strongest supporters concede that enormous technical obstacles still loom ahead.

Yet, even if a continental defense is never actually deployed, the long-term impact of S.D.I. research programs promises to be enormous. In laboratories from San Diego to Boston, Star Wars is no longer a mere phrase or debating point. For better or worse, the controversial Strategic Defense Initiative is already yielding new technologies that seem destined to change the world.

AIR FORCE LIEUT. GEN. JAMES A. ABRAhamson is no stranger to monster-size Federal projects. From 1976 to 1980, he ran the Air Force program that developed the F-16 fighter. Later, he took charge of space-shuttle development for the National Aeronautics and Space Administration, a post he held until 1984.

Now, as director of the Pentagon's Strategic Defense Initiative Organization (S.D.I.O.), the 53-year-old General Abrahamson is responsible for what may turn out to be the biggest Federal research project ever. He currently oversees the distribution of about $6 billion to some 1,300 Star Wars contractors in a program whose size rivals even that of the Manhattan Project, the secret World War II program that created the atomic bomb. (The Manhattan Project, from its inception to the destruction of Hiroshima and Nagasaki, cost $2 billion in 1945 dollars, equivalent to approximately $12 billion today. The current five-year S.D.I. program, which is intended merely to assess possibilities rather than to build a working weapons system, is expected to cost up to $20 billion.)

"When I got here," General Abrahamson said recently as he shared a sandwich with a visitor to his gadget-strewn Pentagon office, "I began looking for a common denominator in all the big technology programs that had been successful — a common factor applicable to S.D.I. But I couldn't find one. For instance, both the German and British jet-propulsion programs were highly successful, but they achieved success under totally different conditions.

"Finally, I came to realize that the common denominator was to be found not in the successful programs, but in the programs that had failed or come in second best. An example was the German atomic-bomb program of World War II, a program that was so highly structured and formal that it was unable to correct itself. By contrast, the Manhattan Project was dynamic, contentious, full of scientific give-and-take, and therefore capable of speedily correcting its own errors.

"I concluded that we needed the same rough-and-tumble intellectual approach — the American approach — to S.D.I. research. I decided that it was better to achieve 90 percent of a bold solution than 100 percent of a timid solution."

The resources now dedicated to finding that "bold solution" represent an enormous national commitment. During the last year, American taxpayers have paid some $3.05 billion for S.D.I. research — nearly $13 for every man, woman and child in the country — and the administration has requested $5.3 billion more in Star Wars money for the coming year. Even if Congress succeeds in cutting this sum — both the House and Senate have voted substantial reductions — S.D.I. will still remain an important component of the national budget.

Star Wars research, moreover, gets contributions from many sources besides formal S.D.I. appropriations. The Strategic Defense Initiative Organization is less than three years old, and virtually all the projects now under its aegis began with other government agencies and organizations. Overlapping research objectives and financing persist, and much of the technology developed by the Defense Advanced Research Projects Agency, the Defense Nuclear Agency and other organizations indirectly furthers Star Wars objectives. An insider acknowledged that "Star Wars money has a way of losing its color after passing through many hands."

When the S.D.I.O. needs something to be invented or built, it pays handsomely and apportions the task to many hands. Predictably, the largest S.D.I. contracts have gone to the giants of the aerospace industry. Heading the 1986 list is the Boeing Company, with contracts totaling $131 million. Other top S.D.I. contractors include TRW Inc., $61 million; Hughes Aircraft Company, $40 million; Lockheed Missiles and Space Company, $25 million; Rockwell International Corporation, $24 million; and the Raytheon Company, $17 million. But Star Wars funds are also earmarked for a wide range of small businesses, government laboratories and agencies (including the Central Intelligence Agency), and academic institutions.

The economic impact of S.D.I. money is ubiquitous and potent. A Stamford, Conn., market research concern, Business Communications Company, has estimated that the commercialization of Star Wars technology will eventually yield private-sector sales ranging between $5 trillion and $20 trillion. The financial inducement for a company to participate in S.D.I. research is so great, in fact, that the S.D.I.O. receives 10 times as many proposals as it can pay for.

Private entrepreneurs can exploit a wide range of inventions and discoveries that grow out of government-sponsored research, and Star Wars technologies are no exception. But the commercial licensing of government processes or inventions is a complex system that sometimes imposes burdensome practical problems. A government agency may be unwilling to grant exclusive long-term rights to the use of an invention or process, for instance, thereby depriving prospective commercial licensees of a competitive edge.

The secrecy of such sensitive military projects also poses a potential problem for the transfer of technology from S.D.I. research to the private sector, but General Abrahamson minimizes its long-term importance: "Of course there are technologies in S.D.I. that are vital to our national interests and are classified top secret. However, you'd be amazed how much of our work is nonclassified or only moderately classified. Our secrecy classification system, like the proposed missile defense itself, is organized in layers, and our policy is to permit the maximum freedom of communication consistent with the national interest. That policy shouldn't pose a real problem for anyone."

"I am determined," General Abrahamson said, "that we not miss the opportunity to capitalize on the results of S.D.I. research and apply it across all facets of our economy and society."

THE COMBINATION OF A thick wallet and a gambler's quest for dramatic gains has already led S.D.I. researchers to discoveries with important implications for fields largely unrelated to strategic defense.

Perhaps the most significant of these areas is conventional warfare, where rail guns and other new "hypervelocity weapons" promise to transform the kind of continental-scale armored combat for which the Soviet and American armies have been girding themselves since World War II.

Both the Pentagon and the Kremlin believe that in future land wars, tanks and armored personnel carriers will decide the outcome of battles. Consequently, both sides press their munitions makers to design ever more lethal projectiles, and sturdier forms of armor to stop the enemy's shells, bullets and rockets.

To defeat the next generation of tough-skinned Soviet tanks, Army planners believe, an entirely new class of weapons might be needed: weapons as superior to today's powder-burning guns

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and rockets as the 15th-century harquebus was to even the best crossbow of the day. And thanks to the Strategic Defense Initiative, the electromagnetic rail gun may provide American armored vehicles with just such a weapon.

In contrast to traditional rockets and shells, which are propelled by expanding gases, the acceleration achieved by a rail gun is not limited by the speed of sound; given enough energy, a rail gun can accelerate objects to speeds comparable to those of meteors. In principle, a rail gun standing on the ground could bombard targets on the moon. A rail-gun projectile might even be made to hit a target hard enough to initiate nuclear fusion — a fact noted by scientists seeking to develop fusion energy as an alternative to the fission process that is used to generate electricity in today's nuclear power plants.

Many government organizations have explored the possibilities of the rail gun. But both financing and research coordination were lacking until the Strategic Defense Initiative Organization stepped in.

Among the technologists responsible was Jon Farber, a division chief with the Defense Nuclear Agency in Alexandria, Va. Mr. Farber has devoted much of his career to the building of machines that mimic the destructive pulses of electromagnetic energy emitted by nuclear explosions. Like many kinds of Star Wars weaponry, these testing machines require gigantic pulses of power.

"I realized," Mr. Farber recalled, "that the greatest possibility for quick progress toward an anti-missile weapon lay in the rail gun, and I predicted that by working on rail guns we could accelerate all our S.D.I. programs, reducing development times by six to eight years."

Essentially, a rail gun is an electric motor, in which two metal rails running the length of the gun barrel are the main stationary elements and the projectile itself is the moving part. When a massive electric current is made to flow between the rails via an armature at the back of the projectile, the flow generates an electromagnetic force that drives the projectile forward.

One of the main problems with such a weapon is providing it with a suitable supply of electric power. Not only must the source yield a gigantic pulse of power for each shot, but it must recharge fast enough to maintain a reasonable rate of fire.

Ignoring bureaucratic boundaries, Mr. Farber broached his ideas directly to the S.D.I.O.. "To establish my bona fides, I offered to lend them a power supply of the kind we use in our simulated nuclear explosions," he said. "They agreed, and starting in March last year, the S.D.I. people agreed to share costs with us in the building of a capacitor-powered rail gun. Only nine months later we were able to fire the first demonstration shot. We blasted a little plastic cube right through a thick metal plate, and the resulting hole was impressive enough to convince even stubborn skeptics."

Since then, researchers have devoted their efforts to reducing the size of the containers needed to contain the electric power for the rail gun. Within a few years, Mr. Farber predicts, high-power capacitors charged by generators of various kinds will be small enough to fit not only into orbiting space stations, but inside tanks and other fighting vehicles.

"At present we are substantially outnumbered and outgunned by Soviet tanks, whose big guns can open fire before ours come into range," Mr. Farber said. "Rail guns could reverse that situation and change the balance of land forces in our favor."

ANOTHER KEY AREA of Star Wars development is the interface between computer science and applied physics, in which researchers are confronting the need to process extraordinary amounts of information in the shortest possible time. Future large-scale conflicts, whether in space, in the atmosphere, on the ground or at sea, are expected to unfold too quickly for even the most efficient consortium of human minds to control without massive computer assistance. A reliable, lightning-fast system for planning battles is therefore regarded as vital both to a defense against ballistic missiles and to the conduct of war on the earth's surface.

Part of the challenge lies in the realm of applied physics. Physicists are following several routes toward speeding up the microscopic switches that operate logic gates — the components of semiconducting chips that enable computers to calculate. The opening or closing of a switch determines whether its gate is to register a zero or a one — the binary numbers used for all computations.

Contractors working for S.D.I. or related defense technology projects are working on an entirely new type of computer switch: one that operates optically rather than electronically. An optical switch would be used to transmit or block a beam of light rather than an electric current, and thus benefit from the enormous speed at which light travels. The switch itself could be actuated by light signals; matching pulses of light applied to opposite sides of the switch would open it, and mismatching pulses would close it.

A remarkable new material being developed for both optical and electronic computer switching is a synthetic crystal, gallium arsenide, and substantial S.D.I. funds have been appropriated for pushing its development. Gallium arsenide transmits electrons several times faster than does the silicon used in conventional chips, and can also function as an optical switch.

Another potential optical switch that has attracted official interest is a plastic called polydiacetylene, under development at General Telephone and Electronics Laboratories Inc., of Waltham, Mass. According to Dr. Mrinal Thakur, a senior member of G.T.E.'s. technical staff, an optical switch based on polydiacetylene could handle up to one trillion operations per second; a conventional silicon switch can manage only about one-thousandth as many in the same time. Optical switches, moreover, would be highly resistant to electronic pulses from nuclear explosions that would disable ordinary chips.

Computer experts working on projects related to S.D.I. are also streamlining problem-solving hardware and procedures. One of their approaches is to break up a complex problem into many small elements that can be solved simultaneously and then be rapidly reassembled to yield the required result. This technique of "parallel processing" is a feature of such advanced machines as the Warp, a new supercomputer developed at Carnegie Mellon University, and the Connection Machine, a product of Thinking Machines Inc. According to the Defense Advanced Research Projects Agency, which paid for its development, the latter machine recently took only three minutes to complete a computation over which a powerful International Business Machines Corporation mainframe computer had had to labor for six hours.

The computers and programs S.D.I. is helping to bring into being are powerful tools whose civilian counterparts will have incalculable scientific value, experts say. These machines might be used for long-term weather forecasting, for example, and for creating reliable mathematical models of the atmosphere and the oceans. Environmentalists regard such models as essential in making accurate estimates of the effects of human activities on climate.

Several strategic defense projects seek to use the computer as an adjunct to the human brain, and the outcome of this work in such "expert systems" is applicable to conventional battlefields and civilian needs as well. Two of the latest Defense Advanced Research Projects Agency's computer projects for the Navy not only organize and assess mountains of information but also make recommendations to fleet commanders for solving specific tactical and strategic problems. The machine intelligence behind such recommendations is compounded by its designers from the knowledge of many human experts, and the computer program is capable of adding to its knowledge from its own problem-solving experiences.

Similar programs, many of which are independent of S.D.I. but have benefited from its discoveries, have begun to help physicians diagnose patients and to assist plant managers in spotting problems in production, inventories and quality control.

Computer pattern recognition is another field of great interest to S.D.I. and other defense agencies. A computer capable of recognizing and interpreting patterns can guide a missile equipped with a television eye, singling out the pattern of a target from a background of clutter.

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Missiles are not the only beneficiaries of this work. Related computing ability is at the heart of the advanced research agency's Autonomous Land Vehicle, an eight-wheeled driverless truck from which it is hoped a robot fighting vehicle will evolve. Although their capabilities are still quite limited, such robots may foreshadow not only the advent of mechanical soldiers but of surrogate servants, laborers and bodyguards — the creatures of science fiction.

IN MANY AREAS, S.D.I. funds have played an important role not in fostering new projects, but rescuing or reviving old ones. One significant example has been the Nova laser, completed last year at Lawrence Livermore National Laboratory in Livermore, Calif., at a cost of $187 million and 8 years' construction time. The world's most powerful laser, Nova is yielding experimental data that may contribute both to a beam defense against missiles and to the generation of electric power by hydrogen fusion.

Nova, which fills one of the largest buildings in Livermore's sprawling laboratory compound, was financed by the Department of Energy as a fusion power experiment. The object was to concentrate the combined beams of Nova's many lasers on a pinhead-size target, the implosion of which would initiate fusion in the target's hydrogen core.

But during the last three years, as financing for many fusion experiments has dwindled almost to the vanishing point, defense scientists began using Nova for another purpose: the production and testing of very short-wavelength beams, including X-ray lasers — a type of laser that many experts believe would be peculiarly effective against missiles.

That Nova is being kept active, for whatever purpose, is a source of satisfaction to fusion power advocates. "The present oil glut will be short-lived, and when the crunch comes the energy shortage is likely to be devastating," an engineer at the Electric Power Research Institute said. "Fusion may be our salvation, and Nova may be the route to fusion. If Star Wars keeps Nova alive, it's all to the good."

Besides lasers, beams of charged and neutral particles are under study as possible directed-energy weapons, and these, too, are expected to find civilian applications. The Department of Energy has sponsored experiments using electron beams for sterilizing food and for removing pollutants from industrial smokestack emissions, for instance. Electron beams developed for killing enemy missiles may also serve mankind by fighting cancer.

"The S.D.I.O. is very interested in a potential weapon called the free-electron laser," said Dr. James A. Ionson, a 36-year-old astrophysicist who is in charge of selecting many S.D.I.O. research projects. "And the work that has gone into it shows considerable promise for cancer therapy."

