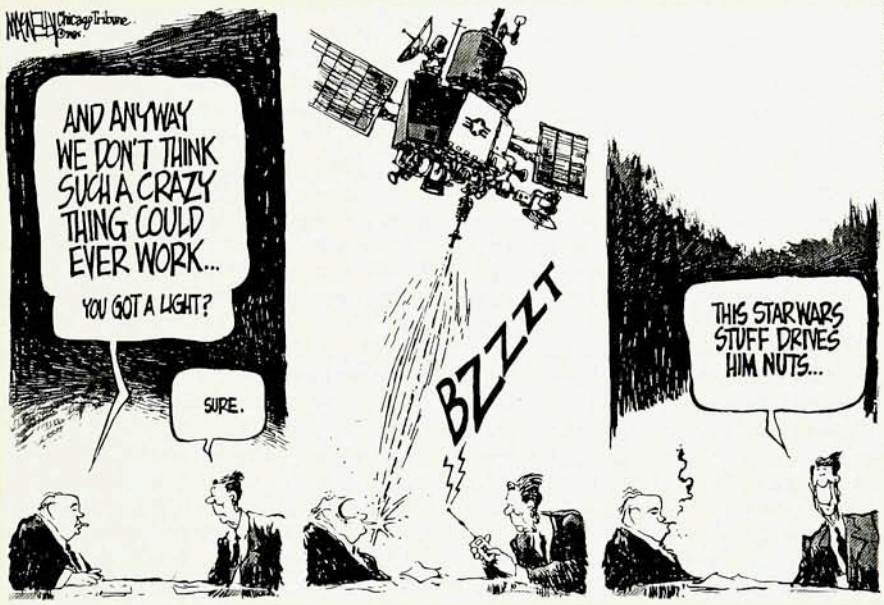
SDI: Losing momentum over what is affordable and possible



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For 3½ years after he revealed his vision of a Strategic Defense Initiative to make nuclear missiles "impotent and obsolete," President Reagan insisted it was not a "bargaining chip" to be used in negotiations with the Soviet Union. When perfected, the President explained, SDI would be a way to deter nuclear aggression by relying on defense rather than on the threat of devastating nuclear retaliation.

The paradox is that SDI, or "Star Wars," as it is commonly known, has had the salutary effect of bringing the Soviet leader, Mikhail Gorbachev, to the negotiating table, first at Geneva in November 1985 and again last October at Reykjavik, where he proposed what US arms control specialists inside and outside the Administration had anticipated: a "grand compromise" by which the US would accept significant limitations on SDI in exchange for phased elimination of the world's nuclear arsenals by the year 2000. Some foreign policy analysts in the US and Europe characterize the USSR's case against SDI and its campaign for nuclear disarmament as simply propaganda gambits. These observers see the Soviet position as an attempt to sow discord in Washington and world capitals.

In two days of talks in Iceland, Gorbachev and his aides argued that the real purpose of SDI is to give the US military and technical superiority, along with a safety net against retaliation, thereby increasing the first-strike capability against the USSR. Reagan, for his part, insisted just as forcefully that SDI would produce a purely defensive "peace shield" against all offensive nuclear missiles and therefore it promises the best moral alternative to the orthodox deterrence based on mutual assured destruction, or MAD—a sardonic term for a strategy that Reagan compares to two men pointing loaded revolvers at each other.

Competition. With neither leader willing to accept the other's reasoning, the weekend summitry ended in disarray and discord. Still, as Michael Mandelbaum and Strobe Talbott wrote in *Foreign Affairs* (Winter 1987), "SDI had undoubtedly played an important part in inducing the Soviet leadership to rethink what common security meant in the strategic nuclear competition." SDI seems to have compelled the Soviets to face up to the awesome consequences of an excessive accumulation of land-based ballistic missile warheads and the prospect of a high-technology race with the US that most observers are convinced Americans would surely win.

