F.A.S. PUBLIC INTEREST REPORT

Journal of the Federation of American Scientists (FAS)

STEALTH (B-2) BOMBER

Volume 41, No. 8 October 1988

THE STEALTH BOMBER: EVEN LESS THAN MEETS THE EYE!

While the stealth bomber is noted for it's invisibility to radar, it has been equally invisible to public scrutiny. The secrecy surrounding this project, intended to protect technological secrets from the Soviets, is also hiding an expensive project of dubious merits from Americans.

Until recently, most public accounts of the Stealth bomber (long known as the Advanced Technology Bomber, or ATB, and recently christened the B-2) have focused on the technological tricks used to confound Soviet air defenses. Political criticism of the bomber tended to focus on the excessive secrecy that attended even the most basic aspects of the program. This secrecy, in combination with the fascination with the technical sweetness of the project, has obscured the more fundamental questions of the ends to which this technological effort is being applied.

Serious Questions Now Being Raised

Now that the public debate has moved beyond the "gee-whiz" phase, disturbing questions are being raised about the inexorably growing cost of the project and the regularity with which its schedule has been delayed. The price-tag of each bomber now surpasses the half billion dollar mark, with each bomber literally worth its weight in gold. There are disturbing signs that the management of the program has been faulty. The magnitude of the technical challenge of stealth was apparently unappreciated.

The rising costs and slipping schedules of the B-2 project coincide with the dawning realization that the B-1B program, which was thought to pose much less technical risk than the B-2, is in serious trouble. Billions of dollars will be required over the next several years to bring the B-1B up to advertised specification. This confluence of forces has led to Congressional concern that the B-2 may be a procurement disaster in the making.

Concerns over procurement problems should not obscure the more fundamental issue of the intended mission of the B-2. A compelling rationale for deploying the new bomber might excuse management and technical difficulties. But if the mission for the B-2 is judged of dubious value at best and dangerously provocative at worst, there may be a case for cancelling the program, no matter how well managed it might be.

Two missions for the B-2 have emerged from the veil of secrecy. Some argue that the B-2 is needed to offset improvements in Soviet air defenses, and that the exertions the Soviets will make to augment their air defenses in response to the B-2 will inhibit their efforts in strategic offensive and conventional forces. Others argue that the B-2 is needed in order to attack Soviet mobile missiles such as the SS-24 and SS-25. Neither of these arguments in favor of the B-2 is particularly compelling.

There is little reason to doubt the ability of air-launched cruise missile to penetrate Soviet air defenses well into the next century. And despite its defects, the B-1B will remain an effective penetrating bomber for some time to come.

The "economic warfare" model of strategic modernization has been often invoked to support new weapons systems, but there is scant evidence to support this proposition. It represents a perennial last refuge of weapons advocates.

The more disturbing rationale for the B-2 is its intended use in attacking Soviet mobile missiles. Over the years a sizable community of opinion in the United States has concluded that mobile missiles are less destabilizing than vulnerable silo-based missiles because they provide a less tempting target for a first strike. It is paradoxical that just at the moment that the Soviet Union appears to have reached the same conclusion, the United States would be moving to deprive mobile missiles of their supposed reduced vulnerability to attack.

An Almost Impossible Mission

The ability of the B-2 to succeed in this mission is far from assured. A stealth bomber cannot use it's own radar continuously to locate targets, since the radar would alert air defenses to the location of the aircraft. The B-2 will apparently depend on target location data supplied in advance, if not also tactically, by the new KH-12 photographic reconnaissance satellite, and similar follow-on satellites, which will be equipped with an imaging radar sensor. But in the wake of the Challenger accident, the future of the KH-12 is unclear, and there are serious questions as to whether the KH-12 and later such satellites would be able to survive an attack by Soviet anti-satellite weapons. In sum, the B-2 may be able to hide but it may not be able to see.

In light of the intense secrecy, we cannot be sure how the Air Force thinks the B-2 is going to locate and destroy these mobile missiles and, very likely, its ideas are changing with time. Congress would be well advised to explore this question. If, indeed, the B-2 cannot, as

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we suspect, perform this mission then, even from the point of view of its advocates, it should not be built.

But what if it could? What if some combination of undestroyed satellites, ground-based measures, and B-2 carried surveillance capacities, could locate hundreds of Soviet mobile missiles in a timely fashion? Would we want to send fleets of B-2 bombers to the Soviet Union just to do that?

The mobile missiles involved are a significant part of the Soviet's secure strategic reserve. Why would we want to encourage Soviet commanders to fire these last-ditch weapons on a "use them or lose them" basis? An attack by B-2 bombers would not be instantaneous but would take hours. During this lengthy period, if the B-2 bomber attack were successful, the Soviets would have both time and motivation to fire some of the rest.

The range of contingencies in which it might be desirable to send in bombers to destroy residual missile forces is narrow. Unfortunately, the bombers, which must be decisively committed for several hours in advance of their attack, need a "go" much too early. Several missile salvos can take place while they fly over the Soviet Union. In an era of stable deterrence, the B-2 bombers have a mission we definitely do not want—that of precipitating spasm war under the guise of searching for "residual" missiles.