By manipulating a beam of electrons produced by a charged-particle accelerator, researchers have found they are able to "tune" the wavelength, or color, of the resulting beam. Such tuning helps scientists create beams with the short wavelengths deemed effective against missiles, and may also provide the key to a potential new cancer therapy, Dr. Ionson said.

"Electron beams can penetrate tissue to any desired depth, and the depth is determined by the energy of the beam," he said. "An electron beam has very little effect on the tissue through which it merely passes. But when it reaches its penetration depth, it releases most of its energy at that spot. Consequently, a precisely tuned electron beam could be used to hit a malignant tumor with pinpoint accuracy without damaging the surrounding tissue. The technique might be especially valuable in brain surgery."

MANY INDUSTRIES and government researchers are quite comfortable with Star Wars, but the S.D.I.O.'s relations with the nation's academic community is ambiguous. Educators have raised moral and political as well as scientific objections to the attempt to build a missile defense, and many believe it cannot succeed, however much money is pumped into the effort.

Both the Union of Concerned Scientists and the Federation of American Scientists have denounced S.D.I., and some 6,500 scientists and scientific educators have signed petitions pledging not to accept S.D.I. funds.

Still, negative opinions about the strategic merits of the President's program can often be separated from attitudes regarding the broader benefits of S.D.I.-related research. According to a survey conducted last spring by Peter D. Hart Research Associates Inc., two thirds of 549 American physicists polled expressed doubts that S.D.I. could ever defend the entire population of the nation against ballistic missiles, and 62 percent declared themselves opposed to deploying a Star Wars defense.

But despite their general opposition to the development of actual S.D.I. weapons, many American physicists saw merit in the basic research involved; the Hart poll revealed that 77 percent of physicists supported basic Star Wars laboratory research and 21 percent opposed it.

To counter the anti-Star Wars lobbying of several professional organizations, scientists favoring S.D.I. research recently organized the Science and Engineering Committee for a Secure World. Among the group's members is Dr. Martin I. Hoffert, chairman of the department of applied sciences at New York University, who describes himself as a political liberal and an opponent of nuclear arms. "When I first heard of S.D.I., I had no real interest in it," he said. "But I was interested in almost any opportunity for ridding the world of nuclear weapons, and I came to believe that S.D.I. might give us a chance."

Some two dozen major educational institutions are now receiving S.D.I. funds, among them the University of California (Los Angeles and Berkeley), the Massachusetts Institute of Technology and Johns Hopkins University. Besides these, many colleges and universities are recipients of second-hand Star Wars money transmitted through various prime contractors.

Highly qualified physicists are sometimes drawn to Star Wars projects by an inducement at least as potent as remuneration: access to the laboratories, equipment and staffs that can take on research programs far beyond the financial reach of even the richest university.

The cumulative impact of such an influx of funds and assistance on the broader course of American science will, of course, be impossible to measure for many years. But scientists and technical experts both inside and outside the strategic defense program agree that the systems, materials and devices brought into being in the name of S.D.I. will leave a profound legacy. One defense physicist (who asked to remain unidentified) put it this way:

"Some say we've made Faustian deals with the Devil, and there's an element of truth in it, if you happen to look at national defense as the Devil, which I do not. I'm being paid to work in a lab that's more exciting than a toy store. I'm given all the fancy hardware I need for my work, which has to do with very short-wavelength lasers. Do you realize what magnificent scientific tools such lasers will one day give us? We could use them to make holographic movies of the interaction of molecules in living cells, catalyzing the whole field of cancer research. X-ray or gamma-ray lasers will help us understand the nature of life at its most basic level.

"Sure, we're working on weapons, and we hope they'll be very good weapons. But the biggest payoff for many of us is the thrill of personal scientific achievement — achievement that in many cases would be impossible without Star Wars tools." ■

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MAY 28 1986

THE WASHINGTON POST

gationist Loses ry to Clinton

e Reelection Battle

omination since leaving office in 967. At age 76, he said that, "win r lose," it would probably be his wan song.

Clinton, 39, has served three of he last four terms as governor, los- g in 1980 to White but winning a ematch two years later. White, 52, ought the GOP nomination again is year.

With 91 percent of precincts re- orted, Clinton had 273,251 votes 60 percent, Faubus had 152,698 tes or 34 percent, and W. Dean oldsby, 50, had 26,651 votes or 6 rcent. Goldsby, who resigned as rector of an antipoverty agency id questions about its use of fed- al funds, was the first black to ek the Democratic nomination.

On the Republican side, White, , had 13,418 votes or 63 percent; ntist Wayne Lanier had 4,355 tes or 20 percent; former lieu- ant governor Maurice (Footsie) itt, had 2,849 votes or 13 per- t, and businessman Bobby K. yes had 787 votes or 4 percent.

Arkansas' Alexander, 52, had en ridiculed by Republicans for frequent travels abroad at tax- payer expense, and Wood, 37, said Alexander was too liberal for the rural district. With 77 percent of precincts reported, Alexander had 57,197 votes or 51 percent and Wood had 53,915 votes or 49 percent.

In Kentucky, Andrews, 40, was endorsed by GOP leaders for the nomination to oppose the popular Ford, 61, who had no primary opposition in his bid for a third term.

With 99 percent of precincts reported, Andrews had 16,123 votes or 39 percent to 9,752 votes or 23 percent for Carl W. Brown, a former Jefferson County commissioner who pleaded guilty to a misdemeanor for giving a handgun to a felon and tried to quit the race. Two perennial candidates split the remaining votes.

In Idaho, Connie Hansen lost her bid to become the 35th woman to follow her husband into Congress. She battled four opponents for the 2nd district seat that Hansen lost by 170 votes to Democrat Richard H. Stallings in 1984. Stallings had no primary opposition.

With 39 percent of precincts reported, Idaho Falls broadcaster Mel Richardson led with 11,339 votes or 45 percent, Hansen had 3,803 votes or 15 percent, state Sen. Dane Watkins had 3,708 votes or 15 percent, former Jerome County prosecutor Dan Adamson had 3,683 votes or 15 percent, and state Rep. J.F. (Chad) Chadband had 2,470 votes or 10 percent.

Pentagon Counterattacks In Bid for SDI Funding Rise

By George C. Wilson
Washington Post Staff Writer

The Pentagon yesterday said it would be "a serious mistake" for Congress to follow the advice of the 46 senators who are demanding a big cut in President Reagan's request for the Strategic Defense Initiative (SDI), the "Star Wars" missile defense effort.

"The president has made it his highest priority," Defense Department spokesman Robert B. Sims said in launching the Pentagon's counterattack against the near majority of senators who last week called for no more than a 3 percent after-inflation increase for SDI over fiscal 1986.

Reagan is requesting a 77 percent fiscal 1987 increase, from $3 billion to $5.4 billion, counting money in the Energy Department budget for SDI.

Sims said Defense Secretary Caspar W. Weinberger will try to derail the effort to curb SDI research. The first test is likely to come next week when the Senate Armed Services Committee begins marking up the fiscal 1987 defense authorization bill, which will set a ceiling on how much can be appropriated.

The 46 senators expressed their objections to SDI in a letter to Armed Services Committee Chairman Barry Goldwater (R-Ariz.).

"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," they wrote.

Sims said the cuts Congress made in SDI last year "have narrowed the range of technologies that we can explore. Further cuts would seriously compound the problems and set back the prospects for an informed decision in the early 1990s" on whether the research on the missile defense justified moving into full-scale development, he added.

The Pentagon, in trying to fend off deep cuts in SDI this year, faces an unusually broad coalition that has agreed to make scaling back SDI its main legislative objective in the defense field this year.

The alliance includes citizens' organizations like Common Cause, scientific groups and one-issue efforts like the National Campaign to Save the ABM Treaty.

Senators who signed the letter demanding the curbing of the Strategic Defense Initiative said their proposal appealed to both liberals and conservatives. Liberals who wanted no growth in the SDI budget went along with the 3 percent increase in the interest of scoring a victory against the Pentagon, while conservatives became convinced that slowing the missile defense effort would free money for conventional warfare accounts on the chopping block.

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COVER STORIES

Star Wars At the Crossroads

Amid arms control maneuvers and budget battles, SDI nears a moment of truth

At the moment, the Strategic Defense Initiative is a starry vision rather than an actual weapons program. It exists only in the mind's eye of Ronald Reagan and on the blinking computer screens and slide projectors of an array of purposeful scientists. Yet the President's concept of a space-based shield against nuclear weapons—the most radical plan put forward by any Administration since the dawn of the nuclear age—has become the single most powerful force affecting Soviet-American relations. It is also becoming the chief element in an intensifying showdown, within the Administration as well as at the bargaining table in Geneva, over the future of arms control.

Ever since Reagan propounded his Star Wars proposal in March of 1983 as part of a campaign to win support for his defense budget and arms-control policies, the fundamental goals and purpose of SDI have been cloaked in a protective shroud of ambiguity. Yet now, as Congress prepares to decide whether to provide increased funding, SDI is approaching a moment of truth, not because of any scientific breakthroughs or the lack of them, but because a series of changes in the turbulent political and diplomatic atmosphere makes it imperative to come to grips with what is the most important strategic issue of the decade: SDI's role in shaping the future nuclear balance.

Among the events that have raised the stakes for SDI is a barrage of assaults on the arms-control environment from which it emerged. Reagan has announced plans to jettison the limits on offensive weapons in the unratified 1979 SALT II agreement unless the Soviets are more forthcoming on new arms-control initiatives, and last week he awkwardly tried to explain what this posture really means. His Administration is split on how to apply the 1972 ABM treaty, which limits development of antimissile systems, but Pentagon hawks have gone a long way toward undermining any restraints the treaty might place on SDI. Both Congress and the NATO allies are trying to pull the U.S. back from an unconstrained arms race that they fear may be provoked by any tinkering with the status quo. And in the midst of this turmoil, the Soviets have tabled proposals in Geneva to cut their offensive arsenals in return for restraints on America's defensive initiatives.

At a conference in Washington on SDI sponsored by TIME on June 3, the discussions revealed that fundamental disagreements still exist about the nature of the program. Assistant Secretary of Defense Richard Perle and Chief SDI Scientist Gerold Yonas agreed that SDI should not initially be regarded as a way to protect the nation's population from nuclear attack, as Reagan has envisioned. The purpose, said Perle, is "the defense of America's capacity to retaliate." Paul Nitze, the Administration's senior arms-control adviser, disagreed. "Maybe it's [Perle's] view," he said, "but I can't see the rationale for it."

Discussing the ABM treaty, Lieut. General James Abrahamson, director of SDI, said that his program might confront "a problem in terms of the narrow interpretation of the treaty somewhere in 1989," two years earlier than previous Administration estimates. Perle declared that a new, looser interpretation of the ABM treaty, one that would permit the development of SDI technology, "is going to happen within the lifetime of this Administration." Although Nitze assented that the less restrictive interpretation was correct, he denied that it was Administration policy to apply it to SDI.

The latest Soviet offer in Geneva may force Reagan to resolve these disputes over the nature of SDI and its role in arms control. At a special session of the two delegations, Chief Soviet Negotiator Viktor Karpov presented proposals that made an explicit connection between reducing offensive weapons and limiting strategic defense programs. The plan amplifies an informal one the Soviets made last month that sought to set limits on America's SDI program through maintaining continued adherence to the ABM treaty. In making their offer, the Soviets have done precisely what U.S. officials have been wanting them to do for months: quietly present a serious plan that contains points of flexibility and possible concessions. "In the past few days," said Nitze at the TIME conference, "there have been a number of indications that the Soviets may be moving to a more flexible position than anything that they have exhibited during the long four rounds of negotiations."

One apparent concession is that in setting a numerical limit on each side's arsenal of strategic warheads, Moscow would no longer insist on counting America's "forward-based" nuclear weapons systems, such as those deployed on carrier-based warplanes and on planes and missiles based in Europe. However, instead of cutting the limit on strategic war-

PHOTOGRAPH FOR TIME BY MICHAEL EVANS


ROGER BESSMEYER

U.S. Arms Negotiator Max Kampleman greets his Soviet counterpart, Viktor Karpov, in Geneva; SDI Director Lieut. General James Abrahamson; laser research at Lawrence Livermore Labs in California

heads from the 3,600 they previously proposed, the Soviets now want to include all cruise missiles in the total and set the ceiling at 8,000. Since the U.S. is first and foremost interested in slashing the number of warheads deployed on big land-based missiles, which form the backbone of Moscow's threatening arsenal, this aspect of the Soviet plan is likely to present a problem.

At his press conference last week, the President was guarded about the Soviet moves. But he seemed to go out of his way to sound conciliatory. In answer to a question about a recent speech, Reagan said that he must have "goofed someplace" if it appeared that he had linked Mikhail Gorbachev with Fidel Castro, Yasser Arafat and Muammar Gaddafi. The President twice described Gorbachev as "the first Soviet leader to my knowledge that has ever voluntarily spoken of reducing and eliminating nuclear weapons." (Not quite: Moscow's long-standing position has been that it would someday like to see the elimination of all nuclear weapons.)

In his attempts to sound accommodating, Reagan further muddled the issue of whether he had in fact decided to abandon the SALT II treaty. The Administration is in the process of dismantling one missile-carrying submarine, thus keeping the U.S. within the pact's ceilings. But it asserted that it would breach the limits late this year, as more B-52 bombers were equipped with cruise missiles. It is possible, however, said Spokesman Larry Speakes, that another submarine might be decommissioned when the cruise missiles put the U.S. over the SALT II limit. Exactly what are you going to do on SALT? Reagan was asked at his press conference. "We've got several months before we reach that point," Reagan answered, adding that he was waiting to see what the Soviets did on arms control. He and his advisers spent the next day trying to clarify his less than explicit remarks. "The SALT treaty no longer exists," said Speakes brusquely. Said a Soviet spokesman at a news conference in Washington: "Actual abandonment and withdrawal from the treaty will affect the entire situation in a most seriously negative way."

Some in Congress who are eager to preserve SALT II point to assessments suggesting that abandoning the agreement could backfire on the U.S. According to a report prepared by the CIA for the Congressional Joint Economic Committee, the Soviets would be better suited to capitalize on the scrapping of SALT II because of two basic advantages: active production lines for manufacturing ICBMs, strategic bombers and submarine-launched missiles; and the greater throw weight of Soviet missiles, which would allow them to be loaded up with many more warheads. House Armed Services Chairman Les Aspin says the Soviet production-line superiority would permit Soviet strategic forces to grow 65% by 1989, compared with 45% for the U.S. The House Foreign Relations Committee passed a resolution last week urging the President to adhere to the limits, and legislation has been introduced in both the House and the Senate to block funding of any weapons that would exceed the terms of SALT II.