The contentious differences over SDI at Reykjavik had an ironic twist: Despite the leverage that SDI apparently holds for arms control and growth of new technologies, few of its most ardent friends or most bitter foes expect the program to survive the Reagan Presidency, at least not in its current manifestation. A few weeks ago, a member of a blue-ribbon Defense Department panel, Robert Sproull, president emeritus of the University of Rochester, told friends he's skeptical about Star Wars enduring beyond Reagan's retirement, basically for political reasons. Similar views were recently expressed in a letter to Reagan by conservative members of Congress, including Senator Dan Quayle (Republican of Indiana) and Representative Jack F. Kemp (Republican of New York), who complained that spending the next 10 years studying the feasibility of a far-out defense system "is not politically sustainable." Their position, endorsed by Edward Teller and by former Secretary of State Alexander Haig, is that SDI should concentrate on relatively simple, essentially ground-based technologies to protect important military installations and major population centers in the US and Europe. They propose launching an operational system by the end of the decade, while continuing to support longer-range space defenses for the decade after that.

Criticism. More concerned about the strategic implications of Star Wars is James R. Schlesinger, who was Defense Secretary in the Nixon and Ford Administrations and Energy Secretary under Carter. He calls SDI "half Buck Rogers, half P. T. Barnum." At an arms control forum in Washington sponsored by the American Association for the Advancement of Science on 4–5 December, Schlesinger observed that the President's claim that SDI "holds the promise of changing human history" may yet come true, not because

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an impenetrable missile defense may be achieved but because it may lead to eliminating nuclear arms altogether.

So when Reagan walked out on Gorbachev after refusing to accept the proposed tradeoff for confining Star Wars to the laboratory, said Schlesinger, "SDI in effect saved us from our own folly." Gorbachev's proposal was not to eliminate all nuclear weapons, Schlesinger asserted, but to eliminate all ballistic missiles, "which would disrupt the defense strategies of our allies in Europe and cast our own strategy back to the 1950s, when our deterrent was located at 52 bases of the Strategic Air Command."

Schlesinger explained SDI as the paradigm of a defense strategy driving weapons technology. "Normally it's the other way round, as it was when the airplane and the atomic bomb were invented and national security policies followed in due course." As for SDI's future, he worried that "whatever momentum of SDI existed even a few months ago is dissipating." Schlesinger's reading of SDI suggests it is coming apart for technological, strategic, fiscal and, mainly, political reasons.

Even now, halfway through Reagan's second term, SDI is being reshaped. The program has already demonstrated that a target can be tracked in space, a missile can be attacked in flight and scientific and technological advances for a defensive system can be achieved. Nevertheless, problems are now apparent that make SDI as Reagan envisioned it much more vexing.

In the Pentagon's budget SDI has grown only about half as expansively as the Administration had wanted. (See box, page 50.) When it formally began in January 1984, SDI inherited roughly $1 billion worth of missile defense programs already under way at national laboratories and military contractors. The budget passed last October gave the program $3.5 billion for fiscal 1987, but not without a struggle in Congress to reduce the President's request from $5.35 billion. Indeed, the 1987 budget is well below the figure that a study committee under James C. Fletcher, now head of NASA, judged necessary back in 1983 to explore all the approaches before a decision on a space defense could be made.

Approaches. In testimony before the House Armed Services Committee months earlier, SDI chief James A. Abrahamson, then an Air Force lieutenant general, and since raised by Reagan to four-star general, specified that even a $1 billion cut in 1987 appropriations would have "a major, major impact on our ability to go forward" and would result in putting off the ultimate decision for SDI. Budget cuts in 1986 had forced SDI program managers to place limits on several technologies and made it impossible to pursue a variety of approaches.