We do not believe, in any case, that bombers can be effective in hunting down hidden and mobile missiles. If they were effective, they would certainly, as a complement, need an effective strategic missile defense. What the strategic analysts call "damage-limiting" cannot be done with offensive weapons only—there are too many Soviet offensive weapons. But we do not believe that an effective strategic missile defense can be constructed against the inevitable countermeasures of the Soviet military. There is no role for the B-2.

Finally, even for those who believe that both the B-2 and the Strategic Defense can be made effective, we point out that any such restoration of U.S. strategic superiority would be transitory as historical evidence shows. During the brief era of American strategic superiority in the early years of the nuclear era, the United States had great difficulty turning this strategic military advantage to political ends.

We should probably use the first B-2 prototype to gain some practical experience with this novel military technology, but there seems little reason to proceed now with production of this bomber. Already, Under Secretary of Defense for Acquisition Robert Costello has contemplated cancelling the bomber because of management problems. This next President should follow this lead, which would result in a multi-billion dollar dividend for the defense budget, or for reducing the federal deficit.— *Reviewed and approved by the FAS Council.* ■

The FAS Public Interest Report (USPS 188-100) is published monthly except July and August at 307 Mass. Ave., NE, Washington, D.C. 20002. Annual subscription $25/year.

POSTMASTER: Send address changes to FAS, 307 Massachusetts Avenue, NE, Washington, D.C. 20002.

THE STEALTH BOMBER—IT'S RATIONALE IS ALSO INVISIBLE

By John Pike and David Bourns

Although the precise origins of the B-2 remain shrouded in the mists of military classification, its initial public debut was highlighted by political controversy. There were only rumors until August of 1980 when the Carter Administration, which had cancelled the B-1 bomber and was being criticized for being soft on defense, revealed the existence of a stealth bomber program. Then Secretary of Defense Harold Brown announced at a press conference that the United States had flown a plane which " . . . cannot be successfully intercepted with existing air defense systems."

This partisan genesis has thus far largely protected the B-2 from political criticism. The B-2 is a "Democratic" weapon, and Republicans have seldom seen a weapon they didn't like. But this bi-partisan support has not prevented a growing awareness of the problems with the B-2 program.

Outside of the Defense Department, only a few Members of Congress, a select few from each of the Armed Services Committees, have any detailed information on the stealth program. While most Members do not have sufficient information to raise questions about the project, some are protesting the secrecy that keeps them in the dark, and challenging the wisdom and propriety of procurement under the "black" budget.

Senator Barry Goldwater (R-AZ), in June of 1984 made the strongest argument against secrecy, noting that "there are technicians in our academic field, there are technicians in the Pentagon, who have doubts not about the concept of the basic technology involved in the ATB, but over things that we cannot talk about here . . . "

B-2 Program Cost and Schedule

Due to the secrecy of the project, estimates regarding the cost and production schedule of the B-2 are quite varied. The Air Force has stated that the program is "fully funded," and "on schedule". Procurement is reportedly to begin in 1989, and production will be completed in 1997. Of the 132 aircraft planned, the first six will be used for testing, with five of these eventually placed in operational service.

But there are growing signs of problems with the program. The first flight of the B-2 was originally anticipated in late 1984, but this soon slipped to December 1987, then to April 1988, then August of 1988, and is now scheduled for early 1989, following a public unveiling in mid-November 1988.

The initial operational capability (IOC) was originally anticipated in 1989, or 1990, and then by 1991, which subsequently slipped to 1992, when deliveries were anticipated to total 18 aircraft, with 35 aircraft delivered each year from 1993 through 1995, with the final 9 aircraft delivered in 1996.

The B-2 will be the most expensive bomber ever produced. Estimates from several sources indicate that from 1981 through 1987 over ten billion dollars was spent on research and development. Initial reports at the time the contract was awarded to Northrop in 1981 suggested that the cost of the program would total $21.9 billion. However, by mid-1988 the cost estimate had grown to $43 billion (in constant 1981 dollars). The General Accounting Office has estimated that the cost of the program in then-year dollars would total $68.8 billion, based on a $36.6 billion cost in constant FY81 dollars.

The cost of owning the B-2 is also likely to be very high. Each bomber will have its own covered maintenance facility, since the B-2's low observable features require frequent performance of structural and maintenance activities. In addition, operational security requirements will add to the cost of maintaining the B-2.

Unfortunately, these cost increases and schedule delays may not be the final word. Many observers are concerned about the concurrence between the development and production of the B-2. David Smith, an investment analyst with Alex Brown & Sons, is concerned that "there's a tremendous amount of concurrence" in the program. Warren Nelson, of the House Armed Services Committee staff notes that "concurrence and the Air-Force's emphasis on meeting a schedule is the problem." This type of concurrence was the source of many of the present problems with the B-1B bomber.

B-2—Technical Concerns

Because of its dramatic departure from traditional aircraft design practice, a number of questions have been raised about the feasibility of the B-2.

General Lawrence Skantze, head of the Air Force Systems Command, claims that "The position we're in is moderate risk, but based on things that are predictable."

But the record suggests that the B-2 is facing a variety of technical difficulties. Some of these problems are as simple as difficulties with the ejection seats, which are based on the seats used in the F-16 fighter. But others are more fundamental.

Engineering problems led to a one year delay in the program in early 1988, stemming from problems integrating the bomber's electronics systems with the airframe. Additional problems include faulty machining of radar-absorbing composite materials.