Congress is involved in an intense tug-of-war with the Administration over SDI funding. The Administration is asking for $4.8 billion in SDI research money for 1987, an increase of 72% over this year's budget. No way, says a bipartisan group of 48 Senators who have signed a letter asking for a $2 billion cut in money for SDI, arguing that funding should be kept to "approximately 3% real growth." Some legislators are reluctant to fund SDI because they see it as the death knell of SALT II, the ABM pact and arms control in general. Aspin predicts that Congress will freeze this year's $2.8 billion SDI budget. The members of the House Armed Services Committee, he says, rank SDI as a low priority. In the Senate, a subcommittee working on the SDI funding proposal cut $800 million from the Administration request last Friday, with conservative Republican Orrin Hatch joining those seeking more substantial slashes.

In order to preserve funding for SDI, the Administration will have to determine more precisely what role Star Wars will play in the strategic balance. Is it an umbrella against Armageddon, an expensive set of exotic gadgetry to protect missile silos or merely a Buck Rogers fantasy? Could it be the ultimate bargaining chip to exchange for deep reductions in threatening missiles or the catalyst for an arms race beyond the fears of reason? Long before the scientists begin to perfect SDI's technologies, policymakers must grapple with these questions. The answers are essential to the future of arms control, a stable nuclear balance and a secure foundation for Soviet-American relations. —*By Richard Stengel. Reported by Johanna McGeary and Barrett Seaman/Washington*

DENNIS BRACK—BLACK STAR

DIANA WALKER

WALKER

WALKER

Nitze, above, hinted at the intriguing possibility of an offense-defense swap. SDI skeptics Drell, Slocombe and Ruina, clockwise at right, warned against setting off an offense-defense spiral. Perle, far right, asserted that even a partly effective shield could enhance stability.

Strategic Questions

Will SDI bring greater nuclear stability—or less?

To Ronald Reagan, the mutual suicide pact that has precariously preserved the nuclear peace for the past quarter-century is unacceptable, indeed immoral. Why not, he asked in his famous Star Wars speech, switch from a policy of mutual assured destruction (MAD) to one of mutual assured survival by creating a defensive shield that would "render nuclear weapons obsolete"? Although that dream might seem unassailable, the strategic realities involved raise a far more unsettling question: Will the attempt to create a nuclear shield enhance stability or undermine it? In attempting to rid the planet of doomsday weapons, might SDI merely increase the risk of their use?

At the TIME conference on SDI, it was apparent that there was a deep division within the Administration over the real aim of SDI. While he applauded Reagan's "vision," Assistant Secretary of Defense Richard Perle bluntly stated that a leak-proof Astrodome against missiles "is not a short-term proposition, and it may not even be possible in the long term." Gerold Yonas, the chief scientist for SDI, was equally emphatic. "The idea that we are going to protect all the people somehow with a perfect defense" is the "wrong approach." Instead, he argued, the goal is to make the Kremlin unsure that it could launch a strike that would knock out America's capacity to retaliate. The immediate goal of SDI, Perle agreed, is "not the defense of the nation as a whole, not of every city and person in it, but the defense of America's capacity to retaliate." Thus he saw a more realistic mission for a space-based defense system: guarding "our critical defense installations, ballistic missiles, command and control facilities." He added that "a 50% effective defense could make a significant and I think vital stabilizing contribution." Later at the conference, when Arms-Control Adviser Paul Nitze was informed of Perle's statements, he expressed surprise. "I know for a fact," said Nitze, "that it is contrary to the White House view of the matter. Maybe it's his view, but I can't understand the rationale for it."

The rationale, according to those who advocate a system to protect silos, is that they are now vulnerable to a pre-emptive attack by the Soviets' vast arsenal of fast, accurate warheads. At the conference, Walter Slocombe, who during the Carter Administration held a Pentagon post comparable to the one now occupied by Perle, agreed that "in principle" defending silos is "not a bad idea." But, he argued, there are cheaper and more reliable ways to defend the U.S. capability to retaliate. Among those suggested at the conference: hardening missile silos and developing a system of mobile missiles that would be less vulnerable to attack. If protecting silos is the real aim of SDI, asked Stanford Physicist Sidney Drell, why has the Administration dropped all funding for the one defensive system now known to be an effective terminal defense: nuclear-tipped interceptor missiles? Though he personally does not favor an active missile defense, Drell questioned the logic of diverting money from available off-the-shelf technology and using it to chase Reagan's dream of a multilayered shield against all Soviet missiles.

Protecting specific targets, be they cities or silos, is not a new idea. Every President from Eisenhower to Nixon considered some kind of terminal defense, said M.I.T. Engineering Professor Jack Ruina, who began advising on nuclear strategy during the Eisenhower Administration. Yet each of those Presidents was ultimately bedeviled by a stark truth about nuclear weapons: it has always been cheaper to build offensive weapons than defenses to stop them. Earlier Presidents, asserted Ruina, realized that by building defenses, they would just invite the Soviets to build more and different types of offenses, thus igniting a destabilizing new round in the arms race.

Even if the presidential dream of a perfect defense against Soviet ICBMs could be erected, it would not stop the Soviets from using other offensive weapons, such as bombers and low-flying cruise missiles. Yonas acknowledged that defending against cruise missiles is "really not part of SDI." To stop a bomber or cruise-missile attack would require an extremely costly air-defense system. Even then, an enemy could no doubt find ways to transport a devastating nuclear bomb to the U.S.

While acknowledging the risk of an

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intensified offense-defense spiral, Perle speculated that the Soviets might not even try to overwhelm a partly effective shield against ballistic missiles. "It just may be," he said, "that the development of a defense would discourage the Soviets from making the very sizable investments necessary to overcome that defense." This was a curiously optimistic view from a hard-liner who in the past has always assumed the worst about Soviet intentions. Nitze, on the other hand, argued that the U.S. cannot afford to hope that the Soviets will in effect say "uncle."

Nitze stressed, as he has on earlier occasions, that the U.S. should not deploy SDI unless it is "survivable." It cannot be so vulnerable that the Soviets would be tempted to shoot it down. And it must be "cost-effective at the margin." This means that once SDI is deployed, it must not be cheaper for the Soviets to add new offensive weapons than it is for the U.S. to add new defenses to stop them. This standard has met some resistance from the chief of the SDI program, Air Force Lieut. General James Abrahamson. In testimony before Congress two months ago, Abrahamson argued that SDI should be "affordable," a more elastic definition. Nitze, a shrewd bureaucratic infighter, persuaded the President to sign a national security decision directive making his criterion official policy.

Asked at the TIME conference whether he was trying to skirt Nitze's standard, Abrahamson demurred. He conceded that he might have "erred" by using the word "affordable," but he seemed to fudge by insisting that the question was not merely economic. "You also have to consider the military situation and what the danger is that the nation faces." Defense Secretary Caspar Weinberger, in an interview with TIME last week, was more explicit in challenging Nitze's standard. "I think the technical definition of cost-effectiveness, somebody trying to define what the margin means, is not very useful," he declared. "We can afford to do what we have to do. My own feeling is that we should do SDI if it is in any way technically feasible."

Star Wars has become so controversial in the academic community that hundreds of scientists have signed petitions saying they refuse to work on the program. This rather short-sighted view was not shared even by the critics of SDI at the TIME conference. They agreed that research should continue, both to match Soviet efforts and to preserve the remote possibility that someone someday might discover a technology that diminishes the inherent advantage of offense.

Building effective nuclear defenses, the conferees acknowledged, is as much a political challenge as it is a technological one. The shift from "offense-dominated" deterrence to "defense-dominated" deterrence, in the argot of the experts, must be accompanied by arms control. "The path to a safer world," argued Drell, "is going to be paved largely by the negotiating process, not by another laser."

For more than a decade, a rickety arms-control structure has attempted to keep a lid on the offense-defense spiral. The ABM agreement in the 1972 SALT I talks curtailed missile defenses, while an interim treaty that year and the SALT II talks of 1979 limited offensive weapons. In the view of Administration hawks, however, arms control has been a failure. Because they felt they could not compete with the U.S. in building missile defenses, Perle said, the Soviets agreed to the ABM treaty and "cleverly negotiated a halt on our side while intensifying their own effort." The Soviets have now "reversed the relative capacity of the two countries to deploy a defense," he charged.

Defense Department hard-liners led by Weinberger and Perle are pressing to scuttle the existing arms-control framework by abandoning SALT II and adopting a revisionist interpretation of the ABM treaty. In its Article V, the ABM pact forbids development, testing and deployment of any new ABM system—land-based, sea-based or space-based. But Perle has focused on another provision of the treaty, the so-called Agreed Statement D, which declares that defenses based on "other physical principles" undreamed of by the 1972 negotiators would be "subject to discussion." The negotiating record, according to Perle, shows that the Soviets repeatedly asked, "How can you ban phenomena you haven't discovered yet?" The ABM treaty, he thus argues, is no impediment to forging ahead with Star Wars.

Nitze, who helped negotiate the 1972 ABM treaty, said he believes this expanded interpretation of the ABM agreement is "correct." Nevertheless, he reaffirmed that the Administration's policy is to stick to the hitherto accepted interpretation of the ABM treaty, which would restrict Star Wars development. Of Perle's statement earlier in the day that the U.S. would adopt the looser ABM interpretation during "the lifetime of this Administration" in order to proceed with testing SDI, Nitze responded, "I think there is no doubt but that that is the view of Mr. Weinberger and Mr. Perle, but it is certainly not my view, and I do not believe it to have been so decided by the President."

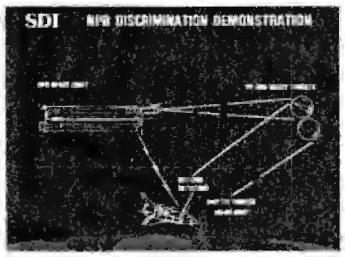
Nitze, who decried the Soviets' superiority in heavy land-based missiles as "a road to disaster," did insist that the U.S. "cannot accept" the Soviets' demand that the U.S. halt "substantive" work on SDI. Yet he hinted that SDI could be an important chip to use in a bargain that would trade limits on offensive weapons for limits on defensive ones. His language in his speech to the conference was carefully hedged, but its implications were intriguing. "Were the Soviets to work with us in a meaningful exploration of significant reductions" in offensive weapons, he stated, "we could examine how the level of defense would logically be affected by the nature and level of offensive arms."

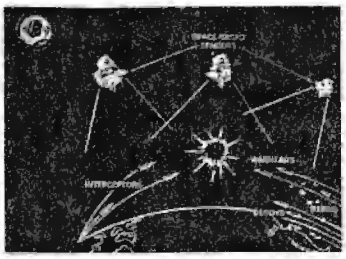
"I'd be interested myself in talking to them about that kind of trade," Nitze stated at a question-and-answer session. Asked if the President would share his interest, Nitze answered, "I honestly believe that the President is in fact very much interested in working out a deal" if it was "consistent with the security interests of the U.S." and part of a "general move toward a stable relationship between the two sides." What the President does not want, said Nitze, "is a bad agreement with the U.S.S.R."

Persuading both the Soviets and Reagan to make the concessions that would be necessary to strike such a grand compromise will be difficult. Just as difficult, perhaps, as developing the technology required to make Star Wars a reality. On this essential point, Drell gave Albert Einstein the last word: "Politics is much harder than physics." —*By Evan Thomas. Reported by Bruce van Voorst/Washington*

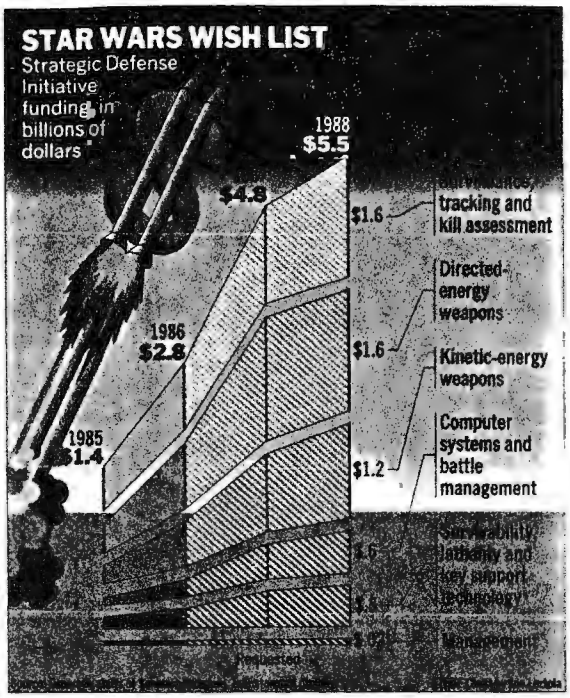
The Principal Speakers At TIME's SDI Conference:

LIEUT. GENERAL JAMES ABRAHAMSON, *director, SDI Organization*
ASHTON CARTER, *associate professor of public policy, Kennedy School of Government, Harvard; editor, International Security*
SIDNEY DRELL, *deputy director, Stanford Linear Accelerator Center*
STEPHEN MEYER, *associate professor of political science, M.I.T.; consultant, Defense Advanced Research Projects Agency*
PAUL NITZE, *Special Adviser to the President and the Secretary of State on arms control*
RICHARD PERLE, *Assistant Secretary of Defense for International Security Policy*
JACK RUINA, *professor of electrical engineering, M.I.T.; former director of the Advanced Research Projects Agency*
WALTER SLOCOMBE, *former Defense Department official and director of the SALT Task Force during the Carter Administration*
GEROLD YONAS, *chief scientist, SDI Organization*





SDI slide show: clockwise from top left, a space-based laser station; a giant mirror reflecting a laser beam from earth to its target; a battle-management scenario; a particle-beam system for detecting warheads



Scientific Hurdles

From sensors to software, the needs are daunting

An all-out Soviet nuclear attack on the U.S. could entail an intercontinental blitzkrieg: thousands of missiles launched from enemy territory, letting loose tens of thousands of deadly warheads surrounded by a nebula of hurtling decoys and debris. In half an hour, this lethal "threat cloud" would be over the U.S., raining destruction on cities and military targets alike.

Trying to stop this deluge would require enormous technological breakthroughs in at least four areas: sensors, lasers, particle beams and computer programming. Should such advances occur, SDI proponents argue, a reasonably effective Star Wars defense would reduce to virtually zero the number of Soviet intercontinental ballistic missiles (ICBMs) getting through outer space to their targets. But critics respond that virtually zero is not enough when nuclear weapons are involved. Moreover, the Soviets have other ways to deliver a bomb—from offshore submarines or cruise missiles, for example, neither of which could be intercepted by proposed SDI technology.