Thus only one type of ground-based laser, a free-electron laser at Lawrence Livermore, is in research, while other free-electron lasers are held back. Research on chemical lasers and the once vaunted x-ray laser, which needs to be powered by nuclear explosives, also seems less attractive. Space-based lasers have been shelved. Work on electromagnetic railguns, which would hurl projectiles at hypersonic speeds and destroy missiles with the force of impact, has been cut back from early plans in favor of developing interceptor missiles that could be fired from platforms in space or from the ground. At the same time, particle beam technologies, once considered useful only as attack weapons, are now getting attention as devices to help discriminate between actual missiles and decoys.

Decisions. By one count, cited last May in a staff report for three Democratic senators, almost half of SDI's projects have been restructured or reduced. In another report issued last year, a panel of leading computer programmers concluded that it is virtually impossible to surmount the largest single obstacle to Star Wars: to devise software without errors and hardware without "bugs" that would work reliably the first time they were put to the test of actual battle management. The first battle in a nuclear war—and possibly the last—would most likely be under the control of computers programmed in advance based on assumptions about attacks and responses. In a matter of seconds, or at most minutes, the system envisioned by Reagan and SDI officials would have to make all the decisions that would be made during a conventional war by legions of reconnaissance experts, field commanders, the Joint Chiefs of Staff and the President and his aides in a period of days or weeks. The system might have to react so fast "there would be no time to wake the President," one SDI official said.

Possibly just as daunting is the job of discriminating between real warheads and dummy decoys, which so far have not yielded to passive infrared sensors, as it was once thought they would, or even to active sensors such as radar. Instead, conclude SDI officials, the job will require interactive discrimination: hurling particle beams or lasers at targets to determine whether they are genuine or just decoys.

Requisites. Still another problem is how to launch the enormous number of space platforms that will be required. SDI officials told the Senate Appropriations Committee that as many as 2000 shuttle launches may be necessary to lift the system into space. NASA expects to build up to a maximum of 16 launchings per year after the shuttle starts to fly again in 1988, but many space scientists and even some NASA officials doubt whether that schedule is attainable.

SDI is at such an early stage and involves such exotic technologies that few people have a clear idea of how well it is proceeding. And because much of the work is classified "secret" or above, it is difficult for outsiders to judge the program's progress. Abrahamson and Defense Secretary Caspar W. Weinberger speak of "major breakthroughs" and "amazing progress," but only a few demonstrations have been announced—and then always in conjunction with an appearance by Abrahamson or Weinberger before some key committee of Congress. In 1984 an interceptor, fitted with a long-wave infrared sensor, destroyed a dummy warhead in space over the Kwajalein missile range. In 1985 one laser beam seared through a Titan missile casing on the ground and another beam was bounced off a shuttle mirror in space. Then last September, just in time for appropriations hearings, a satellite tracked, intercepted and destroyed another test satellite by crashing into it.

By all accounts of SDI officials the centerpiece of the program is the free-electron laser (PHYSICS TODAY, April 1985, page 17). The idea at first was to station free-electron lasers in space, where they would bounce light beams off mirrors and strike missiles in their boost stage with enough power to destroy them. This has been succeeded by a plan to place similar lasers on high ground, perhaps on mountaintops, where they could be within easier reach of large power sources and defended more easily than in space, as well as have the additional virtue of being less expensive.

To be considered successful all SDI technologies would need to meet the two criteria set forth by Paul H. Nitze, the State Department's veteran arms control and strategic planning expert: The system has to be survivable against enemy attack, which is a critical problem for anything stationed in space, and it needs to be "cost effective at the margins," meaning it would cost the Soviet Union more to overwhelm the system than it would cost the US to maintain it. SDI's former chief scientist, Gerold Yonas, emphasized in PHYSICS TODAY (June 1985, page 24) the importance of Nitze's standards.

Politics. Nitze also has emphasized that a desirable, possibly essential, requirement for attaining Reagan's goal of a defense fully capable of

Slicing pie in the sky

Defenders of the faith in SDI argue that Congress is trying to starve it to death. True, the Reagan Administration request for the program was thinned down by $901 million in fiscal 1986 and reduced by almost $2 billion for the year that began last October. Still, SDI can hardly be described as anorexic. Its appropriations have more than doubled in the past three years, from $1.62 billion in fiscal 1985 to $3.53 billion for 1987.

