ABM: Critical Report by Scientists Brings Sharp Pentagon Rebuttal

"There is no need for a decision to deploy the Sentinel/Safeguard ABM system at this time. [It] cannot perform effectively the missions suggested for it."—From a report by Jerome B. Wiesner and scientific colleagues.

"One does not obtain a meaningful technical judgment by taking a vote of the scientific community or even of Nobel laureates."—John S. Foster, Jr., director of defense research and engineering.

The technical and political arguments over the proposed antiballistic missile (ABM) system crystallized last week with the release of an unusual document—a sort of "Summa Theologica" of the anti-ABM forces.* The document—a booklength criticism of the Nixon administration's proposed Safeguard ABM system—was prepared for Senator Edward M. Kennedy (D–Mass.) by a group of eminent scientists, academicians, and public figures, including two former presidential science advisers, a Nobel Prize winner, and high officials in recent Democratic administrations. It is believed to be the most voluminous and comprehensive public attack on a major weapons system ever made by prominent members of the scientific community.

The study was commissioned by Senator Kennedy last February in order that Congress and the public might have a "non-Pentagon report" to weigh against the official administration reports justifying the ABM. The authors attempted to develop what they call the "other" side of the argument, and their conclusions, not surprisingly, are diametrically opposed to the Pentagon's reasoning. Their report asserts that the ABM is not technically capable of performing the missions assigned to it, that it is not needed at this time, and that it would probably accelerate the arms race, thus decreasing national security rather than increasing it.

These conclusions are given weight by a roster of distinguished names. The report was prepared under the direction of Jerome B. Wiesner, science adviser to the late President Kennedy, and Abram Chayes, former legal adviser to the State Department. It was reviewed "for factual accuracy" by George B. Kistiakowsky, science adviser to the late President Eisenhower, and Paul Doty, of Harvard, both chemists. And it contains separate chapters by such notables as Arthur J. Goldberg, former U.S. Ambassador to the United Nations; Theodore C. Sorenson, special counsel to the late President Kennedy; and Bill Moyers, special assistant to former President Johnson. Scientific contributors include Nobelist Hans Bethe, of Cornell; Leonard S. Rodberg, of the University of Maryland. Jeremy Stone, of Stanford; and George Rathjens, Steven Weinberg, and Bernard Feld, all of MIT. The separate contributors took responsibility only for their own chapters, but Wiesner, Chayes, Rathjens, and Weinberg authored the section of the report setting forth the overall argument and conclusions.

Obviously stung by the attack, the Pentagon promptly sent its own top scientist into the ring to criticize the critics. At a hastily called press briefing, John S. Foster, Jr., director of defense research and engineering, charged that it had been "impossible for the authors . . . in the time available . . . to produce a paper which meets the standards of the scientific profession." Foster claimed the report "contains a number of errors and is internally inconsistent." He also said he found "nothing in the report that has not been analyzed in depth by the Department of Defense and the technical community over the past 10 years."

Meanwhile, in a development which received little attention in the press, prominent scientists associated with the American Security Council, an industry-supported group dedicated to "meeting the Communist challenge to world freedom," issued a 60-page booklet supporting deployment of the ABM.† The Council's report was prepared by a 31-man committee headed by Nobelist Willard F. Libby, of UCLA; William J. Thalor, Georgetown University physicist; and Retired Air Force General Nathan F. Twining, former chairman of the Joint Chiefs of Staff. The group also included Edward Teller, of the Lawrence Radiation Laboratories, and Nobelist Eugene P. Wigner, of Princeton.

Thus the arguments for and against the ABM were drawn into somewhat sharper focus last week. Most of the arguments had been made previously—either in Senate ABM hearings or in public statements—but the case against the ABM, particularly the technical objections, had never been presented quite so comprehensively, and Pentagon scientists had not felt obliged to defend themselves quite so vigorously. The net result of last week's developments, when coupled with the debate that has been carried on in Congress and in the press for several months now, was to present the public with more information for judging the desirability of a weapons system than ever before. There are pitfalls in this situation, but, on balance, it seems much preferable to the old practice of having costly weapons systems devised by small groups of experts and then approved by docile congressional committees which seldom ask questions.