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STEALTH TECHNOLOGY

Stealth has become the magic word in contemporary weapon systems. Often thought of simply as the use of special materials to render aircraft invisible to radar, stealth is actually a complex design philosophy to reduce the ability of an opponent's sensors to detect, track and attack an aircraft (or other platforms such as warships). Since a variety of sensors would be used in this process, design of a stealth vehicle requires careful trade-offs among different techniques.

There is no one optimum stealth design, but rather each mission requirement generates an appropriate mix of techniques. Implementation of stealth is not without penalties. Some of the materials used require special and costly maintenance. And the maneuverability of an aircraft can be compromised by the introduction of stealth design features.

The principal focus of stealth is the reduction of the radar cross-section (RCS) of the aircraft, thereby reducing the range at which the aircraft can be detected by radar. The RCS is a measure of radar signature expressed in terms of the projected area of a spherical reflector that would return an equivalent signal. Thus, although an aircraft might have a physical frontal cross-section of 10 square meters, an aircraft with stealth features might have an RCS of only 0.01 square meters, whereas an aircraft without stealth features might have an RCS of 100 square meters. The B-52 has a frontal RCS of about 100 square meters, and the B-1A had an RCS of 10 meters. The addition of engine inlet baffles to the B-1B reduced its RCS to 1 meter, and the RCS of the B-2 is significantly less.

Although the use of innovative materials are important, the design of the surface of the aircraft is the single most important technique for reducing RCS. The configuration avoids sharp edges, discontinuities in the skin structure, and curves of small radius. The surface of the skin should be free from visible seams, welds or bolts. The aircraft's surface eliminates large flat surfaces that would reflect a strong signal back to a radar receiver. The skin of a stealth aircraft consists of gently sloping curves of constantly changing radius, or of a large number of flat plates of varying orientation. Wings on a stealth aircraft are blended into the fuselage, giving rise to a lifting-body flying-wing configuration. Air intakes for engines are placed out of view of the likely direction of threat radars. For aircraft that normally fly above radars, this means placing the intakes on the top of the aircraft. Intakes are recessed into the aircraft fuselage, and do not use the flat slab control surfaces common on other aircraft. A zig-zag curve in the inlet tunnel keeps the front of the engine out of direct radar sight.

Stealth Materials

An additional stealth technique involves building the aircraft of non-metallic materials that are very poor reflectors of radar signals. Thus a major focus in recent years has been on developing larger carbon-fiber composite material structures such as wing spars. Non-metallic composite materials might account for between 30% and 50% of the weight of the B-2.

A more effective technique is the use of radar absorbing materials (RAM). Ferrite-based materials use multiple layers of small particles of iron oxide suspended in a plastic medium, separated by layers of dielectric material. A radar signal passing through the first ferrite layer and the dielectric would be reflected by the inner ferrite layer. Incoming radar waves cancel the reflected waves, which are dissipated in the dielectric layer. Longer wavelength radars require deeper layers of radar absorbing material than do shorter wavelength radars. Use of multiple layers can provide protection against a range of wavelengths.

Protection against the full range of radar wavelengths would require a large number of prohibitively thick and heavy layers. And protection against the long wavelength radars used for area surveillance would require very thick layers. These search radars could thus be able to determine the general location of a high-flying stealth aircraft.

Radar absorbing materials would be used primarily to defeat higher frequency radars carried on interceptor aircraft and missiles, which would thus have difficulty following up on an initial contact by the search radars. Paradoxically, the closer one approached a stealth aircraft, the more difficult it would become to track it by radar.

An alternative to ferrite-based and other layered materials are carbon compounds that absorb microwave energy. Reinforced carbon/carbon structural materials are an excellent absorber of radar signals, as are a recently disclosed class of polymers which contain salts that absorb radio-frequency energy, and dissipate it as heat.

Reducing Active Emissions

Reducing the ability of a radar to detect an aircraft does little good if transmitters on the aircraft itself are broadcasting its location. There are a number of electronic systems used on conventional aircraft for navigation or jamming hostile radars that cannot be employed by stealth aircraft.

Sensors to locate targets pose a particular problem for stealth aircraft. The large radars used by conventional aircraft would obviously compromise the position of a stealth aircraft. Optical sensors can be used for precise aiming at targets whose general location is known, but are poorly suited for searching for targets over a wide area. Stealth aircraft may rely on an airborne laser radar, although such a sensor may prove of limited utility in poor weather. A more promising approach would be to use data from reconnaissance satellites, either transmitted directly from the satellite or relayed through communications satellites from processing centers in the United States.

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These difficulties with novel stealth materials are complicated by the strict internal compartmentalization within the program, which has led to poor interfaces between systems and airframe segments of the program. Some assemblies — such as the wings — were not thoroughly tested before delivery. Production delays have resulted from compatibility problems between the engines and the air inlets on the first aircraft which may result in a major redesign of the inlet and power-plant mounting structure.

Additional delays have been experienced due to problems with the flight control system. Problems with the stability of flying wing designs date back to the YB-49 flying wing in the late 1940's. And the F-19 stealth fighter has suffered several flight accidents, which were probably caused by the poor aerodynamics of the plane. This has led to concerns about the handling charac teristics of the B-2. The inherent instability persists, but supporters say that fly-by-wire technology that is now used on planes like the F-16 can control the problem.