If Congress continues to make ever deeper cuts in the program, which is likely in the political and economic climates in the country today, as much as $8 billion may be eliminated from the Pentagon's budget requests over the first five years alone. It is not surprising that many now doubt whether a sound decision can be made in the early 1990s about the development, let alone deployment, of President Reagan's missile shield.

The table below illustrates the persistently widening gap between Pentagon expectations and Congressional realities. The first of the three tiers of figures indicates the budgets that the Pentagon had planned to submit for missile defense before the President's "Star Wars" dream speech in March 1983. The numbers in the first line indicate a modest Defense Department program. The second line shows proposed budgets for work to be funded by the Department of Energy. The sums would have covered R&D for the limited deployment of a once planned ground-based missile defense system and a new tracking network for missiles and satellites. Events overtook this budget and the figures were never submitted to Congress. The second tier contains the proposed and projected SDI spending requests by the Defense and Energy Departments for fiscal 1985–89, assuming annual rises of 15%. Such a growth pattern is considered wildly optimistic. The third tier shows the money Congress actually appropriated for Star Wars in fiscal 1985–87 and the amounts it might approve in 1988–89. While the bottom line also shows a 15% increase from 1986 to 1987, the projections for 1988 and 1989 are not likely to be attained. The total five-year gap between requests and reality is indicated at $7 billion, but even conservative wisdom on Capitol Hill now figures the gap will be between $9 billion and $9.5 billion for the period.

	1985	1986	1987	1988	1989	Total
			(millions of US dollars)			
Before SDI program						
Defense	1 527	1 802	2 181	2 699	2 982	11 191
Energy	210	295	365	439	505	1 814
Total	1 737	2 097	2 546	3 138	3 487	13 005
SDI budget requests						
Defense	1 777	3 722	4 803	5 221	6 282	21 805
Energy	224	288	603	481	838	2 434
Total	2 001	4 010	5 406	5 702	7 120	24 239
SDI appropriations						
Defense	1 397	2 759	3 213	3 695	4 249	15 313
Energy	224	350	317	365	420	1 676
Total	1 621	3 109	3 530	4 060	4 669	16 989

protecting the nation's cities, industries and military installations is reducing the number of nuclear weapons in the Soviet Union. He goes even further to suggest that stability between the superpowers would be enhanced if they both developed and deployed missile defense systems more or less in parallel. Nitze's message is clear: Technical progress must be matched by political agreement.

Joseph S. Nye Jr, director of Harvard University's Center for Science and International Affairs, claims SDI "could be part of the solution" to a negotiated arms control—"though some officials make it part of the problem." As Nye sees it, "there is no doubt that the threat of accelerated American technological–military progress in space is one of the incentives for Soviet movement at the arms control talks. But to reap that benefit requires a flexibility about the scale and pace of the program that some within the Reagan Administration resist." Weinberger and Nitze argue that they oppose extending the 1972 Antiballistic Missile Treaty or "doing anything that would prevent our doing all the things we need to do" to develop SDI.

Technology. In opposition to this, Harold Brown, former director of the Livermore National Laboratory and Defense Secretary in the Carter Cabinet, states that SDI is not a realistic possibility because the technology is largely mythic. Still, because Reagan's concept of SDI would rely on technology that is not likely to be available until well into the 21st century, it is relatively easy to reconcile continued adherence to the ABM Treaty and even the Strategic Arms Limitation Treaties with carrying on SDI laboratory research. Brown, Nye and other arms strategists identified with Democratic Administrations worry that the US is locking itself into immature technologies by spending billions on a program they see as "pie in the sky."