SDI planners see their defense as a multilayered "architecture" that could blunt a Soviet attack during the three distinct stages of delivery: the missile's boost, or launch, phase; midcourse, essentially the intercontinental space flight after the nuclear warheads and decoys have been released; and terminal, or re-entry, when the deadly warheads drop back into earth's atmosphere heading toward their targets. The most important of these is the boost phase, during which an ICBM's multiple warheads are still onboard and can be knocked out with a single shot. Hitting a missile in boost, says Stanford Physicist Sidney Drell, "is like tackling the quarterback before he can throw the ball." SDI Director Air Force Lieut. General James Abrahamson told the TIME conference it represents the "big payoff" of Star Wars.

Boost phase provides certain other opportunities for the defender. As missiles rocket through the atmosphere, their thrusters emit a hot, bright tail of fire, making them an excellent target for heat-seeking infrared sensors. SDI researchers hope to develop small, inexpensive but highly accurate self-guided missiles known as "smart rocks," which could home in on a rapidly moving missile or warhead and destroy it by force of impact.

But if boost-phase kill is attractive, it is not easily achieved. Because infrared sensors cannot "see" around the curve of the earth, they must be in an orbit high enough to spy into Soviet territory. Some would even have to be fixed in geosynchronous orbit, 22,300 miles up. Smart rocks would also have to be launched from space in order to hit a missile during boost. One plan would fire the rockets from "gun pods" in low orbit so they could speed to the vicinity of a rising Soviet missile. But Ashton Carter of Harvard, an SDI skeptic, points out that such sensors and gun pods would be vulnerable: "Hovering a couple of hundred kilometers over enemy territory is a very uncomfortable place to operate." In fact, the entire SDI apparatus for boost-phase sensing and shoot-down would have to be predeployed in space and would therefore be extremely susceptible to a pre-emptive enemy attack. "It is easier to destroy the space-based components of a strategic defense system," says former Secretary of Defense Harold Brown, "than it is to destroy the ballistic missiles."

Nor would defenders have much time to identify and hit a missile during this initial stage. Today the Soviet ICBM boost phase lasts up to five minutes. "Fast-burn booster" technology now in development may cut that time to as little as 50 seconds—a "short fighting window."

Missiles that escape the boost phase and enter midcourse flight present an overwhelming problem. By that time they have released their re-entry vehicles (warheads aimed at U.S. targets), as well as thousands of decoys and reflective metal scraps known as chaff, forming a threat cloud of up to 1 million objects. The challenge for a defense during this 20-minute midcourse flight is to pick the RVs out of this debris and disable them.

Infrared sensors are ineffective at this stage, so recent research has concentrated on an interactive sensor, a stream of highly accelerated uncharged atomic particles that would penetrate an object and

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SDI's Chief Scientist Gerold Yonas, above, and one of his critics, Harvard public policy professor Ashton Carter

"see" what is inside. When these neutral particle beams hit a massive object like a warhead, gamma rays are emitted. Decoys, which have very little mass, give off virtually no emissions. "When you get a signal," said SDI's Chief Scientist Gerold Yonas, "it's the warhead. When you don't, it's a decoy." At present the paraphernalia needed to produce these beams is so large that it would be impossible to put in orbit as a fighting machine.

Once the real warheads have been identified, they could be targeted for kill by laser weapons, intense beams of light that could destroy a Soviet missile or warhead by burning through its skin or, in a pulsating version, by hitting it with a sledgehammer-type blow. SDI scientists have been exploring the merits of deploying several types of laser weapons in space. Chemical lasers, generated by the reaction of gases such as hydrogen and fluorine, are now considered too unwieldy for space deployment. When they are ground based, their long-wavelength beam would be too ineffective to penetrate the atmosphere and make a missile kill. Today the hottest option is the free-electron laser, generated by the action of electromagnetic fields on electrons. Although it might also be too big to lift into orbit, this laser has a shorter wavelength, which gives it the potential to penetrate the atmosphere from the ground. Whatever ground-based laser weapons are chosen, their beams would have to be bounced off high-tech mirrors that would retarget them from space.

Warheads that survive the boost and midcourse onslaughts hurtle toward earth in a "terminal" phase, the last 125 miles and the final two minutes of their mission. Back in the atmosphere, space-related problems no longer deter the defender. An RV can be detected by standard imaging radar and shot down, preferably with smart rocks. But little time remains once the RVs are spotted, which means a defense runs the risk of being overwhelmed. In addition, the Soviets could blind radar with nuclear bursts in the sky and skew targeting by outfitting their RVs with stubby wings that would allow them to maneuver and escape the defensive rockets. Like fast-burn missiles in boost phase and decoys in midcourse, stubby wings are just one of the available conventional methods the Soviets might use to counter complicated Star Wars technologies.

Whatever obstacles SDI must overcome in developing sensors and weapons are dwarfed by the difficulty of coordinating these elements into an overall defense. Says SDI Critic John Pike of the Federation of American Scientists: "The issue is not whether some individual SDI elements work, but whether it would work at the systems level." For SDI to be effective, battle-management computers must coordinate sensing devices, track myriad Soviet warheads throughout their flight, aim the U.S. weapons, assess the success of a hit and then retarget.

In addition, the space-based portion of the SDI system, including the lethal smart rocks and beam weapons, would be orbiting the earth. All battle-management information, including detection and tracking of Soviet ICBMs, would have to be relayed from one satellite complex to the next, as parts of the entire affair moved alternately in and out of range of the U.S.S.R.'s threatening zone. The computer software needed to direct such a defense is vastly more complicated than any yet operating: Yonas estimates that up to 50 million lines of information code would be necessary. The space shuttle's operating software consists of only about 500,000 lines, and still computer glitches have resulted in frequent launch delays.

Yet because the stakes are so immeasurably high, the SDI system would have to work perfectly the first time out. Yonas concedes that "there is no way we could go into battle without a system that has been highly tested." But there is no way to test the system under real battlefield conditions. Final testing will be done in simulations by the "national test bed," a supremely sophisticated computer-video model of a nuclear battle incorporating SDI components. The people who program the test bed must try to anticipate every countermeasure the Soviets might conceive. Said Stanford's Drell: "You can't say to the Russians, 'Hold your attack. I'm not quite ready.' "

SDI advocates cite promising advances in complex technologies. But few scientific experts find it possible to put faith in the ability of such a system to operate in a nuclear showdown. At the TIME conference, Drell quoted a pertinent scene from Shakespeare's *Henry IV,* Part I: " 'I can call spirits from the vasty deep,' says Glendower. 'Why, so can I, or so can any man,' replies Hotspur. 'But will they come when you do call for them?' " Given the unique mission of SDI, and the stakes involved, that question is critical. ***—By Amy Wilentz. Reported by Michael Duffy and Bruce van Voorst/Washington***

How to Master Starspeak

When Star Wars enthusiasts speak of an engagement in the national test bed, they are not talking about what one might think, even when rubber mirrors and hardbodies are tossed in. The SDI program, making no effort to construct a multilayered shield for the English language, has launched a lot of new lingo. A sampler:

National Test Bed: A high-tech computer and video operation designed to simulate space-battle scenarios.

Hardbody: A targeted missile, often hidden from infrared detection by its huge plume of heat and gas.

Smart Rocks: Small kinetic-energy projectiles that can be hurled at missiles or warheads.

Pop-Up: The fast launch of a missile carrying a nuclear weapon to generate an X-ray laser that can shoot from space; because the system is not already in orbit, it is not vulnerable to a pre-emptive strike.

Rubber Mirror: A computerized mirror of thin glass on honeycomb panels; the panels are controlled by microchips and mechanical arms that enable them to compensate for the distorting effects of the earth's atmosphere on laser beams.

Interactive Discrimination: A system that transmits neutral particle beams to distinguish warheads, which emit gamma rays, from decoys, which do not.

Red Team: A group of scientists within SDI whose task it is to develop and analyze possible Soviet countermeasures to the program.

Space Mines: Orbiting explosives designed to threaten satellite defenses.

Precursor Bursts: Nuclear explosions in space designed to foil defensive systems by creating a background of nuclear emissions, magnetic pulses and heat that can fool sensors.

Grand Compromise

SDI could end the arms-control stalemate

President Reagan's Strategic Defense Initiative has had a stunningly paradoxical effect on arms control. The American effort to create a shield against enemy missiles has given the Soviets a fresh incentive to develop new offensive weapons that would burst the remaining bonds of the arms-control process, which has been in stalemate. Yet it has also given the Soviets an incentive to return to the bargaining table and offer serious proposals in the hope of tightening the bonds of arms control around SDI itself. If there is a summit in November or December, Reagan the Star Warrior might be able to extract from Mikhail Gorbachev an agreement-in-principle for a trade-off between existing Soviet offensive forces and the American SDI while it is still only a gleam in the President's eye. Since there are reasons to question whether SDI is scientifically feasible or strategically wise, restricting the program to research in exchange for significant reductions in the most threatening Soviet weapons could be the deal of the century.

Because of his awesome political strength, Reagan is in a unique position to cut that deal with the Kremlin and win the approval of Congress. But to do so, he will require not only the luck and acumen he has already demonstrated in such abundance but a clearer understanding than he has shown to date of both the risks and opportunities he faces as a result of SDI. He will also need a firmer ability to control the unruly, ideologically divided bureaucracy over which he presides.

Both the case against SDI and the considerable leverage it gives the U.S. in arms control stem from the peculiar nature of nuclear weapons. Because they are too powerful to use and too powerful to defend against, nuclear weapons are self-deterring. The two nations that possess such huge arsenals of last resort dare not go to war against each other. As Stanford Physicist Sidney Drell put it during the TIME conference, mutual assured destruction (MAD) "is not a policy but a condition." There is something almost poetic in the concept: for the first time in history, two major enemies have kept the peace by keeping themselves vulnerable.

Not that either is comfortable with that vulnerability. But previous attempts to seek defensive protection from nuclear delivery systems have merely spawned new types of such systems. In the 1950s and '60s, the superpowers threatened each other with bombers and defended themselves with antiaircraft installations. But air defenses only stimulated the development of intercontinental ballistic missiles. Then both sides developed anti-ballistic missiles, but they soon learned that these could be overwhelmed by missiles with multiple independently targetable re-entry vehicles, known as MIRVs. The way in which ABMs provoked MIRVs is the classic paradigm of an "offense-defense spiral." The resulting proliferation of MIRVs has been one of the most disruptive factors in both the preservation of strategic stability and the quest for arms control.

Illustrations for TIME by Eugene Mihaesco

Today the stockpiles of the superpowers are roughly comparable in overall size, and the U.S. has an edge in some weapons (such as cruise missiles and submarine-launched ballistic missiles). But the Soviets have an advantage in a key category: accurate, destructive warheads on ICBMs. They have more than 6,000, compared with some 2,000 for the U.S. Those are the "silo busters," the instruments of a hypothetical first-strike threat against America's 1,000 ICBM launchers.

This Soviet preponderance in ICBM warheads contributed to Reagan's disenchantment with Strategic Arms Limitation Talks (SALT) as well as to his enthusiasm for SDI. For years he had questioned the efficacy and morality of MAD. Was not there a better way to keep the nuclear peace than through a suicide pact? Wasn't there some way to mount a defense that really would defend against all those Soviet weapons?

This was a legitimate question, one that has gnawed since the dawn of the nuclear age. But more than three years and $4.7 billion after Reagan's Star Wars speech of March 1983, there is no evidence that the answer this time is yes. Even if SDI could theoretically create a system that is survivable (i.e., invulnerable to a crippling preemptive attack) and cost-effective at the margin (cheaper to maintain than the enemy's offensive countermeasures)—and there is no evidence yet that this is possible—the situation would not last long. While one side is perfecting its defenses, the other is working feverishly on countermeasures—and very likely nuclear countermeasures, precisely because those are probably going to be the most cost-effective. It may be a permanent fact of the nuclear age that offense wins. No matter what SDI produces in the way of lasers and particle beams, the Soviets' nuclear offense—unless it is constrained by arms-control agreements—will eventually be able to "beat" Reagan's ray guns just as it beat Ike's antiaircraft system and Nixon's ABMs.

In an attempt to deal with that dilemma, some officials have linked SDI to arms control: the superpowers should agree to an orderly, regulated transition from the MAD world of "offense-dominant" deterrence to one of "defense-dominant" deterrence; while developing and phasing in their defenses, they would reduce their offenses. That scheme, however, leads straight into another dilemma. One side's defenses are virtually certain to appear more ominous to the other side than they are intended. How can the Soviets be expected to reduce their offensive weapons when they need those weapons—and more—to overcome burgeoning American defenses? Says former Defense Secretary James Schlesinger: "By asking the Soviets to reduce offense while we pose to them the possibility of greatly increased American defense, the Administration has created a situation in which the Soviets cannot accommodate the U.S. even if they wanted to."

The question of the hour—and of the coming months—is to what extent the Soviets might be willing to accommodate the U.S. in order to head off SDI. This possibility is sometimes called the "grand compromise." Such a deal could accomplish what Reagan proclaimed as his goal when he sought to replace SALT with the Strategic Arms Reduction Talks during his first term. The Soviets would be required to cut back drastically on their ICBM warheads in a way that reduced or, better yet, eliminated the theoretical possibility of a first strike against American ICBMs and the danger of political intimidation and blackmail that

they might derive from that capability. During his first term, Reagan proposed drastic reductions in Soviet offensive forces, especially in ICBM warheads. But his only leverage then was the prospect of an American offensive buildup, which included plans for the ten-warhead MX missile and the highly accurate Trident II submarine-launched ballistic missile (SLBM).

The Soviets were willing to risk an offense-offense arms race and were not prepared to bargain away their existing weapons for future American ones. But the prospect of an offense-defense race is another matter. If SDI goes ahead, the Soviets will have to spend vast amounts of money expanding and transforming their offensive and defensive systems to cope with the new American threat. It would be cold comfort to the Kremlin that SDI would probably end up costing the U.S. more than the countermeasures would cost the U.S.S.R. Faced with an offense-defense arms race, the Kremlin might choose instead to pay a sizable price in Soviet offense in order to curtail SDI.