Even if all these problems are overcome, there are a number of questions regarding the extent to which the B-2 and its stealth technology will be effective.

One major concern involves the B-2's small payload. Estimates are that the ATB will have a payload of about 40,000 pounds, compared to about 75,000 pounds for the B-1B. This has been the subject of Congressional concern. Senator John Glenn (D-OH) notes that "there is very, very serious doubt about the Stealth technology being able to perform in the same way the B-1 will . . . I have serious reservations about some of the difficulties with the ATB."

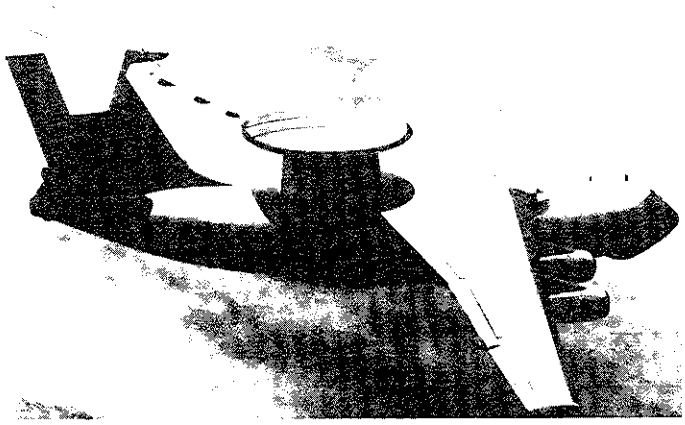
Another concern has to do with the B-2's range. Although some reports suggest that the B-2 will have a range of 7,500 miles, other sources have suggested that the plane's actual range could be as low as 4,000 miles. Because it would need aerial refueling, the B-2's stealthiness would be compromised by rendezvousing with tankers that currently are not stealthy. Thus refueling would have to take place outside Soviet radar coverage, limiting the endurance of the B-2 over the Soviet Union.

Survivability after a nuclear conflict has broken out is also in question. Would tankers or runways be available to service the aircraft so that it could stay in combat over an extended period of time?

One Case for the B-2—Countering Soviet Air Defense

One of the principal arguments in favor of the B-2 is its improved ability to penetrate Soviet air defenses. Casper Weinberger, then Secretary of Defense, stated in the 1986 "Annual Report to the Congress" that "As Soviet defenses become more formidable, we will deploy the ATB to carry out the most challenging penetrating bomber missions."

The current force of B-52's will continue to be operational well into the 21st century. The airframes of these bombers are estimated to remain airworthy until at least the year 2030. Given the extensive modernization and upgrades that have been performed over the past several decades, very little remains of the original hardware in these aircraft. Horror stories about planes that are older than their pilots fail to take this into account.



Despite claims that the deployment of the Air-Launched Cruise Missile would lead the Soviets to expand their strategic air defense efforts, the leisurely pace of the development of new systems such as this Mainstay radar warning aircraft suggests that the Soviets do not directly respond to American innovations. Thus there is reason to doubt that the B-2's will lead the Soviets to divert money to air defense from other military missions.

The United States plans major upgrades to the air-breathing led of the triad over the next decade, including deployment of several thousand stealthy advanced cruise missiles. There is little reason to doubt the ability of air-launch missile to penetrate Soviet air defenses well into the next century. And despite its defects, the B-1B will remain an effect penetrating bomber for some time to come. Recent congressional testimony indicates that even with its technical problems, the B-1B will nonetheless pose a serious threat to Soviet air defenses, and approximately 50% of attacking B-1B's would successfully penetrate Soviet defenses, in contrast to the 80% penetration originally intended.

The effectiveness of Soviet air defenses should not be over-estimated. Robert M. Gates, chairman of the CIA's National Intelligence Council, told a Senate panel in June of 1985, "Against a combined attack of penetrating bombers and cruise missiles . . . Soviet air defenses during the next ten years probably would not be capable of inflicting sufficient losses to prevent large-scale damage to the U.S.S.R."

A more subtle version of this argument in favor of the B-2 is the idea that the Soviets will have to spend huge amount of money in order to counter stealth.

In hearings in March of 1985, Sen. J. Bennett Johnston asked, "I understand that the ATB would require the Russians to spend $500 billion to try to defend against" the ATB. "I'm not sure about the exactness of $500 billion. If the ATB forces the Soviets to spend 10 times more money than they would without ATB, we can consider that healthy," said James P. Wade Jr., then acting Defense Under Secretary for Research and Engineering.