Shifting Objectives

The framework of the ABM debate has shifted considerably in recent months. The Johnson administration's version of the ABM—known as Sentinel—was aimed primarily at defending the nation's cities against a possible light ICBM attack from Communist China in the mid-1970's, but it also carried an option to add additional sites to protect our own ICBMs against Soviet attack if the threat ever warranted. However, the Nixon administration—reacting to a storm of protests over the original plan and responding to what it described as "new" intelligence data—has reversed this emphasis. Nixon's proposed Safeguard system seeks primarily to protect our land-based retaliatory forces against direct attack by the Soviet Union, and secondarily contains an option to protect the

* The report, entitled *ABM: An Evaluation of the Decision to Deploy an Antiballistic Missile System*, will be published early next month in a hardback edition by Harper & Row, priced at $6.95, and in a paperback edition by New American Library, priced at about $1.

† Available from the American Security Council, 1101 17th Street, NW, Washington, D.C. 20036; $1.50.

population from a Chinese missile attack or an accidental missile launch from any source. Neither the Johnson nor Nixon administrations believe it would be possible to protect the population against the kind of massive attack the Soviet Union is capable of launching.

The Nixon administration stresses that its Safeguard system would be installed in phases, with the first installations being placed so as to protect two ICBM bases in Montana and North Dakota, and with options being left open as to whether future installations should be added to protect additional missiles or to protect bombers or to provide "thin" protection for the entire population against a Chinese attack.

Despite the changed emphasis of the ABM system and President Nixon's all-out endorsement of the system as vital to national security, the intensity of the opposition does not seem to have diminished appreciably. Most of the same arguments that were raised against the Sentinel system have been raised against Safeguard as well. The principal contentions of each side in the debate are summarized below.

Is an ABM Needed?

The United States has long sought to deter deliberate nuclear attack on this country by maintaining the ability, even after a surprise attack, to inflict unacceptable damage on an attacker. To achieve this ability, we have developed a diversified array of "deterrent" or retaliatory forces—including land-based ICBMs, long-range bombers, and Polaris submarines—and have tried to make these forces relatively invulnerable through such techniques as dispersal and "hardening" of ICBM sites. Much of the ABM debate turns on the question of whether our deterrent forces are still relatively secure, of whether they have been endangered by recent Soviet advances in military technology and weapons deployment and hence need the additional protection of an ABM system.

Secretary of Defense Melvin R. Laird has warned that the Soviets may be moving toward a "first-strike" capability—that is, the ability to launch such a devastating surprise attack that we could not respond effectively. He has stated that the Soviet Union already has in being or under construction more ICBM launchers than the United States; and he has released previously classified information indicating that the Russians, since last December, have been rapidly deploying a very heavy ICBM, known as the SS-9, whose size, accuracy, and ability to carry multiple warheads pose a particular threat to our own missile sites. Laird has also warned that our Polaris submarine fleet may be endangered by Soviet advances in antisubmarine warfare, and that our land-based bombers may be vulnerable to sneak attack by new Soviet missile submarines or by Russian development of a Fractional Orbital Bombardment System. Defense officials insist that Laird's assessment is based on "new" intelligence.

However, the report prepared by Wiesner and Chayes states that Laird's assertions are "not based on any intelligence about new weapons systems. They represent his interpretation of facts that have, in the main, been known for some time, but have not been viewed heretofore by the responsible officials as signalling a Soviet attempt to attain a first-strike capability." Wiesner and Chayes suggest a "less threatening interpretation" of the intelligence data, namely, that the Russians are catching up with our earlier build-up and are primarily developing second-strike weapons. "The non-existent bomber gap of the early fifties, and a similar missile gap of the early sixties—and the vast armaments we built to fill them—are earlier monuments to our propensity for exaggerating Soviet capabilities and intentions," their report says.

Even if Laird's predictions turn out to be correct, the Chayes-Wiesner report argues, the "lead-time" in developing and deploying weapons systems is so great that there will be ample time to take protective measures after a year or two, when the present intelligence picture has been clarified.