That choice did not come into focus until late in the first Reagan term, after the Soviets had walked out of the Geneva talks. SDI was a factor in luring them back to the bargaining table last year. For that Reagan deserves credit, and his critics owed him some patient support as the negotiations have proceeded during the past year. SDI helped elicit from the Soviets a dizzying barrage of proposals—some largely propagandistic headline grabbers, some formal treaty language put forward in diplomatic channels and some sotto voce feelers. Sorting out the tricks, traps and teasers from the genuine offers is complicated, but the contours of what Moscow might be willing to offer to reach a grand compromise are now emerging.

Most important, the U.S.S.R. has said in earlier versions of its proposal that it would be willing to reduce its ICBM warheads from the 6,000-plus level allowed by SALT II to 3,600—a dramatic cut, nearly as deep as the one sought by Reagan and rejected by the Kremlin during the first term. For that reduction to improve the strategic balance, the Soviets would also have to give up what has been palpably the most unacceptable aspect of their position over the past year: an insistence on counting as "strategic" weapons those American shorter-range systems that can reach the territory of the U.S.S.R. If the U.S. had to reduce its carrier-based aircraft and Europe-based missiles along with its intercontinental weapons, it would have to get rid of so many ICBM silos that the resulting ratio of Soviet warheads to American targets would be more disadvantageous to the U.S. than the current worrisome equation.

But in a new version of their proposal presented in Geneva last week, the Soviets showed flexibility on a number of points, and they took a big step toward dropping their "reach criterion" and counting only genuinely strategic weapons as defined by SALT (ICBMs, SLBMs and heavy bombers). What was not immediately clear, however, is whether the new formula they are using to count "nuclear charges" (warheads, bombs, cruise missiles) will include the earlier "force-concentration" rule, which limits them to no more than 3,600 ICBM warheads. If that old feature is carried over into their new proposal, the arithmetic of the Soviet position would be much

What the Soviets Are Doing


DIANA WALKER

One of the Administration's repeated arguments for pursuing SDI is the excuse given by any kid caught in a fight: somebody else started it. "The Soviet Union," President Reagan said last fall, "is about ten years ahead of us in developing a defensive system." As Richard Perle put it at the TIME conference, "The Soviet SDI program preceded that of the U.S., and they've made a larger investment than we have." But in an analysis presented to the conference, Stephen Meyer, an associate professor of political science at M.I.T. who is a consultant for the Pentagon on Soviet technology, said that Moscow's program is far more limited in its aims than the U.S.'s, with its goal of building a space-based defense against missiles.

"It is true that the Soviets do have the largest SDI program in the world," Meyer said, "but that effort is overwhelmingly an air-defense effort." It relies on radar systems, interceptor aircraft, surface-to-air missiles for anti-cruise-missile defense, all designed to protect targets close-in just before they are struck. Even the large radar being constructed at Krasnoyarsk in Siberia (which has become a focal point of the debate over whether Moscow is violating the ABM treaty) is not particularly impressive, according to Meyer. "The systems do not move," he said, but rather are fixed in a certain direction. "There is great uncertainty here about both the operational reliability of those systems and, more important, the computer-processing capability."

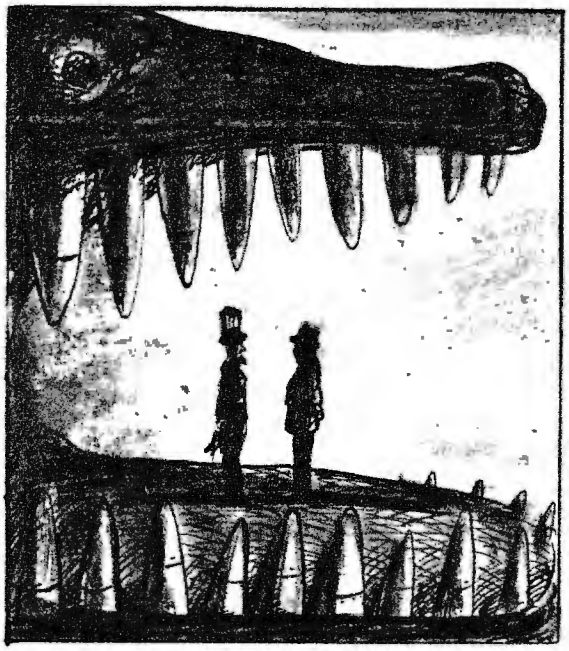
Gerold Yonas, the chief scientist for SDI, noted of the Soviets that "their laser weapon program, if you just look at the size of their facilities, is mind boggling." Exotic weapons systems—lasers, particle beams, orbiting accelerators and the like—are indeed on Moscow's research agenda, Meyer said. But he contended that they are 20 or 30 years away from becoming operational. In the Soviet Union, he said, the research phase, known as NIR, involves looking into basic scientific principles and "is not linked to weapons programs at all." By one account, less than a third of these projects ever enter the design and engineering phase, known as OKR. Because plant construction begins long before prototypes and test models have been built, it is possible to determine when a project has progressed to the OKR phase. "There is no such construction going on related to any of these exotic technologies at all," said Meyer.

He pointed out that the Soviets have had serious difficulties making particle accelerators. No evidence suggests that they have successfully solved the problems generally besetting kinetic-energy weapons, which have rails that tend to warp after repeated firings, or gasdynamic and electrical-discharge lasers, technologies discarded by the U.S. a decade ago. Strategic defense requires far more than just kill mechanisms such as lasers, accelerators and particle beams. "It requires sensing, tracking control and targeting," said Meyer. "This is where perhaps the grossest of all Soviet weaknesses in technology industry lie."

more attractive. This would especially be true if the Soviets eventually make good on other hints that they might give up their largest MIRVed ICBMs, restrict new missile types to single-warhead ones and accept an explicit limit on ballistic-missile throw weight (another index of strategic power in which they have a disconcerting edge).

A package of Soviet reductions along these lines would be particularly welcome because it would be relatively easy to verify. Verification is a critical issue, one on which the Administration has shed more heat than light by overstating the case against Soviet cheating on SALT. Words like "massive," "wholesale" and "flagrant" have been bandied about. But the more accurate description is that the Soviets, who are Philadelphia lawyers at heart, have been chiseling at the fuzzy margins of pacts to see what they can get away with. That combination of effrontery and ingenuity has allowed them to build a huge ABM radar and say it is for tracking satellites in space; it has allowed them to sneak in a formidable new type of ICBM and say it is just an improved model of a lemon they halfheartedly deployed nearly 20 years ago.

But they have not cheated on the numerical ceilings of SALT, because those are clear-cut. The limits on the number of ICBM silo launchers and on the number of MIRV loadings on each type of ICBM are clearly defined in the treaty. More important, they are readily monitored by U.S. spy satellites. At the heart of the grand compromise would be a lowering of precisely these verifiable limits.



If the Soviets do offer to give up their largest missiles, they would probably demand that the U.S. give up the MX and the Trident II as well. That would be difficult to accept. There are widespread questions about how to base the MX and about Congress's willingness to fund it fully. But the Pentagon sees the Trident II as a crucial component of the U.S. arsenal for the 1990s because, like its predecessors, its submarine basing makes it invulnerable to a Soviet pre-emptive attack (assuming, of course, that the Soviets do not achieve a breakthrough in antisubmarine warfare).

But the stickiest and most controversial part of the trade-off would be the limits the Soviets would demand on SDI. Here their position has been evolving. A year ago they wanted to ban not only development and testing but also research on "space-strike arms," a term they defined in a way that was so comprehensive and one-sided it might have meant the cancellation of the space shuttle. Then, in an interview last August with TIME, Gorbachev said that what he called fundamental research would not be covered by the ban. But Soviet officials subsequently explained that "purposeful" research on strategic defenses would still be forbidden. Since purpose would be a matter of declared intention, the American SDI would be outlawed, while the Soviets could continue testing huge high-energy lasers in Central Asia by claiming that they were for medical purposes.

Even SDI skeptics like Sidney Drell believe that the U.S. should maintain a vigorous—and very purposeful—research program in strategic defense for two reasons: as insurance against breakthroughs that the Soviets might come up with in their program and as a hedge against the remote possibility that someone, someday, really does discover a defensive technology that diminishes the advantage of offense. A serious, sustained research program is not a bargaining chip and should not be used as one. However, a research program that is driven by good science rather than high-pressure politics would not hold out false hopes for large-scale population defense; and yet it still could pave the way for a grand compromise by inducing the Soviets to agree to significant cuts in offensive weapons in return for reinforcing old agreements that limit the development of defensive systems.

Indeed, the Soviets have recently begun exploring ways to restrict SDI by reaffirming the ABM treaty of 1972. That approach has considerable promise since it is potentially compatible with Reagan's own public statements on SDI. Largely as a result of the quiet urging of British Prime Minister Margaret Thatcher and Secretary of State George Shultz, Reagan has said repeatedly that SDI is a research program being conducted within the bounds of the ABM treaty. The nub of the American end of an offense-defense deal would be for Reagan to repeat that statement once again, only this time in a document co-signed by Gorbachev.

Thus, even though the devil would be in the details and a full treaty would probably take many months if not years to negotiate, there is no mystery about the basic ingredients of a framework agreement that Reagan and Gorbachev could sign this year or next. They are evident to both advocates and opponents of arms control within the Administration. That is why the opponents, led by Defense Secretary Caspar Weinberger and Richard Perle, have been waging a fierce but largely invisible campaign to put the kibosh on the arms-control agreements of the past lest they provide the basis for new agreements in the future.

Last month this faction won a major victory against Shultz and the State Department by persuading Reagan to declare his intent to end American compliance with the offensive limits of SALT II at the end of the year. The next battle could be more important and more intense. Administration hawks are laying the ground for a breakout from the defensive limits of the ABM treaty. The terms call for the signatories to review its viability every five years, and it is up for review next year. The Pentagon and its allies elsewhere in the Administration are pushing for a looser interpretation that would exempt the development and testing of an SDI system from the treaty's restrictions. The result, as fully intended, would be to render the ABM treaty worthless as the basis for a new deal with the Soviets.

Sooner or later, Reagan is going to have to decide these issues. As in the past, his Administration is too sharply divided for the bureaucracy to produce anything more than cumbersome, half-a-loaf truces among its own warring factions. Like SDI, the grand compromise with Gorbachev would have to be a very personal initiative on the part of the President.

For Reagan, the hardest part will be deferring indefinitely the fulfillment of his dream of a nuclear-free world in which ballistic missiles have rusted away in their silos and launching tubes. But his lieutenants, notably Perle, are talking about SDI not as an alternative to offensive nuclear weapons but as a supplement to a steadily upgraded American arsenal that will face a steadily expanding Soviet one. That, in fact, is what SDI would likely become, and such a prospect ought to be just as unappealing to the President as it is to many strategic experts and to the body politic in general.

Once Reagan realizes what SDI has become, perhaps he will use it for the best purpose it can serve: a goad to bring about the first genuine reversal in the nuclear arms race since it began 40 years ago. That would be a historic legacy of which Ronald Reagan—and his countrymen—could be proud. —*By Strobe Talbott*

House Panel Cuts 'Star Wars'

The House Armed Services Committee yesterday reported out its version of next fiscal year's defense authorization bill in which it made sharp cuts in President Reagan's Strategic Defense Initiative, or "Star Wars," and strategic weapons modernization programs.

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The committee also did away with $1.5 billion the administration sought for the 14th Trident missile-carrying submarine.

Committee members did not want to eliminate the nuclear sub, which carries 24 missiles and is becoming the backbone of the U.S. strategic retaliatory force, an aide said. But members had to cut shipbuilding back because of overall budget reduction requirements.

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How SDI Is Being Undone From Within

Angelo M. Codevilla

A people without walls is a people without any choice.

—Aristotle, *Politics*, Book 7, Chapter 11

PROTECTION against enemy attack is not just a military necessity. It is a political imperative. Aristotle and many after him have recognized that a country may sometimes leave its borders undefended, trusting in the ability of its armed forces to deter, or defeat, the enemy in battle. But Aristotle also recognized that this is not only militarily risky but, above all, politically unhealthy. Peoples, especially democratic ones, who are asked to live out their lives on the edge of destruction either become excessively tempted into making preemptive attacks or, enervated by the tension, give themselves up to flights of fancy. So Aristotle, like other prudent politicians before and after him, counseled reliance on the best protection available. In Aristotle's time, that meant walls. He offered this counsel, remarkably enough, while noting that the technology available for breaching walls had just improved dramatically.

Popular opinion in the U.S. has always been on Aristotle's side. But for much of a generation, the opinion of those who exercise influence over American foreign and defense policies has been quite the contrary. Thus, unbeknownst for the most part to the American people, the U.S. has been thoroughly bereft of defenses against Soviet missiles and bombers. So long as our offensive forces were clearly superior to the Soviet Union's, few influential Americans worried about this. But when the Soviets became able to do more harm to the United States than the United States could do to the Soviet Union, and when the Soviet Union acquired the means to disarm many of our means of doing it harm, some influential Americans did begin worrying enough to reconsider our need for protection.

Indeed, as the 1970's ended, these Americans concluded that the Soviet Union had built such a commanding lead in strategic offensive forces that the only chance for the free world to avoid permanent Soviet military hegemony was to do what most people (mistakenly) believed was already being done: build strategic defenses.

This strategic awakening occurred just as changes in technology were providing unprecedented ways of destroying missiles and bombers in flight and on the ground. It occurred also at a time when no one in the mainstream of public opinion any longer denied that fifteen years of the arms-control process had left the American people not safer, but less safe. By the early 1980's, not even the most ardent advocates of arms control contended that the Soviet Union could be made to abide by future agreements more faithfully than it had done in the immediately preceding period, during which it had used the negotiating process as a screen for its drive to military superiority. By the early 1980's, then, strategic defense seemed to be not just a good way out of the American strategic predicament, but the only way.

Beginning in 1980, Senator Malcolm Wallop (R-Wyo) and his congressional allies were able to structure a set of programs in the Defense Department which produced some of the key hardware that might be involved in space-based anti-missile defense. They publicized the promise of new space-defense technologies and betweeen 1980 and 1982 won several votes on the floor of the Senate actually to build space laser weapons. Hence, by the time Ronald Reagan announced a turn toward strategic defense in his speech of March 23, 1983, important components of anti-missile weapons, both ground-based and space-based, were already under development, and the idea had had a rather successful political test-marketing.

Yet while the turn toward a Strategic Defense Initiative (SDI) was caused by recognition of the nation's strategic predicament, the White House and the Defense Department quickly defined SDI as research into technology that might or might not be useful after the year 2000—but surely not by any time on which we could immediately plan. In other words, they defined SDI as an open question. This effectively detoured discussion from the essential question: how shall we meet our urgent need for protection *now*?