"The Soviets have enormous respect for US technology," says Marshall Goldman, associate director of Harvard University's Russian Research Center, "probably more than Americans themselves." Nonetheless, as the development of nuclear weapons and Sputnik demonstrated, Soviet technological competence should not be entirely discounted, especially if it's for defense. In this context, Goldman observes, Gorbachev and his Politburo would unquestionably forgo their avowed effort to rebuild the Soviet economy in order to compete against the US for military supremacy in space. "The USSR could not allow the US to proceed unilaterally in the research and development of a strategic defense force," declares Brown. It would be prudent of Gorbachev and his colleagues in the Kremlin, he says, to "mount a comparable R&D program simply to guard against any technological breakthrough that just might come out of SDI." Nor would this be all, Brown says. In addition to whatever else the Soviets are doing, they would no doubt increase their offensive forces, Brown believes, by increasing the number of nuclear warheads and ballistic missiles to overwhelm whatever defense the US may place in space.

Counteractions. The Soviet Union indicates it has picked up the US gauntlet. On 17 December the Kremlin held a news conference to publicize *Weaponry in Space: The Dilemma of Security*, a book that describes in general terms how it proposes to "suppress" or "neutralize" SDI. It would use precisely the same means that Brown, Richard Garwin of IBM, and the Union of Concerned Scientists have spoken about so frequently: development of space mines, fast-burn boosters, nuclear explosions in the upper atmosphere to black out battle management systems, larger numbers of land-based ballistic missiles, more warheads and dummy missiles, and carbon-fiber coatings on missiles to reflect laser beams. Roald Z. Sagdeyev, director of the Soviet Space Research Institute, acknowledged that the countermeasures were being developed to deal with the central criteria that Nitze had set down for SDI—survivability and cost effectiveness. "The Americans have given no hint how they could possibly make space-based battle stations invulnerable and we think cost efficiency favors countermeasures by a wide margin," Sagdeyev said in Moscow.

The Reagan Administration has been asserting since the President's SDI speech that the Soviet Union is far ahead of the US in developing Star Wars high tech. This contradicts a variety of CIA and Defense Department assessments, which say that while the USSR has extensive defenses,

SDI champions and critics: Frederick Seitz (top left) with Robert Jastrow of the Marshall Institute; and James R. Schlesinger (lower left) and Harold Brown, both former Defense Secretaries.

such as the antiballistic missile array around Moscow, there is little evidence that it has surpassed the US in laser research and computer technology. US defense experts agree, however, that the Soviets have built thousands of air defense radars, antiaircraft missiles and jet fighter–interceptors that would be used to counter US bombers and cruise missiles.

Revisionists. Champions of SDI in Congress, the press and the scientific community are now urging the President to speed up the program lest its antagonists redirect its course. One staunch advocate, Gregory A. Fossedal of the Hoover Institution, wrote, under the headline "SDI for Democrats" in *The New Republic* (17 November 1986), that next year's budget could be cut in half by eliminating work on some laser beams and other exotic "kill mechanisms" and by using what's left in the program to build an advanced defense with less futuristic technology, such as ground-based interceptor rockets and tracking systems operated out of aircraft and satellites. This, wrote Fossedal, would be an SDI acceptable to all but the most obstinate opponents.

This suggestion was followed on 15 December by a report of a George C. Marshall Institute panel, which included Frederick Seitz (former president of the National Academy of Sciences and Rockefeller University), Robert Jastrow (founder and former director of NASA's Goddard Institute for Space Studies) and William Nierenberg (retired director of the Scripps Institution of Oceanography), evaluating the options for deploying a kind of "start up" Star Wars system in the 1990s. Early deployment of so-called endoatmospheric reentry vehicle interceptors, a land-based system of the sort used in the Delta rocket experiment earlier this year, could be achieved by 1992—though, say the authors with some bite, "if management and procurement practices are conducted on a business-as-usual basis, deployment of the ERIS will not commence until the mid-1990s." The panel claims that if the decision to deploy such a system is made in 1987, then ERIS could provide better than 90% protection by 1994 against an attack consisting of 10 000 warheads and 100 000 decoys.