Whether a year or two's delay would be dangerous or not is a matter of disagreement. Secretary Laird told a Senate committee that the first two ABM sites must be included in the budget now before Congress for approval if our deterrent is to remain credible in the years after 1973. On the other hand, Daniel J. Fink, who was in charge of the Pentagon's ABM research program from 1963 to 1967, told the same committee, shortly before Nixon unveiled his Safeguard system, that he would be "hard pressed to say there would be any real danger" in delaying a year or so.

The proposed Safeguard ABM system is perhaps the most complicated weapons system yet devised, and there is considerable controversy over whether American technology is equal to the job. The chief components of the system are missiles, radars, and computers. A large, long-range radar, called the Perimeter Acquisition Radar, or PAR, is designed to detect attacking missiles while they are still some 1000 to 2000 miles away. The PAR tracks the target and feeds information to a computer, which computes a probable point of intercept. As the missile approaches closer, it is picked up by a second radar, known as the Missile Site Radar, or MSR, which tracks and then guides a large ABM missile, called Spartan, to an intercept point high above the atmosphere and several hundred miles away. If the Spartan fails to destroy the enemy warhead, the MSR then sends up a fast-accelerating Sprint ABM missile to intercept the incoming warhead within the atmosphere, at a distance of 25 miles or considerably less. Both the Spartan and the Sprint ABM missiles carry nuclear warheads.

Will the ABM Work?

Can this complex system be counted on to operate reliably? According to the Chayes-Wiesner report, "Safeguard is unlikely to perform according to specifications in the event of nuclear attack." The report states that each of the system's components—missiles, computers, and radars—"is at the extreme of sophistication for its type." It also notes that the system requires "extraordinary coordination" among these elements during the 20 minutes or so that are left between the time an incoming warhead is spotted and the time it must be destroyed.

The report particularly singles out the computers as a likely source of trouble. It says the computers would be "the largest and most complex ever built" and that the programming would have to be "more sophisticated and complex than any accomplished so far." Leonard S. Rodberg, a University of Maryland physicist and former chief of the science office at the Arms Control and Disarmament Agency, states flatly: "Many computer engineers currently involved in the project profess uncertainty as to whether they will ever be able to design the software, much less assure that all sources of potential failure have been removed." Rodberg says the ABM computer system would use a new "time shared" approach that is "in its infancy." He says the first practical time-sharing system became operative only 4 years ago, and

that our largest computer firms have encountered "severe difficulties" in developing reliable small-scale systems for commercial use.

The report also raises questions about the reliability of the missiles and radars. It quotes an article by Fink, former deputy research director at the Pentagon, stating that offensive planning must assume that only 41 to 65 percent of our offensive missiles will function reliably. If this is true for the "simpler" offense problem, the report says, "it would be folly to rate the reliability of defensive missiles any higher." The report also estimates there is a 72 percent chance that one or more MSR radars will be out of service at any one time in the fully deployed Safeguard system.

Yet, despite all these uncertainties, the report says, "there will be no possibility for realistic testing of the system as a whole in the setting in which it will be called upon to operate." The report asserts that it is impossible to simulate realistically the conditions that would prevail during a surprise blitz attack by a significant number of nuclear-armed missiles; that we cannot know what attack patterns and deceptive countermeasures an adversary might use to overwhelm the ABM; and that the system will have to operate in an environment involving numerous nearby simultaneous nuclear explosions, whose possible blackout effects on the ABM radars and missiles is not well understood. The nuclear environment cannot be simulated, partly because of the atmospheric test ban treaty, but more fundamentally because we can't very well explode nuclear missiles over our own defense system.

The authors argue that past experience with both simple and complex military systems, even after extensive testing and correction, has been discouraging in terms of reliability. They note that the M-16 rifle and F-111 (TFX) plane failed to work satisfactorily when first put into the field, that five demonstration firings of ICBMs for Congressmen have failed, and that two Air Force fighters were unable to hit towed targets the first time they fired their rockets in a test. Among more complex systems, the authors state that the SAGE air defense system, "after 15 years and the expenditure of more than $20 billion," still does not provide "a significant capability to defend against a well-planned air attack"; and that the Ballistic Missile Early Warning System once misidentified the moon as a bunch of incoming warheads, a situation which could have produced "the greatest tragedy in history" had not "cool wisdom" and "lack of confidence" in the new system prevented our release of a counterstrike. They also cite numerous other alleged problems with systems ranging from computerized airline reservations to the Strategic Air Command Control System.