This argument echoes a similar one offered in 1981 by

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SOVIET AIR DEFENSE AND THE AMERICAN THREAT

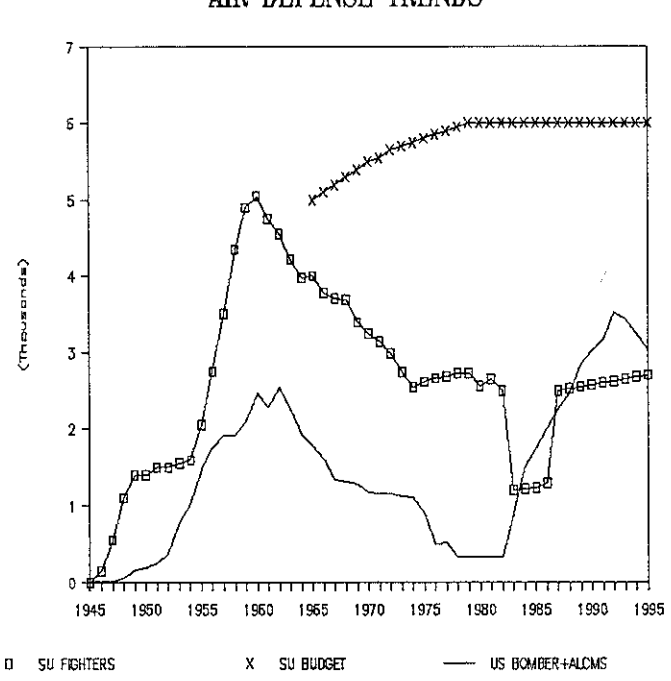
Precise measures of the interaction between offensive and defensive forces are difficult to develop, but some impression of this interaction can be gained by examining air defense force and budget levels over time. One indicator of the offensive threat is the total number of independently penetrating targets (both bombers and cruise missiles) that an air defense must intercept.

Several distinct periods can be seen. During the forties and fifties, the American air-breathing threat expanded greatly, as did the number of Soviet air defense interceptor aircraft. And the decline in the American threat, beginning in the early sixties, was mirrored by a decline in the number of Soviet air defense fighters. During this period, the Soviets consistently deployed about two air defense fighters for each independently penetrating American target.

But this logical correlation between offense and defense dissolved in the mid-1970's. The American abandonment of the Hound Dog long-range air-launched cruise missile did not result in a further reduction in the number of Soviet air-defense fighter aircraft.

Paradoxically, the only visible Soviet response to the deployment in 1983 of air-launch cruise missiles was the transfer of half of their strategic air defense interceptor aircraft to other duties. Although the Soviets returned these fighters to the strategic air-defense mission by 1985, they have not increased their numbers over the original pre-1983 level, despite a continuing build-up in the number of ALCM's.

Other elements of Soviet air defenses seem equally independent of American actions. The number of Soviet surface-to-air missiles has remained constant at about the 10,000 missile level since the 1960's. The new Soviet Mainstay AWACS radar aircraft, with improved ability to track low-flying targets, has been developed at a remarkably leisurely pace, and is only just now entering active service.



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Under-Secretary of Defense for Policy Fred C. Ikle. He stated, in reference to the B-1 program, that "the Soviets would never get the whole [air defense] system to be 100 percent effective . . . and even the process of making it partially effective may cost two or three times what we will put into the . . . program." And it is also reminiscent of Defense Secretary Harold Brown's assertions advanced in support of the deployment of air-launched cruise missiles a decade ago.

The "economic warfare" model of strategic modernization has been often invoked to support new weapons systems, but there is scant evidence to support this proposition.

It is true that the Soviets have continuously modernized their air defense forces, adding new systems with improved capabilities against the changing American threat. But the level of Soviet investment in this modernization suggests that these upgrades are more the result of the march of technology, than a specific response to discreet changes in the nature of the threat.

The Soviets appear to invest a constant amount of money in upgrading their air defenses, independent of changes in the strategic threat. According to the American intelligence community estimates, the Soviets have consistently invested the equivalent of about $6 billion per year in air defense modernization over the past two decades, with essentially no variation in this level of effort from year to year.

The Soviets will undoubtedly continue to upgrade and modernize their air defenses in the coming decades, just as they have in prior decades. But this modernization is likely to take place regardless of American initiatives, and equally regardless of American initiatives, this modernization seems destined to consume neither more nor less than the equivalent of about $6 billion dollars each year. There is little reason to believe that this long-standing historical pattern will change in the face of the B-2.

The Second Case for B-2: Attacking Mobiles

The second argument for the B-2 is the supposed need to attack Soviet "strategic relocatable targets" such as mobile ICBM's. Gen. Bennie L. Davis, former SAC chief, stated in the spring of 1985, that the "advanced, state-of-the-art bomber offers the best potential for dealing with the growing threat posed by Soviet relocatable weapons systems."

Over the years a sizable community of opinion in the United States has concluded that mobile missiles are less de-stabilizing than vulnerable silo-based missiles because they provide a less tempting target for a first strike. It is ironic that just at the moment that the Soviet Union appears to have reached the same conclusion, the United States would be moving to deprive mobile missiles of their supposed reduced vulnerability to attack. A major effort

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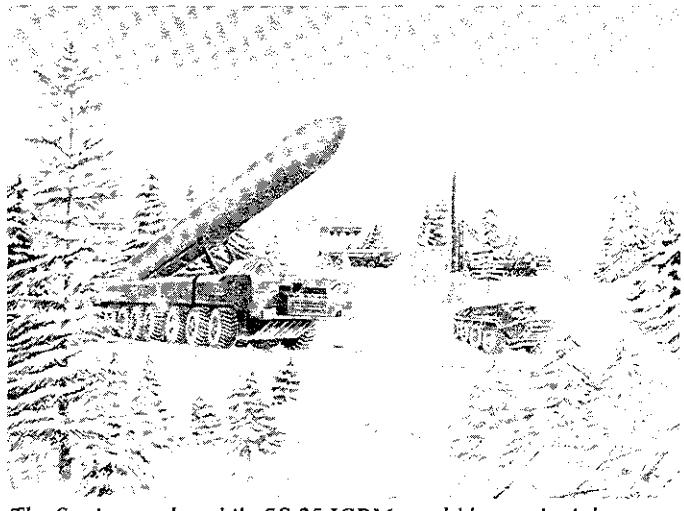

The Soviet road-mobile SS-25 ICBM would be a principle target of the B-2 bomber.