The Marshall Institute panel seems to advocate an "incremental approach to deployment of the complete defense." The report says, "It would provide the earliest possible protection against accidental or irrational launches and would also provide a useful degree of deterrence against limited attacks on key military sites." By using interactive discrimination with lasers and particle beams that are now in research stages but could be available sometime in the 1990s, the effectiveness of the ERIS defense, the panel maintains, could "well be in excess of 99%." What is the value of such a defense? With this level of effectiveness, the report asserts, ERIS will virtually foreclose the possibility of a nuclear first strike against the US. The reason is that the adversary will not attack first, the report says, "unless he has calculated a very high probability of its success."

While the report sets lower sights than Reagan's original version of SDI, it is not expected to win many hearts and minds on Capitol Hill, where 49 senators, including nine Republicans, signed a letter last May objecting that "the SDI program is being rushed to a premature development decision in the early 1990s" and "budget growth in SDI has outpaced the progress in technology." In fact the situation is apt to be worse in the 100th Congress, which begins on 6 January, because some of SDI's partisans were defeated last November by avowed opponents of Star Wars.

The cost of the Marshall panel's initial system is figured at $54 billion and full operational capability is estimated at $121 billion in 1986 dollars. What's more, the annual cost of operation is somewhere between $10 billion and $15 billion. While not cheap by any reckoning, the system would become more expensive as it expanded.

Analysis. Similarly, cost calculations by two defense analysts, Barry M. Blechman of the Johns Hopkins University Foreign Policy Institute and Victor A. Utgoff of the Institute for Defense Analysis, revealed last July that developing and operating Star Wars over a 10-year period will tax US resolve to have both an SDI and conventional arms. The report, which makes several optimistic assumptions about technical progress in space weaponry, compares four systems, each with a different level of technical sophistication. The cheapest consists only of ground-based interceptors and would cost $150 billion to procure and another $9 billion per year to run. The most expensive is estimated at $630 billion to $770 billion (in 1986 dollars) for acquisition and operation over a 10-year period. The estimate assumes that the Star Wars system could be made 90% effective by hardening the space battle stations against directed-energy weapons. A lower success rate would mean more stations would have to be deployed. The report also assumes that satellites can be made resistant to attack without much added cost—a formidable technical challenge.

A report by the Office of Technology

Assessment, issued in September 1985 as the centerpiece of Congress's attempt to clarify the issues rather than to resolve the debate over Star Wars, reached the conclusion that funding SDI in line with Pentagon plans would mean settling for immature technologies in the early 1990s. Already, SDI has been trimmed back to a point where what was once described as a program limited only by what is technically feasible has been transformed into one constricted by what is fiscally affordable and politically possible.

—IRWIN GOODWIN

Making waves: Poindexter sails into scientific databases

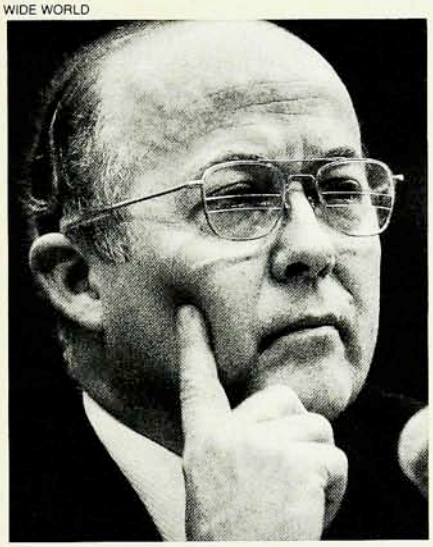
It probably seemed like a great idea, but it confirmed the worst fears of the information industry and the scientific community. Last 29 October, Vice Admiral John M. Poindexter, then President Reagan's national security adviser, issued a policy paper before he left the ship of state over the clandestine Iran–Nicaragua contra affair. The Poindexter paper calls for sweeping new government controls on data and information stored in computer systems and transmitted by electronic communications. The reason for this policy is the fear among many at the White House and on Capitol Hill that a great deal of sensitive but unclassified scientific, technical and even political and economic information is reaching the Soviet bloc.