Certainly, in any enterprise, one might always wish that there were more effective tools available. But the difference in human contests is always made by the materials on hand. In military mat-

ANGELO M. CODEVILLA, formerly an aide to Senator Malcolm Wallop of Wyoming, is now a fellow at the Hoover Institution, Stanford. He is working on a book about strategic defense to be published by Macmillan.

ters, especially for a country like the U.S., which leaves to others the choice of when to make war, it is very dangerous indeed to wait for better weapons in the future while one's enemies build weapons in the present which they deem good enough. In fact, the Soviet Union is not only widening its lead in usable offensive missiles, but anti-missile devices are also already rolling off Soviet production lines, and the 1980's will see Soviet high-energy lasers in space. To count on the forbearance of a superior Soviet military while the U.S. plays Hamlet would be suicidal self-indulgence.

It is therefore important to examine how and why the U.S. government over the years has spurned the means at hand to develop anti-missile defenses in favor of utopian arms-control initiatives and research into anti-missile systems defined always as beyond our grasp. As we proceed with such an examination, we will find that today's situation differs little from previous ones except for urgency, and that the deep-rooted U.S. commitment against defensive weapons can be reversed only by changing men, budgets, and organization.

THE temptation to treat new weapons irrationally is perennial. We laugh too easily at the medieval politicians who saw crossbows and gunpowder as harbingers of the end, at their military commanders who either dismissed them or thought there could be no defense against them, and at their legal advisers who tried to outlaw them. In our own century, the airplane, then the nuclear bomb, and finally the ballistic missile have provoked similar reactions.

Thus, before World War II, there developed the triple assumption that "the bomber will always get through," that its natural target would be the mass of humanity in cities, and that its primary effect would be not to destroy military targets but to inflict punishment on populations. Consequently, Winston Churchill had to fight uphill battles in order to divert some resources away from bomber forces, seen as threats of indiscriminate destruction and therefore useful for deterring Germany, toward the interceptor aircraft necessary for defending Britain.

In spite of prewar assumptions, however, the experiences of the war itself left no doubt that indiscriminate destruction did not pay and that air defenses could be very effective. Air defense, for example, saved Britain and sealed the fate of the German army at Stalingrad. And with the advent of nuclear bombs, air defense came to seem even more important. Accordingly, between 1950 and 1960 the U.S. built and manned a huge defense system consisting of radars and interceptor aircraft and missiles—a system employing directly some 250,000 people and costing some 200 billion of today's dollars.

To say that this system was entirely effective is not to say that it was possible, by 1960, to guarantee that no Soviet bomber could have dropped a single bomb on an American city. The purpose of any defense is not to preclude irrational acts such as the sacrifice of an entire military force for the sake of destroying a single militarily meaningless objective. Rather, the purpose of any defensive system, whether against mounted knights or Napoleonic armies or nuclear weapons, is to make it very unlikely that an attacker can achieve any results that are worth the trouble. By this practical standard, the U.S. air-defense system succeeded completely. The Soviet Union provided double confirmation of this by ceasing large-scale production of bombers in the late 1950's. It resumed such production only in the 1970's, *after* the U.S. had totally dismantled its air-defense system. By 1980, if the Soviets wished to bomb the U.S., new bombers were not really needed. Cargo planes would do.

In contrast, by 1980, the Soviets' own air-defense system had long since put the United States out of the business of even *considering* high-altitude penetration of Soviet airspace. The old American B-52 bomber force had been reduced to launching long-range cruise missiles, and the new American bomber, the B-1, was designed to attempt penetration at treetop level, in the hope of gaining momentary advantage over the newest tower-mounted Soviet phased-array radar and its associated SA-10 missile.

ALL OF which is to say that the U.S. knows, from having to work against them, how well air defenses can work. Why then does the U.S. have virtually none?

The reasons follow from the utopian sentiments which nuclear weapons have awakened among American intellectuals and politicians. In the military field, this utopian response came within weeks of Hiroshima in the form of Bernard Brodie's book, *The Absolute Weapon*. Although he never denied that prudent preparations for dealing with nuclear attack would significantly affect its results, Brodie assumed that nuclear weapons would be targeted primarily on cities, and that it would be impossible to avoid total destruction. Despite the many contradictions it contained and the many questions it left unanswered, little by little Brodie's thesis became the intellectual currency of American military leaders.

For the first fifteen years of the nuclear era American military supremacy was so great, and American military leaders faced so few momentous choices, that their verbal adherence to the tenets of *The Absolute Weapon* hardly mattered. America could deliver many bombs on the Soviet Union, while the Soviet Union could hardly deliver any weapons on the U.S. For the U.S. the danger was theoretical.

All this changed when, *circa* 1960, the prospect arose that the Soviet Union could bypass our air defenses by lobbing ballistic missiles at us. Faced

with this new vulnerability and relying on the new Atlas, Titan, and Minuteman missiles as well as on the new reconnaissance satellites which pinpointed Soviet missile bases, President Kennedy's Secretary of Defense, Robert S. McNamara, declared:

> The United States has come to the conclusion that to the extent feasible, basic military strategy in a possible general war should be approached in much the same way that more conventional military operations are. That is to say, principal military objectives in the event of a nuclear war should be the destruction of the enemy's military forces, not his civilian population.

Of course at this time McNamara took no action to diminish U.S. air defenses or to interfere with the effort to develop defenses against missiles. The purpose of these, after all, was to limit damage to the United States.

Yet beginning in 1963, McNamara changed his mind, and also the shape of the U.S. military. Whether McNamara was impressed by his aides' commitment to the tenets of the "absolute weapon," or frightened by the Cuban missile crisis, or desirous of cutting the strategic forces' share of the budget to fight the Vietnam war, his purpose ceased to be the limitation of damage in case of nuclear war. Instead it now became the avoidance of such a war through the policy of Mutual Assured Destruction (MAD).

Thus when, in late 1963, it became clear that the Soviet Union was going to emplace its new ballistic missiles in blast-resistant silos, the U.S. faced a decision: should we target them? The answer from McNamara's Pentagon was no. He later explained that our safety rested on our willingness to "destroy the attacker as a viable 20th-century nation," and not from any "ability to partially limit damage to ourselves."

Defining the appropriate level of destruction was a problem. Pentagon analysts sought the "flat of the curve," that is, the number of Soviet cities hit, after which hitting another would cost more than the damage inflicted. Give or take a little, McNamara settled on a figure:

> . . . I would judge that a capability on our part to destroy say one-fifth to one-fourth of her population, and one-half of her industrial capacity would serve as an effective deterrent. Such a level of destruction would certainly represent intolerable punishment for a 20th-century industrial nation.

His calculations about the Soviet Union did not take into account a very different value system from our own, and his calculations about the damage our weapons would cause were proved wrong in tests by the Boeing Corporation. But right or wrong, McNamara not only explicitly took up the "absolute weapon" rhetoric of the Eisenhower officials he had once criticized; he now *acted* in a way that was wholly consistent with the rhetoric. He made U.S. missiles incapable of striking Soviet missiles. He oriented American targeting toward populations. He phased out the U.S. air-defense system. And he worked to prevent an American anti-missile system from coming into being.

Yet no knowledgeable person in the 1960's denied that radars and missiles existed which could intercept incoming missiles. The very first radar "discrimination" of a warhead from other materials accompanying it had occurred in 1958. By 1962, when the Soviets had only 14 ICBM's, our Nike Zeus anti-missile system had intercepted a warhead. By the mid-1960's Robert McNamara was conceding in congressional testimony that the even newer Nike-X system could have effectively protected every urban area in the U.S. as well as our military bases. But as Harold Brown, then McNamara's Undersecretary for Research and Development (R & D), testified: "The decision on Nike X will not be made, or should not be made, merely on the basis of technical capability. That is, even though the system does what we say it will do, that does not mean necessarily that we should deploy the system." (Why not? Because the Soviets could always explode nuclear warheads upwind of populated areas—for example in the Mojave desert—and spread radioactive dust.)

Thus when McNamara told the Congress in 1968 that "defense of our cities against a Soviet attack would be a futile waste of our resources," he was expressing a judgment not about what *could be* done to defend against ballistic missiles but about what was *worthwhile doing*. This judgment, which the public mistook as a technical one, ultimately led American leaders to reject protection against ballistic missiles in favor of the ABM treaty of 1972 prohibiting such protection.

By 1979, however, even as President Carter was signing the SALT II treaty, no one could, or did, argue that the objectives for the sake of which the U.S. had seven years earlier signed SALT I and the ABM treaty had been achieved. Through SALT I, the "best and the brightest" of the American establishment thought they had persuaded the Soviets to refrain, in accordance with the theory of MAD, from any attempts to defend themselves by preparing to destroy our missiles on the ground, as well as in flight. Now, by 1979, it was obvious, even to the CIA and to Harold Brown, one of the architects of MAD and now Carter's Secretary of Defense, that the Soviets had never ceased making preparations for self-protection, at least through counterforce strikes—that is, preemptive attacks on American missiles.

The specter of "Minuteman vulnerability," which has haunted the Pentagon from afar since the mid-60's, and which SALT I had supposedly exorcised, was thus now a reality. Little by little the Soviets had acquired the ability to take out

our land-based missile force in a first strike. But what to do about it? The answer, in terms of MAD, lay either in making our own offensive forces more "survivable" or in preparing to "launch on warning." "Launch on warning" was deemed too dangerous a policy (since it might mean the initiation of a nuclear war by accident). Therefore the MAD orientation necessarily led to an enormous effort to find a survivable basing mode for the Minuteman's proposed successor, the MX, a 200,000-pound missile, whose size precludes significant mobility.*

Even if a significant portion of President Carter's proposed 200 MX's could have been assured survival, the United States would still have found itself in a world far more ominous than that which the architects of SALT had foreseen in 1972. The models of "stable equality" so popular in those days did not envisage that the Soviet Union would have a near-monopoly of counterforce missiles, *plus* reserve nuclear forces far superior in number and dispersion and yield to those of the U.S.—forces that the U.S. could not hope to reduce meaningfully after having absorbed a first strike. No one contended that the 200 MX's proposed by President Carter would change this predicament significantly.

Nor, by 1979, could anyone be found who would argue in public (as Gerard Smith did in 1972) that the Soviets had agreed, in the new treaty, to solve our strategic problems for us. Although the Carter administration carefully avoided charging the Soviet Union with violations of SALT I, it had to admit that the Soviets had wholly circumvented its basic purpose. Moreover although SALT II's advocates maintained that the Soviets would not violate it, they could not explain why the Soviets would be more faithful to the new agreement than they had been to the old.

Hence, in 1979, the choice was between hoping against hope that through SALT II and the arms-control process a bad situation might not become much worse, and advocating that the United States match the Soviet Union in numbers of missiles. Few Americans outside the extremes of the political Left and Right felt comfortable with those alternatives. The first amounted to an indefinite surrender of military supremacy to the Soviet Union, while the second appeared to be a race in which the Soviets had already moved out of reach, with five open ICBM production lines as compared with none in the U.S.

In addition, some of the most scrupulous analysts of intelligence noted that the Soviet Union was building the huge radars necessary for a nationwide anti-missile system; perfecting both the interceptors and the small radars such a system would require; developing a state-of-the-art air-defense missile system (we now know it as the SA-12), each unit of which could defend against at least a small number of American warheads; and acquiring the elements of space-based laser systems. The Soviets, it seemed, might be on the way to doing to the ABM treaty what they had done to SALT I. How could the U.S. live with a Soviet Union possessed of a superior counterforce sword *and* a budding monopoly of anti-missile shields?

The obvious way out of this political and strategic predicament was to devalue the Soviets' huge lead in ballistic missiles, as well as the sacrifices that a generation of Russians had made to build them, by devising defenses against them. This reasoning led several Senators, and several strategic thinkers as well, to go looking for the necessary technology. It was not, in other words, the appearance of new technology that renewed interest in defense. Rather, a heightened realization of danger, combined with a lack of viable alternatives, led to a closer examination of the technology available for defense.

THAT technology, in a nutshell, allowed the following:

Large, ground-based radars could see tiny warheads and decoys thousands of miles away, and their computers could perform enough calculations to distinguish substantially between the two. They could also track the warheads, divide the track files into "bundles" according to destination, and transmit the bundles to the appropriate engagement radars. Detection and discrimination could also be done by electro-optical devices, either on satellites, or probes shot into space, or on high-flying aircraft. The information, similarly divided, could be sent to engagement radars.†

Already in the late 70's, technology developed for the U.S. space-based intelligence collectors was usable to attack missile boosters soon after they left the atmosphere. Electro-optical devices, extensions of ones in use for missile warning, could see, in detail, the missiles' unmistakable, undecoyable, plumes. The techniques developed to take pictures from space could be adapted to determine where plumes and missiles meet. The mirrors from their telescopes, or larger ones like them properly coated, could focus laser light on the boosters. The computers aboard these intelligence marvels were more than equal to the task of choosing the most convenient target for each defensive satellite to engage, and for keeping every defensive satellite apprised of what every other one was doing. By the end of the 70's, also, it was clear that a 10-megawatt chemical laser could be built.

* The MX is a product of arms control. Restrictions on the number of launchers led the U.S. to pack much capability into each missile, making the MX mobile only on the nation's railroads.

† These, nowadays, can be made small enough to be transportable. Interceptor missiles can now carry much better computers, and therefore are likely to get close enough to their targets not to need nuclear warheads. By lifting an electro-optical probe and a group of miniature homing vehicles far into space in the path of an attack, ground-based defenses can even reach warheads in mid-course.

It was also clear that technology would continue to progress and in the future might provide not just other kinds of lasers and particle-beam devices for boost-phase defense, but more accurate and reliable ground-based interceptors, earlier and even more perfect discrimination, and more foolproof battle management. Finally, a very great, but conceivable, extrapolation of present sensors and data-processing would allow a sophisticated attack on "clouds" of warheads and decoys in mid-course.

It is essential to reiterate, however, that interest in strategic defense arose in the late 1970's not because of any millennial hope that technology just over the horizon would prevent any Soviet missile from reaching the U.S. Rather, it arose because there was no other way out of our strategic predicament, and because the technology then in hand, if used, would have radically decreased the military and political usefulness of Soviet missiles while providing substantial protection to the American people.

WHILE the popularity of strategic defense was rising in the press and in the Congress, that of the Reagan military build-up, announced with great fanfare in October 1981, was falling. Since that build-up was not conceived either to match or counter Soviet capabilities, and certainly not to protect Americans if war ever came, its advocates never managed to make a great case for it. A year later President Reagan bought time by appointing a commission to study the problem.