Even if all the ABM components operate reliably, the authors argue, it would still be relatively easy for an aggressor to overcome the ABM through various countermeasures. The report says the long-range Spartan missile defense "can be easily penetrated" by fooling the system with decoys, or by blacking it out with nuclear explosions or electronic jamming techniques. The short-range Sprint defense is less easily overcome, the report admits, but is still vulnerable to skillful offensive tactics and evasion. Finally, the whole system is vulnerable to penetration, the report says, because the radars, if they are to scan the skies effectively, can't be placed in "hardened silos" of the sort that encase our ICBMs. Hence they "can be destroyed by attacking weapons of relatively low yield and accuracy." Once a radar is destroyed, the report says, all the defensive missiles controlled by it are out of action for the rest of the attack.

Pentagon Rebuttal

The Pentagon disagrees sharply with this analysis of the reliability and penetrability of the ABM. Foster, the Pentagon's research chief, told reporters the Chayes-Wiesner analysis "greatly overstates the technical and tactical problems of the proposed ballistic missile defense" and "understates" the problems of overcoming Safeguard. Foster described Safeguard as a "forgiving" system which "doesn't have to know everything that could happen to it to make it work." He said Safeguard could miss some attacking warheads, but still achieve its purpose if it destroyed enough attacking warheads to preserve a substantial part of our "deterrent" ICBM force, thus making it clear to the Soviets that a surprise at-

POINT OF VIEW

"Scientific-Military-Industrial Complex"

Senator Barry Goldwater (R–Ariz.), a member of the Armed Services Committee and a retired major general in the Air Force Reserve, took the Senate floor on 15 April to defend the size of the U.S. "military-industrial complex" and the scientific, academic, and economic communities which assist in military work. Excerpts from his address follow.

. . . I am greatly interested in the growing preoccupation of some groups and individuals these days with the so-called military-industrial complex in the United States. Indeed, if I were a psychologist, I might be tempted to the conclusion that the left wing in American politics has developed a "complex over a complex." . . .

Rather than deploring the existence of a military-industrial complex, I say we should thank heavens for it. That complex gives us our protective shield. It is the bubble under which our Nation thrives and prospers. . . .

What is more, I believe it is fair to inquire whether the name presently applied is inclusive enough. Consider the large number of scientists who contributed all of the fundamental research necessary to develop and build nuclear weapons and other products of today's defense industries. Viewing this, should not we call it the "scientific-military-industrial complex"?

By the same token, do not forget the amount of research that has gone on in our colleges and universities in support of our defense-related projects. Maybe we should call it an "educational-scientific-military-industrial complex." . . .

What we are talking about, Mr. President, is an undertaking which grew up from necessity. . . . Its ultimate aim is peace in our time, regardless of the aggressive, militaristic image which the left wing is attempting to give it. . . .

tack would result in disastrous retaliation.

On the question of reliability of components, Deputy Defense Secretary David Packard, who conducted a review of the ABM program for the Nixon administration, has testified that all components are "sound and feasible technically." Packard said he particularly investigated possible computer software problems, and concluded: "This data processing job is a large one. It does not involve any new technology. It's simply a large system involving data processing." Similarly, a ranking Pentagon ABM scientist told *Science* that "while the computational job is very difficult, I see nothing in it beyond the state of the art."

This same scientist also said that ABM missiles may actually be more reliable than existing ICBMs because the ABM doesn't need "a fancy inertial guidance system" and doesn't have to hit a target 5000 miles away.

As to the Wiesner-Chayes recital of poor weapons performance in the past, the Pentagon tends to dismiss the examples cited as irrelevant or exaggerated, and points instead to such American technological successes as the Apollo moon program as evidence that big systems have worked in the past.