"Sensitive" data have been defined by the Defense Department for some time as information under its control that is not classified but is subject to export control restrictions. In Poindexter's dictionary the term means "information the disclosure, loss, misuse, alteration or destruction of which could adversely affect national security or other Federal government interests. National security interests are those unclassified matters that relate to national defense or foreign relations.... Other government interests are those related but not limited to the wide range of government or government-derived economic, human, financial, industrial, agricultural, technological and law enforcement information, as well as the privacy or confidentiality of personal or commercial proprietary information provided to the US government by its citizens."

Crackdown. Though scientific and technical research is not on Poindexter's list, it is precisely that subject that has haunted the Reagan Administration since it came to Washington in 1981. When it began cracking down on meetings of science and engineering societies attended by researchers from Warsaw Pact countries or China, tensions increased between scientists and the government. Reagan's Executive Order 12356 of 2 April 1982 sanctioned controls on access to research results beyond the procedures established by every President since Truman. Accordingly, the intelligence groups within the Defense, Commerce and Energy Departments stepped up their activities at open meetings.

A furor followed. In an effort to set a prudent course, a special panel of academics, scientists and industrialists brought together by the National Research Council issued a report, *Scientific Communication and National Security*, concluding that between basic research, which should remain open and unfettered, and classified work there are some sensitive "gray areas" (PHYSICS TODAY, November 1982, page 69). In these, stated the panel, headed by Dale R. Corson, president emeritus of Cornell University, the government might reasonably impose some controls, using contract restrictions in preference to export regulations or security classifications.

WIDE WORLD



POINDEXTER

Directives. While the government continued its practice of restricting reports of research that its authors considered unclassified (PHYSICS TODAY, June 1983, page 41), the President issued two National Security Decision Directives signed a year apart. Both had the effect of strengthening the government's hand in keeping secret any data and information its bureaucrats claimed "could adversely affect the national security."

The first, NSDD 145, issued on 17 September 1984, created a national policy on security for telecommunications and automated information processing systems under a Cabinet-level interdepartmental group that was directed to explore ways of protecting not only government data and information but private or proprietary material in electronic systems. The President's order stated that a "comprehensive and coordinated approach" was required to regulate "information, even if unclassified in isolation, [which] often can reveal highly classified and other sensitive information when taken in aggregate." It directs the Secretary of Defense to take charge of the situation.

The second was NSDD 189, signed by Reagan on 21 September 1985. It sought to calm the troubled waters that the government had stirred up around scientific and technical information. After the government used export control regulations and a 1981 amendment to the Atomic Energy Act to exclude dozens of unclassified papers from some scientific and technical conferences where foreign nationals were present, several professional societies protested the action and a few went so far as to impose a kind of self-censorship (PHYSICS TODAY, November 1985, page 55). NSDD 189 was promulgated to explicitly exempt unclassified "fundamental research" from restraints on communications.

Loophole. Even though it allowed for no shadings between open and classified research, the directive carried a loophole permitting each agency to periodically review all research in progress "for potential classification ... as provided in applicable US statutes." In a covering memorandum to the directive, the President's national security adviser, Robert C. McFarlane at the time, reminded both bureaucrats and researchers, just in case they may have missed the point, that the policy "preserves the ability of the agencies to control unclassified information using legislated authority expressly for that purpose in applicable US statutes."

NSDD 189 marked an uneasy truce in the government's battle to keep scientific and technological secrets. The Poindexter policy paper, with its emphasis on electronic databases and information systems, only slightly changes the course of the battle but renews the war.

Question. The strategy was enunciated to members of the Information