On February 11, 1983, during a meeting with the Joint Chiefs of Staff, President Reagan heard the grim news that the strategic gap would continue to widen, and that political support for new missile programs in the country was fast disappearing. Reportedly expressing reasons both political and strategic, Reagan ordered that his next speech on strategic affairs contain a turn to the obvious way out: strategic defense.

As usual, he was not specific. Few who were not in the room knew about the decision. The paragraphs on the subject were drafted in great secrecy by the staff of the National Security Council (NSC). The first draft was a rather specific commitment to build strategic defenses on the ground and in space, "such as" lasers and particle beams. Two days before the speech, these paragraphs were circulated to a wider audience within the military, the Defense Department, and the White House. The overwhelming reaction was negative. Misgivings were expressed about the effects on the Europeans and on arms control, and about the scientific obstacles that lay in the way. As a result, though the original draft's rhetoric was not toned down, the commitment was fuzzed into a call for the best minds in the country to think about a task whose accomplishment was left for an indefinite someday—not at all like John Kennedy's call to put a man on the moon by the end of the 1960's.

The job of defining what the President had said fell to the only people at the higher levels of the White House and the NSC who were acquainted with research and development: the science adviser, George Keyworth, and the deputy National Security Adviser, Robert McFarlane. Keyworth and his staff had argued strongly in Washington against strategic defense. Then, the Sunday after the President's speech, McFarlane said on national television that it had represented a commitment to nothing but research, and that nothing would happen to the U.S. strategic posture in the foreseeable future as a result of it. (Senator Wallop immediately wrote the President to complain about McFarlane's remark, and was assured that McFarlane had not meant what he said.) At the Department of Defense, the task fell to Robert Cooper, the Deputy Undersecretary and director of the Defense Advanced Research Projects Agency (DARPA), who had striven to reduce pressure from Congress for strategic defense, and had shifted DARPA's work away from weaponry and toward "pure" or "generic" high technology.

Together the White House and Defense Department appointed two committees. By far the more important was headed by James Fletcher, former (and future) director of NASA. The members were carefully chosen to represent the interests of the national laboratories, and of the several parts of the U.S. government involved in R & D. The Fletcher panel's charter directed it to disregard how currently available technology might be made into anti-missile devices, and to consider only advanced technology that would be effective against a "responsive threat" in the long term.

Defining the "responsive threat" is, in the lingo, a "reiterative process." In practice it means that no sooner are technologists able to meet one set of impossible criteria than managers are free to imagine the next set. It also means that one should conceive only of systems with a near-absolute certainty of success. None of this is peculiar to strategic defense. This is how Bradley Fighting Vehicles and $7,000 coffee pots are designed.

In short, the Fletcher panel was mandated to conceive only of systems able to defeat the best imaginable countermeasures.

Perhaps the best example of how the "responsive threat" affected strategic defense was the Fletcher panel's operative assumption that the Soviet missiles to be defeated would be resistant to 100,000 joules/cm^2 of radiant energy—over one thousand times reality! Although no one could justify such a figure with any data, that figure "drove"—and continues to "drive"—the calculations on which SDI is based.

The Fletcher panel also stipulated that each layer of the defensive system should be able to destroy at least 90 percent of the targets coming its way (in the worst of circumstances) so that the system would achieve an overall effectiveness of 99.75 percent against the simultaneous launch of all So-

viet missiles—not, again, the real Soviet missiles but rather missiles a thousand times "harder" than real ones. There was no room in this directive for the notion that one should worry first about militarily rational threats.

THE report of the Defensive Technologies Study Team (DTST), as the Fletcher panel was called, reflected both its membership and its guidance. A carefully brokered report, it protected the programs of all the parties involved, promised steady increases in research funds available to all, set no deadlines against which anyone's performance might be judged, and foreshadowed no programs that might seriously divert major funds from any existing part of the government. Indeed, by putting off consideration of what to do after preliminary research until the time of future Presidents and future Congresses, it magisterially took from the President for whom it was written the authority ever to do anything about the subject again.

The report's substance was characterized by the recommendation that currently usable technology be laid aside while the most difficult parts of an overall system were developed—namely, the sensors and data-processing required for intercepting missiles in mid-course. These would involve formidable technical challenges because the Fletcher panel defined the task of midcourse sensing and data-processing as the imaging and analysis of every missile, decoy, and piece of debris by space-based radars, infra-red, and laser sensors—all collected and compared in a central processor. The flipside of this recommendation was that no part of the overall system be built before all parts were ready to be built.

Regarding battle management, the report recommended birth-to-death track files for every booster, missile, decoy, and piece of debris identified and transferred through all layers of the system. It also banished nuclear weapons from any role in strategic defense, and devoted serious consideration to mining the moon and inventing "anti-matter beams."

The report, in short, was a caricature of the latter-day American approach to military R & D—the most direct antithesis imaginable of the principle that you should do the best you can with what you've got. Not only did the Fletcher panel say precisely nothing about how the United States might actually defend itself in the foreseeable future; this question did not rate even the smallest mention in its report.

During the late summer of 1983, complaints about the Fletcher panel's "far-out" report received a sympathetic hearing from the National Security Adviser, William Clark. He then ordered a new study, under NSC auspices, to integrate the Fletcher panel's findings with those of another panel under Fred Hoffman, of R & D Associates, Los Angeles. This group had been chosen largely by the Undersecretary of Defense for Policy to examine the policy implications of the President's speech. Although not allowed to touch the vital subject of systems engineering, it focused on the real world, and on what even limited defenses could do for the country. By the time the new, somewhat more present-oriented report reached Clark's desk in October 1983, however, he had been replaced as National Security Adviser by McFarlane, who shared in the consensus that SDI should be soft-pedaled.

THE upshot of all this is that since May 1984—and still to this day—SDI has taken the form of a label applied to a number of preexisting programs of the Defense Department that bear an arguable relationship to strategic defense. The five program elements are as follows, in order of the amount of money and attention being devoted to them:

First is Surveillance, Acquisition, Tracking, and Kill Assessment (SATK). This is "chartered to *explore the technologies* [emphasis added] needed to detect, identify, locate, and track ballistic missiles or their components during the boost, mid-course, and terminal phases of their trajectories." The second program element, Directed Energy, covers the longstanding program in chemical lasers in industry, as well as particle beams, x-ray lasers, and Free Electron Lasers (FEL's) in the national laboratories; the emphasis on ground-based Excimers and FEL's is new, having come with SDI. The third, Kinetic Energy Weapons, covers research on "smart bullets that could be fired from the ground or space." The fourth, Systems Concepts and Battle Management, consists primarily of studies on paper about "how *positive* [emphasis added] command and control might be structured for a defensive system," and also about what a defensive system might consist of. The fifth, Survivability, Lethality, and Key Technologies, covers programs, many new, to explore, largely on paper, but with some experiments, longstanding questions about how key offensive and defensive components could be made resistant to various kinds of attack.

A glance at the organization makes two points evident. First, no part of it has the task, or even the opportunity, to design and develop any weapons system or any part thereof. Such things would require integration of work in all five program elements. Each of the dozen-to-hundreds of parts of each program element necessarily proceeds without a goal, either in the form of a product to which its work would contribute, or of a date by which it must be ready in order to be part of something. Severally and jointly, the parts do not necessarily have any connection with the reality of weaponry.

Indeed, the managers of SDI have gone out of their way to remove such connection to anti-missile weaponry as had earlier existed in the pro-

grams, and to make sure that none enters in. For example, the original design of the Army's Airborne Optical Adjunct (AOA), a kind of electro-optical device that controls a battle against warheads as an AWACS controls a battle against fighter planes, was ready to fly in 1986. But it had its performance requirements raised, thus necessitating more research. The SDI office also ordered that the AOA's key electro-optical component be split into two parts, and that work proceed wholly apart on the low-power laser device which the AOA uses to find the range of each warhead. Among the reasons for this, and dozens of other similar orders, is the judgment of the SDI office, in cooperation with the Pentagon's and the State Department's lawyers, that to do otherwise could be construed as a violation of the ABM treaty.

So it is that the specter of the ABM treaty and the organization of the SDI program have served to enforce on SDI the "research forever" approach that had been embodied in the guidance to the Fletcher panel.

The second evident point is that as it is structured SDI is indeed, as advertised, "an assessment of technologies and systems that might provide a defense against ballistic missiles . . .," designed to last until the early 1990's when a decision on whether to enter systems development could be made by a future President and a future Congress. It is a set of studies to find out whether certain kinds of anti-missile weapons are feasible and worthwhile according to a set of fantastic criteria. *Thus SDI is, in effect, a decision to postpone until the 1990's any serious consideration of what, if anything, the United States shall do to prevent Soviet missiles, once launched, from landing in the U.S.*

This makes little sense. Why investigate whether defenses against ballistic missiles are feasible? Some means are obviously quite feasible. In fact, they are in hand. Others are not in hand, and may never be. Space-based kinetic kill vehicles, possibly using Phoenix or Maverick terminal guidance, are too well-known to be worth testing in a highly abstract mode. It makes sense to build prototypes of operational weapons based on that technology, and then to decide whether or not to mass-produce them. Space-based chemical lasers are in the same position; so is the Airborne Optical Adjunct. The Aegis Radar can provide a basis for an American version of the SA-12. That too is a useful device. The technology to support certain approaches to battle management is also available, while the technology to support birth-to-death, centralized battle management is certainly not available. But why should one wish it to be?

Whether or not any or all of these devices ought to be built is not a technical but a prudential decision, to be made on military and, above all, on *political* grounds. Unfortunately, the premise of SDI in 1986 is that no military or political choice will be available until the mid-1990's. That, of course, is true with regard to some devices and approaches. But the bureaucracy works mightily to give the impression that it is true of all devices and of all reasonable approaches to ballistic-missile defense.

Nor will the decision, now put off to the 1990's, be any more technical in character then than it is today. Without doubt, in the early 90's, notions of the "responsive threat" will have evolved at least as much as the technology in U.S. hands to meet that threat. No doubt, too, we will then be able to conceive of even superior technology that might be in our hands ten years hence.

IN SUM, whether or not technology is acceptable depends on our definition of the threat, and on our perception of the necessity of dealing with it.* For example, the Soviet Union decided in favor of counterforce missiles long before it could build SS-18's and SS-24's. It decided that our Nike-X was a feasible and worthwhile thing before it could build anything like it, and just as Americans, having built it, were deciding it was an unfeasible instrument of defense.

The Americans who, in the late 1970's, perceived the imminence of overwhelming and usable Soviet military superiority and wanted to build strategic defensive weapons as the only way to negate it, judged the available technologies acceptable, according to criteria very different from those of the Fletcher panel. Their judgments regarding the feasibility of strategic defenses are not any more or less *technically* worthy than those of the Fletcher panel and the SDI's management. Reputable people work from precisely the same technical data base. There are vast differences in the facts that each side chooses to emphasize, but disagreements on facts and figures themselves are rare. The differences lie in strategic and political perspectives.

The fact is that, for a variety of reasons, neither the White House nor the Pentagon is particularly eager to build strategic defenses. That is why SDI, as currently structured, does absolutely nothing for the foreseeable future to alter a military balance rapidly shifting against the U.S. But neither the White House nor the Pentagon appears to be surprised by this. Hence we have the interesting spectacle of Secretary of Defense Caspar Weinberger referring to SDI as "the very core" of U.S. defense policy while maintaining sincerely that SDI is a research program meant only to answer an open question. This incongruence, along with the political posturing which invariably characterizes Congress's treatment of non-serious programs, accounts for the reception of SDI on Capitol Hill.

* A physician once thus answered a patient's question about how soon after his heart attack he could resume sexual activity: "When the desire overcomes the fear of death."

A good illustration was the hearing before the Senate Armed Services Committee on March 8, 1984. It began with a codeword-level review of Soviet developments in strategic defense, which the CIA's Lawrence Gershwin summed up in open session as: "The Soviets are ten years ahead of us in this field." Undersecretary Richard DeLauer and Robert Cooper then explained SDI as a $26-billion research program that would last until the early 90's, which might possibly be followed by a development program running into the late 90's, which, if successful, might yield initial, limited deployments around the year 2000.

Liberals and conservatives unanimously thought this silly. Perhaps, so reasoned the Senators who spoke up, there really is some protection to be gained, and the Soviets really are ten years ahead. In that case, the reasoning went, we should be building similar things quickly. As the program stands, ten years hence we will be twenty years behind. Perhaps, however, there really is not much protection to be gained, or any gain would be highly uncertain. If so, the Soviets are wasting their money on strategic defense, and are ten years ahead in a wild goose chase. In that case, why spend $26 billion on a lottery ticket that will yield only another lottery ticket?

At about the same time, Congressman Les Aspin (D-Wis), later chairman of the House Armed Services Committee, was telling a large private audience in Washington that, if the administration were to present a plan actually to build weapons to protect the American people, there would be a political realignment in the House and the plan would pass. He concluded, however, that so long as SDI remained an R & D program, Congress would not feel public pressure on its behalf and would continue to cut it.

Indeed, the fate of SDI in Congress is effectively decided by bargaining between people like Senator John Warner (R-Va) who, on the Pentagon's behalf, works to protect the future of current accounts, and ideological opponents like Senator Dale Bumpers (D-Ark). The administration for its part has opposed amendments to reserve any portion of the funds authorized for SDI actually to build defensive weapons. As a result, Congress's authorization for SDI for FY 86 is $2.7 billion. Note that the programs now labeled SDI, before they received SDI's alterations and labels, were scheduled to amount to a total of $2.8 billion in FY 86. Even by this measure, then, SDI is falling short.

In June 1985, Secretary Weinberger reportedly asked the SDI office to prepare for him an account —not a judgment, but an *account*—of what the U.S. could do immediately to destroy ballistic missiles if it were to build defensive systems based on technology currently available. This is precisely the right question to ask. It is the question to which the Defense Department should have addressed itself after the President's speech, if not before. In fact, it is the question with which Senator Wallop began in 1978. On the basis of the answers, politically responsible people can make politically responsible judgments about what is and what is not worth doing.

Yet on the many occasions where policymakers ask such questions the bureaucracy habitually loads the answers with assumptions that can be factored out only by a reading far more careful than any but the most dogged policymakers are likely to give to them. Nevertheless, as the 80's and the Reagan administration head toward their close, even people at the top are beginning to perceive how silly and how repetitive of past mistakes it is for the U.S. to confine SDI to research while knowing we have no alternative to strategic defense.