ABM Can Be "Exercised"

Pentagon scientists insist that the Safeguard system can, to a large extent, be tested. They say the missiles, warheads, radars, and computers can be tested individually; that many of the components can be tested in tandem on the Pacific Missile Range; and that the limited Phase I deployment of two ABM sites will provide an opportunity for shake-down testing and integration of the complete system. Foster told reporters that Safeguard operators will be able to "exercise" the system against computer tapes that "run through an attack and put the operators to the test." He said such tapes come from the output of radars that observe Soviet missile tests, and thus the system could always be exercised against the latest Soviet weaponry. Although Pentagon scientists acknowledge that the ABM system can't be tested against an actual nuclear attack, they claim the effects of the nuclear environment can be deduced, and that all weapons systems involve some element of deduction. "How do we really know our Polaris missiles will get through the defense system around Moscow?" asked one Pentagon specialist. "We don't know for certain, and the Russians don't. We deduce it."

Pentagon scientists claim it will not be very easy to fool the ABM system or penetrate it. Foster said that while the Chayes-Wiesner report indicates it would be "simple" for the Soviet Union or China to develop effective penetration aids, "I can just tell you from our actual experience over more than a decade that it isn't simple at all." Foster said a $5 billion research and development effort on ABM over the past 10 to 15 years has given us "some feeling for the kinds of techniques that could be used to try to penetrate Safeguard," but he added: "The people who know this information . . . are not the Chinese and they are not the Soviets. The technological base that provided all of that capability is not . . . possessed by the Chinese or the Soviets."

The shift of emphasis from an ABM system designed primarily to protect cities to one aimed primarily at protecting missiles has provoked charges that the system is not well designed to perform its new mission. The Chayes-Wiesner report asserts that, even if an ABM system should be deemed desirable, the Safeguard configuration would not provide a cost-effective defense of our deterrent. The authors recommend that Safeguard be redesigned "almost from scratch." Specifically, they suggest that the system should use "cheaper, harder radars and more of them," that the computer programming should be made "simpler," and that the Sprints should be replaced with "a simpler, cheaper weapon to permit deployment in great numbers." However, in rebutting charges of mis-design, a top Pentagon scientist told *Science* that the system has always been designed, at least in part, to protect missiles, since such missile protection was one of the options contained in the original Sentinel ABM plan. This scientist acknowledged that "if we were starting over today, we'd probably do something different," but he pointed out that deployment would then have to be delayed.

Effect on the Arms Race

The Nixon administration states that its Safeguard ABM system will not provoke a response from the Russians that would escalate the arms race. The administration argues that the Russians have not been severely critical of our ABM plans, that the Russians already have a small ABM system of their own, and that the reorientation of Safeguard to defend missiles rather than people should reassure the Russians that we are not seeking to erode their ability to inflict great damage on the United States. However, the Chayes-Wiesner report suggests that, in the end, the Russians will be forced to respond, because they will see that the fully deployed Safeguard system is ten times larger than their own ABM system, and because they will realize that Safeguard could be rapidly expanded into a "thick" city defense system.

Thus the arguments for and against the ABM were drawn into somewhat sharper focus last week, but the form of the debate raised serious questions as to whether Congress and the public are capable of making sensible decisions on complex technical issues. Both sides in the ABM debate tend to rely heavily on argument by assertion ("it will work"—"it won't"), or else engage in "numbers games" which are too complicated for most observers to understand, let alone evaluate.

Some years ago James B. Conant suggested that, in considering weapons of great technical complexity and cost, there should be a quasi-judicial review of proposals, including a form of adversary proceeding. "When a question comes up to be settled," he suggested, "one or more referees might hear the arguments pro and con. If there were no contrary arguments, some technical experts should be appointed to speak on behalf of the taxpayer against the proposed research and development." In the present debate over the ABM, it seems that Wiesner, Chayes, and the numerous scientists who have spoken against ABM are playing the role of adversary with distinction. But that leaves Congress in the role of referee—and whether Congress is equipped to handle that role is open to question.

James R. Killian, Jr., science adviser to the late President Eisenhower, has suggested the creation of an independent commission to study strategic weapons technology and has also suggested that Congress might benefit from creating special task forces to study complex issues in depth. But those are steps for the future. In the meantime, Congress will have to vote on the ABM appropriations, possibly next month. The result will probably depend less on comprehension of the complex technical arguments than on "gut feelings" as to whether this country is more threatened by military attack from abroad or by a runaway defense budget that diverts resources from unmet civilian needs at home.—PHILIP M. BOFFEY