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to target Soviet mobile ICBM's only discourages them from making this stabilizing move.

The potential superiority of bombers over long-range missiles is not difficult to understand. Any targeting of mobile missiles will require some cuing by satellite systems. It might prove difficult to communicate the needed target coordinates to ballistic missiles on submerged submarines. In addition, the 30 minute flight time of a long-range SLBM or ICBM would provide enough time for the mobile missile to move a few dozen miles, and time for the intelligence processing cycle would add further delays and greater target location uncertainty. Thus attacking the mobile targets would require large numbers of warheads for each target. The resulting laydown would be little more than a glorified saturation barrage attack, with consequent unfavorable warhead exchange ratios, and extensive collateral damage (which could provoke Soviet escalation to counter-value attacks on the United States).

The technical challenge of incorporating terminal homing sensors and the associated data processing systems into ballistic missile reentry vehicles is not trivial, and at a minimum would result in large warheads that would require major reductions in the number of warheads that could be carried by missiles such as the MX or Trident II.

In contrast, after the initiation of hostilities, bombers loitering over suspected mobile missile deployment areas are positioned to attack their targets within minutes of receiving target coordinates, using either SRAM II's (short range attack missiles) or gravity bombs. This raises the prospect of one shot kills, with favorable weapon exchange ratios and greatly reduced collateral damage. The possibility of carrying imaging sensors on the bombers, as well as the greater space available for data processing, also improves the prospects for targeting mobile missiles.

Thus the targeting debate often centers on the question "how many of which bombers?" But the efficacy of any combina tion of bombers or warheads depends upon the ability to locate targets. The various options pursued to meet this "threat" rely on strategic intelligence provided by reconnaissance satellites.

Doubts about the ability of the B-2 to perform its intended mission have been expressed by the Defense Department. In the 1987 Posture Statement by the Joint Chiefs of Staff, the B-2 was described as having the capability "to penetrate Soviet airspace and attack the *full range* of fixed and relocatable targets"(emphasis added). But the 1988 Posture Statement down-grades this claim, asserting that the B-2 will be able "to attack the full range of fixed targets and *present an increased threat* to some relocatable targets (emphasis added)."

The ability of the B-2 to succeed in this mission is not obvious. A stealth bomber cannot use it's own radar to locate targets, since the radar would alert air defenses to the location of the aircraft. The B-2 will apparently depend on target location data supplied by the new KH-12 photographic reconnais sance satellite, which will be equipped with an imaging radar sensor. But in the wake of the Challenger accident, the future of the KH-12 is unclear, and their are serious questions as to whether the KH-12 would be able to survive an attack by Soviet anti-satellite weapons. The use of the KH-12 to support the B-2's attack on Soviet mobile ICBM's would certainly provide the Soviets with considerable incentive to attack these satellites early in a conflict, greatly escalating the scope of combat with potentially incalculable consequences.

Locating Relocatable Targets—A Difficult Task

While delivery systems and the weapons themselves obviously are needed to destroy the relocatable targets, the primary difficulty is finding them. The development of technologies to identify and target mobile targets is therefore a current priority. To find mobile Soviet missiles, which increasingly are camouflaged and moved at night, the U.S. needs its most advanced photo-reconnaissance capability, the KH-12 and similar follow-on satellites.

There are a variety of countermeasures available to the Soviets to frustrate these efforts. Decoy SS-25 transporters and SS-24 trains can be deployed in large numbers, since they would not require the expensive missiles and electronics needed by real launchers. The trains that support the SS-24 can be disguised to resemble regular Soviet rolling stock, and can be hidden in tunnels. Visual camouflage (paint patterns, nets, etc) can frustrate and slow the imaging analysis process. Radar jammers and other forms of electronic countermeasures are available to reduce the effectiveness of imaging radars.

While these countermeasures will not be completely successful, they will undoubtedly result in many mobile missiles escaping early detection, and many bomber weapons being expended against decoy targets.

Locating Relocatable Targets—Using Satellites

It is apparent that the B-2 cannot rely heavily on its own sensor suite to locate and identify mobile targets. Active sensors such as imaging radars would emit signals that would quickly compromise the location of the bombers, serving as a beacon that Soviet defenses could home on. Passive sensors, such as television or forward-looking in-

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frared, avoid this problem, but their performance is dependent on weather conditions, and there is no assurance that World War III would occur on a nice day. In any event, the data processing requirements for analyzing the images are likely to prove beyond the capabilities of computers carried on the B-2. And while automatic target recognition algorithms could cue sensor operators to potential targets, the identification of actual targets would likely overwhelm the bomber's crew.

Thus the B-2 must rely heavily on off-board target data acquired by satellites, and analyzed at processing centers in the United States. The B-2's penetration capabilities will be slowed without survivable C3I systems needed to acquire targets.

The KH-12

In the 1960's, the Air Force and the Central Intelligence Agency operated parallel imagery intelligence satellite systems. The Carter Administration sought to consolidate all imagery collection into a single system.