THE education of high American officials in reality is occurring at the price of time—years whose fruit, once the enemy has picked it, no human power can restore. Yet the education is far from complete. The same President who speaks moving words about protecting the American people also speaks with obvious conviction about the need to "restore the integrity of the ABM treaty." Never mind that the essence of the ABM treaty is that the more vulnerable we are, the better off the world is. Never mind that no responsible official has ever proposed any means of *enforcing* an arms-control agreement with the Soviet Union, and that the Soviets have no reason whatever to heed the wishes of a nation that has allowed its agreements to be violated for a decade.

But suppose for a moment that one could, magically, "restore the integrity of the ABM treaty," which bars the protection of populations. Which of these two wholly contradictory approaches, self-protection or vulnerability, would the President urge the American people to embrace? It is difficult to believe that the President or his advisers have ever come to grips with the question.

In practice, their equivocation has proved once again that it is impossible for anyone, no matter how able, to embrace two contradictory propositions simultaneously without discrediting both. Moreover, even if one were abstractly to choose a pristine ABM treaty over defenses, how could one justify that choice in the light of the Soviet Union's growing ability to protect itself by counterforce strikes that are not restricted by any treaty and that continue to grow? The ABM treaty's very negotiators stated, also with apparent conviction, that the treaty would have to be renounced unless limitations were placed on offensive weapons to prevent the advent of counterforce missile arsenals. But such an arsenal is now with us—or, rather, with the Soviets. Every month in which American officials indulge in contradictions that they dare not resolve, every month in which they abdicate

to technicians the responsibility for deciding when to build defenses, every month these technicians become, by default, policymakers, our predicament deepens.

Nor can America's political leaders rely on the U.S. intelligence community to tell them when the time is right to build defensive weapons. Intelligence has done its job—not as quickly or as neatly as it could have done, but well enough to notice the Soviet Union's counterforce arsenal, the Soviet Union's commitment to strategic defense, and the Soviet Union's production of several key components of such a defense. It is unreasonable to expect more than this.

Current technical intelligence systems were conceived primarily to monitor activities connected with long-range missile forces. Despite their many shortcomings, the systems did a passable job until the advent of mobile missiles. Unfortunately, most components of defensive systems are also readily mobile; moreover, they are built wholly under roofs.

Thus, while the term "deployment" was meaningful as a benchmark for Soviet capabilities and, to a lesser degree, intentions with regard to offensive missiles from 1959 to about 1982, applying that term to defensive forces fosters misunderstanding. U.S. intelligence analysts who look for evidence of Soviet defensive deployments as an index on the basis of which to warn policymakers look for the wrong thing, both because what they look for is hard to see, and because the concept is not very meaningful. "Production" is a much better criterion, but no serious student of U.S. capabilities would argue that our intelligence can be expected today to come up with meaningful figures on the production even of offensive weapons, let alone defensive ones—except by windfall.

As for the *quality* of defensive weapons, it is almost entirely beyond the ability of current technical intelligence to calibrate. Yet much of the argument within the U.S. government about whether the Soviets would be emboldened by their defensive weapons turns upon our judgment of those weapons' quality. Nor can we expect intelligence to tell us anything about how Soviet planners factor into their calculations any given level of defensive proficiency. Intelligence gives what it can.

Unlike intelligence analysts, however, policymakers receive the pay, perquisites, and deference of their offices precisely because they are expected to make up for uncertainty with judgment, and to do so in time.

IN July 1985 Zbigniew Brzezinski, who had been President Carter's National Security Adviser, published an article in the *New Republic* arguing that our strategic predicament demands that we now build—not conduct research into, but build—strategic defenses at least capable of thwarting a Soviet counterforce strike. Clearly, it is impossible to consider the substance of our strategic predicament and arrive at any other conclusion.

The counsel of common sense has also come from a place we have been led not to expect it: Europe, for the sake of which, we often hear, we should limit SDI to research. Writing in the Winter 1986 issue of *Strategic Review*, Germany's Minister of Defense, Manfred Woerner, says that while SDI is all very well and his country looks forward to helping make decisions about the far-off future, many hundreds of Soviet ballistic missiles are aimed at his country now. These Soviet missiles are becoming more accurate and more usable. Hence his country needs and will develop antimissile forces.

As for our own security, Senator Pete Wilson (R-Cal) has correctly observed that it has already been jeopardized by over three years of inaction since the President's speech, while the Soviet threat has continued to grow. Worse, nothing now authorized by Congress, or even proposed by the administration, will keep the gap between Soviet and American strategic capabilities from widening. Nor will anything change until we resolve to do what we can, with what we have—*now*.

SDIO's Gardner Out; Smith In (Continued from p. 1)

SDIO will lose another key official this summer when Yonas, the program's chief scientist, returns to Sandia National Laboratories. Yonas is serving in SDIO on a two-year leave of absence from the lab which will expire in August.

The top-level turmoil comes as "Star Wars" employees are bracing for a major reorganization. As the multi-billion-dollar research effort has progressed, the job of managing SDIO has become increasingly complicated, officials said. In the absence of a full-time deputy, the entire administrative responsibility has fallen to Abrahamson. At the same time, the number of SDIO employees is scheduled to double to around 200 in fiscal 1987.

"There is a sense as the program gets larger it becomes a bigger management job," Gardner said. "There are stronger organizational structures that could be created."

The new organizational structure officials are mulling would whittle the number of officials who report directly to Abrahamson from the current total of nine down to two. At present, the chiefs of eight separate SDIO departments—from directed energy weapons to resource management—as well as chief scientist Yonas have direct access to Abrahamson.

Under the new structure, set to be unveiled sometime this month, two new layers will be inserted between Abrahamson and his department heads. Directly below Abrahamson will be the new deputy director. Below him will be twin assistant directors, each responsible for one-half of SDIO. Exactly how the office will be divided between the two new assistant directors is not yet known. Gardner said the two slots will probably be filled by individuals already employed by SDIO.

Said one SDIO official: "This takes the day-to-day burden of management off of Abrahamson. It will facilitate management of the program."

NAVY SEEKS 125 ORIONS

The Navy has set July as the month it will ask aircraft manufacturers to bid on a multi-million-dollar contract to build new versions of the P-3 Orion, now built by Lockheed Corp. The Navy hopes to change the airframe of its antisubmarine warfare workhorse, according to officials.

Under the Navy's plan, the service will award a "winner-take-all" contract to build 125 P-3s at a rate of 25 per year.

The Navy is putting Lockheed's aircraft up for competition because service officials believe the company's plane costs too much at $35 million a copy.

The Navy said last week that a contract will not be awarded until 1987. It will require firm fixed prices. "The major competition will be for the airframe and some contractor furnished equipment, while the government expects to continue purchasing and supplying some articles on a government furnished equipment basis. As part of the P-3D competition, the competitors' options such as new engines, reliability and maintainability improvements, survivability improvements and/or enhancements to operational capabilities will be requested," a Navy spokesman said.

Star Wars Feasible, Says Abrahamson

BY DAVID J. LYNCH

The technical feasibility of a "Star Wars" defense has been established, according to Lt. Gen. James Abrahamson, the director of the Pentagon's Strategic Defense Initiative Organization. Abrahamson told an industry group last week the program is moving into a new phase of making the components of a defensive shield less costly.

"We are nearly there," Abrahamson said. "It is no longer a question of 'ifs', it's a question of 'how long', and 'how expensive'." The general's remarks came during a Feb. 26 luncheon address to the American Defense Preparedness Association.

With the resolution of the technical questions ostensibly in sight, Abrahamson said the Pentagon will be stressing ways to make a "Star Wars" defense affordable. "It's not enough to show that it's technically feasible," he said. "We have got to now move into the next phase of the program."

The SDI chief cited the ERIS missile contract recently awarded to Lockheed Missile and Space Co. as an example. The ERIS interceptor should be capable of killing Soviet warheads for less than $1 million, he said. Abrahamson acknowledged that cost goals can not be set for each SDI project, but said estimating component costs will be a "major thrust" of the program in the coming year. "This must be an affordable kind of option for the future," he said.

SDIO officials have also decided to apply fixed price contracting standards to at least one research effort, the troubled Space Surveillance and Tracking System, according to Abrahamson. SSTS has been on hold since last last year while Pentagon officials mulled revisions in the sensor design.

Abrahamson recently returned from a trip to Britain and Israel where he discussed possible allied participation in the research phase of the SDI. While abroad, he reviewed architectural analyses of an anti-missile defense against short-range missiles in both countries. Israeli officials also demonstrated a 30mm cannon they had converted into a railgun, Abrahamson said. Announcement of a formal agreement with Israel on its role in SDI is expected sometime next month.

The SDI is already beginning to benefit conventional military forces, Abrahamson said. "The fallout is already beginning to develop," he said. SDI spin-offs will extend beyond better military gear to the commercial sector, he added. And the SDI chief told the industry group that Pentagon war games have demonstrated that the U.S. and Soviet Union can make the transition to strategic defenses safely. "We can be stabilizing right from the very beginning," he predicted. The actual results of those Defense Department efforts are classified.

topics in terms of how they can contribute to the solution of the broader problems and challenges," they added.

Phase 1 SDI contracts could rise as high as $100,000, executives said, and SDIO is encouraging small high-technology business to form cooperative arrangements with university researchers by involving them in Phase 1 and Phase 2.

Selected Topics

Specific topics that could involve small businesses include directed energy concepts; kinetic energy weapons; sensors for surveillance, acquisition and discrimination; nuclear space power concepts and thermal management; non-nuclear space power and power conditioning; propulsion; system survivability; target lethality; computer architecture and very-high-level language design for battle management; space materials and structures, and space transportation and support.

Proposals are now being accepted by the Strategic Defense Initiative Organization, IST/SBIR, Pentagon, Washington, D. C., by routine U. S. mail. Prospective bidders are asked to interpret the SDI topics in the context of its present mission—a research program to provide a sound basis for making future decisions. □

Railgun Experiments Strive For High Velocity, Repetition

Washington—Strategic Defense Initiative Organization will conduct an electromagnetic launcher experiment in summer, 1988, designed to demonstrate both hypervelocity and high repetition rate firings.

Westinghouse Marine Div., Sunnyvale, Calif., will develop the experiment, named Thunderbolt, in a $31.5-million contract.

Space- and ground-based electromagnetic launchers could be used to defend against all phases of an intercontinental ballistic missile attack. Space-based launchers would be used during ICBM boost, post-boost and midcourse phases, and ground-based launchers could be employed to attack reentry vehicles during their terminal phase.

As basic research on electromagnetic launchers continues, scientists are interested in achieving hypervelocity (in excess of 10 km./sec.) with projectiles weighing up to a kilogram, repetition rates of one shot/sec. and energy conversion efficiencies of 50%.

A new electromagnetic launcher facility—named Checmate, for compact high-energy capacitor module, advanced technology experiment—at Maxwell Laboratories, Inc., San Diego, Calif., became operational last November and is capable of conducting two shots per day (see p. 92). This rate will allow researchers to develop much more rapidly the detailed data base required to make improvements in electromagnetic launcher technology, according to Dr. James A. Ionson, director of SDIO's Innovative Science and Technology section (AW&ST Nov. 18, 1985, p. 117).

This increased firing rate marks a considerable improvement over earlier launchers, such as the one at Picatinny Arsenal, N. J., that can fire only once a month, due to the required replacement of the launcher's barrel rails after each firing because of erosion.

Ionson prefers the term "electromagnetic launchers" to the more common "railguns." The electromagnetic launchers being used for research now are laboratory devices designed to launch small projectiles at high velocities by converting electrical energy into kinetic energy.

Railguns and chemical rockets are potential kinetic energy weapons in any ballistic missile defense. Both, however, are slow compared with directed-energy weapons such as lasers and particle beams. Limit velocity for chemical rockets is approximately 7 km./sec., and electromagnetic launchers must demonstrate velocities in excess of 20 km./sec. before the technology can be considered a serious candidate for a deployed, kinetic-kill vehicle, Ionson said.

While higher velocities are desirable, SDIO officials are concerned that excessive velocities may cause the projectiles to skip off the surface of the target without inflicting sufficient damage to render it inoperable.

SDIO officials are planning to experiment with projectiles of differing composition to counter the projectiles' tendency to shed pieces after leaving launcher rails. The 1-in.-thick steel plate targets are fixed at a distance of 2 meters from the launcher rails, and enough of the projectile has remained intact to penetrate the plate.

Researchers in the Innovative Science and Technology directorate are investigating several issues that affect electromagnetic launcher capabilities, including:

- Effect on the environment of the plasma formed by the vaporization of the conducting foil on the rear of the projectile.
- Recoil and shock effects.
- Electromagnetic pulse effects on the launchers.
- Thermal effects.

Electromagnetic launcher technology has tactical as well as strategic applications. The Navy has considered the use of railguns to replace the General Electric Vulcan/Phalanx close-in weapons system for shipboard air defense. □

U. S. Industry Executives Will Visit Israel

Washington—A group of about 40 U. S. industry executives will visit Israel Apr. 12-20 to explore opportunities for cooperation with Israeli companies in high-technology and space research and development projects, including the U. S. Strategic Defense Initiative.

The executives will meet top Israeli government and military officials and chief executives of Israeli companies for political, economic and technical briefings as well as direct business discussions, according to Joyce R. Starr, organizer of the trip and director of the Georgetown University Center for Strategic and International Studies' Near East program.

The visit will be hosted by the Israeli Ministry of Defense because of the potential for U. S.-Israeli cooperation on aspects of SDI.

The first day's program will include briefings by ministers of defense, science, industry and commerce, finance and economy, the air force and navy commanders and the chief of the general staff as well as military chiefs of armament development, intelligence and defense research and development.

Israeli Prime Minister Shimon Peres is scheduled to host the opening dinner, Starr said.

Second and third day will consist of visits and contacts focused on the needs of individuals or small groups of participants, with Israeli corporations including military contractors Israel Aircraft Industries, Israel Military Industries, Rafael Armament Development Authority, Elron Electronic Industries, El-Op Electro-optics Industries, computer systems producers Elbit and Elisra and Tadiran, Ltd.

Civil products manufacturers to be visited will include producers of communications systems, computerized publishing systems, medical lasers, microelectronics, quality control computer systems, pharmaceuticals, robotics, fiber optic data transmission and distribution systems and biotechnology.

The Israeli embassy in Washington is supporting the planned visit, an official said.