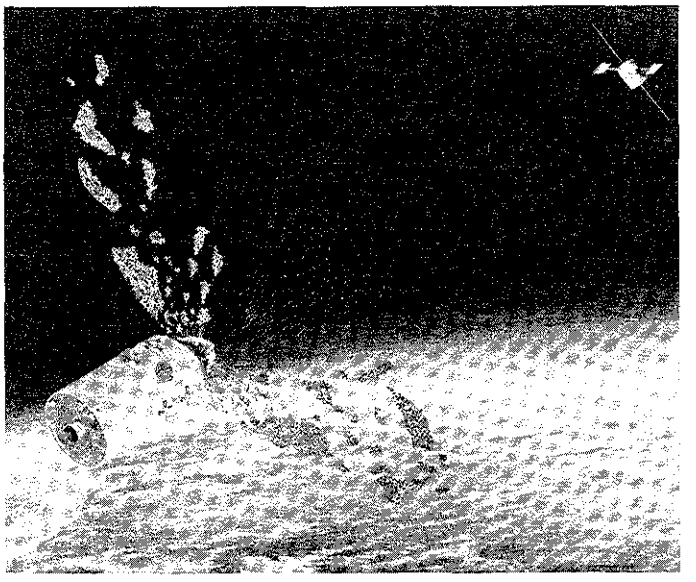
With the progress of technology, it became possible to combine the high resolution of film with the availability of electronic transmission into a single satellite, the KH-12. From the outset the Shuttle was designed with the KH-12 in mind. DOD support was the key in the battle for Congressional approval of the Shuttle, and DOD's requirements for the Shuttle played a critical role in its development.

But in the wake of the Challenger accident, this decision appears to have been reversed. Now each of the major satellite user communities is attempting to develop its own satellite system.

The optical sensors on the KH-12 are similar to those of the KH-11. These electronic cameras provide real-time transmis sion of images to ground stations via Milstar relay satellites. The KH-12 sensors operate in visible and near infrared light, as well as thermal infrared to detect heat sources. These sensors probably incorporate low-light-level image intensifiers to provide night-time images.

A high resolution Synthetic Aperture Radar (SAR) satellite imaging sensor, code-named Lacrosse, is currently under development for deployment in the late 1980's. After the successful test of the Indigo prototype of this satellite radar in January 1982, the KH-12 weight increased by several tons in 1983, suggesting that this radar was added to the KH-12 sensor suite. Although this radar might have a resolution of about 1 meter, the SAR can penetrate cloud cover. This would enable the KH-12 to follow Soviet troop movements, as well as to monitor military production facilities that might be obscured by clouds. The original plan for operations of the KH-12 system would involve a constellation of four satellites orbiting simultaneously and operating continuously, providing more comprehensive coverage than previous systems.

The Shuttle was to be used to refuel each satellite as frequently as once a year. With frequent maneuvers a routine element of operations, it could respond rapidly to emerging situations, as well as pass unpredictably over a target, frustrating evasion/deception efforts on the ground. Maneuverability also permits shorter intervals between coverage of individual targets, as several satellites can maneuver for repetitive passes over the target area.



The KH-12 satellite will be vulnerable to destruction by the Soviet anti-satellite interceptor, pictured above, which would greatly impair the ability of the B-2 to attack Soviet mobile missiles.

The most significant impact of the Challenger accident is the apparent abandonment of the KH-12 program. A number of developments in late 1987 and early 1988 suggest that the program has been terminated, and that the development of follow-on systems has begun.

At least three follow-on systems to the KH-12 seem to be under consideration, one for each of the major user communities. One satellite system will support the national intelligence community, particularly the CIA. Another satellite system may also be in the works to support tactical users.

A third satellite, to support the B-2's mission against Soviet mobile ICBM's, is also planned. While DoD is playing down the capabilities of the B-2 against mobile targets, it has also noted that this capability will be delayed to the mid 1990's, several years after the early 1990's initial operational capability of the B-2. This is consistent with the time needed to develop and deploy a new satellite system for this specialized mission.

Survivability

Given the variety of users of the KH-12, and the vital importance of this system for the successful prosecution of current tactical and strategic targeting concepts, destruction of the KH-12 satellites and its follow-on substitutes must be a very high priority for the Soviet military if conflict breaks out. Successful negation of this intelligence collection platform would severely degrade the effectiveness of the NATO AirLand battle doctrine of follow-on forces attack, and impede American Navy over-the-horizon targeting. Denial of target location data from the satellites to the B-2 might eliminate the ability of the B-2 to successfully attack Soviet mobile ICBM's.

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Thus it is not surprising that this satellite system has been equipped with a variety of survivability measures. The most important of these is the large reserve of maneuvering fuel carried by the satellites. This would permit extensive evasive maneuvering, to avoid interception by Soviet co-orbital anti-satellite (ASAT) interceptors. The KH-12 carries on-board radar attack warning sensors, which would enable it to detect the targeting radars used by Soviet ASAT interceptors. The satellites are also hardened against nuclear radiation, and against laser attack.

The American Air-Launched Miniature Vehicle (ALMV) ASAT, a hit-to-kill direct ascent rocket launched by specially modified F-15 fighters, would also have provided further protection to the KH-12, by destroying Soviet co-orbital ASAT interceptors before they could attack the KH-12 satellites.

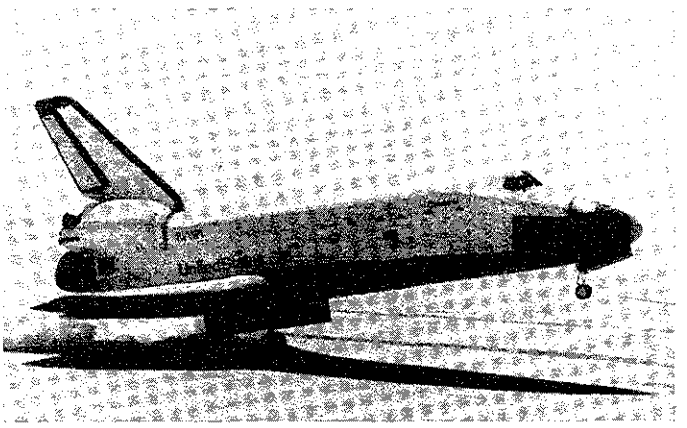
But the survivability of the KH-12 constellation and its follow-on satellites is questionable. The ALMV ASAT has been cancelled, and no replacement is in immediate prospect. At the same time, the Reagan Administration has opposed all efforts at negotiating limits on Soviet ASAT capabilities, which remain largely intact, despite a five year test moratorium. Given the very large and wide-ranging impact on American forces that would flow from the destruction of surveillance satellites of the KH-12 variety, the Soviets have clear incentives to expend considerable effort to this end. The KH-12's are the keystone to a multi-hundred billion dollar American investment in conventional and strategic weapons. A Soviet investment of even a small fraction of this amount of money would almost certainly insure the successful negation of tactical targeting from space.

Some analysts have suggested that the only way out of this dilemma is the development of a new "Lightsat" reconnaissance system. These Lightsats would be sufficiently small and cheap that they could be launched in wartime from survivable mobile launchers, and in sufficient numbers that they could be launched faster than the Soviets could shoot them down. However, there are questions whether such small cheap satellites would have the capabilities needed to support the B-2, and in general the Air Force has been fairly hostile to the entire concept.

The Stealth Bomber and Nuclear War-Fighting

An assessment of American strategic capabilities planned for the 1990's leads to the conclusion that the United States continues to procure strategic weapons systems under the assumption that it is possible to fight and win a nuclear war. The US plans to field an impressive array of counterforce systems. These can be thought of as the "pre-boost phase" layer of a strategic defense system. The addition of boost-phase and subsequent layers to the defense would greatly add to the damage-limiting potential of the "pre-boost phase."

Soviet ICBM silos will be vulnerable to destruction by the very capable Trident-II. Ballistic missile submarines will be threatened by the new SSN-21 Seawolf-class attack submarines, which are specifically designed to operate under the Arctic ice pack, where they can seek out and destroy even the Typhoon-class submarines. The small force of Soviet bombers would be subject to destruction on the ground by the Trident-II, and interception over the Arctic by an upgraded North American Air Defense system. Soviet command and control facilities could be attacked by sea-launched cruise missiles, further inhibiting a retaliatory response.



In the aftermath of the Challenger accident, the Defense Department has cancelled plans to service KH-12 intelligence satellites with the Space Shuttle. This calls into question the viability of using these satellites to locate Soviet mobile ICBM's for the B-2.

There are certainly some limitations to these counterforce capabilities. At least some of these mobile ICBMs would escape destruction, as would at least a fraction of the silo-based missiles. The Seawolf might prove highly effective in an attrition campaign during a conventional theater conflict prior to the initiation of the use of central forces, but some Soviet missile submarines would surely remain at sea. Together, these surviving forces could clearly destroy the United States.

In the absence, therefore, of an effective anti-missile defense, the military and political utility of these American systems is difficult to identify. The damage limitation they could provide would be slight.

On the other hand, if the United States continues to pursue its present course of purchasing all possible counterforce capabilities—hard target killing missiles, bombers which in principle at least could destroy mobile missiles, and a vigorous SDI program—the Soviet planners could be led to believe that the U.S. might someday secure a meaningful damage-limiting capability.

As always in the logic of strategic analysis, the opponent's defense analysts can be assumed to be working on worst case analyses. U.S. weapons which, on our reasoned second thought, are unlikely to work, may well influence Soviet procurement; after all, the Soviets have a right to assume that the U.S. would not purchase weapons it was certain would not work.

With this in mind, assuming that both SDI and B-2 bombers could perform their functions, there are some elements of synergism between them.

For example, it is normally assumed that whatever SDI program might be purchased would find it harder to cope

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with a salvo of missiles than with a few. Accordingly, the Soviets could fear that isolated responses from their fields of several hundred mobile missiles would not seem so threatening to the U.S. in the presence of SDI. And they might find it hard to coordinate such a salvo from mobile missiles. Mopping up activities from B-2 bombers, albeit over time, might be synergistic with mopping up activities by an SDI program turned on in advance of a first strike for precisely that purpose.

For another example, the initial phase of SDI deployment is primarily aimed at silo-based liquid-fueled missiles such as the SS-18. Liquid-fueled missiles have longer boost-phases, and are thus easier to intercept, than solid-fueled missiles such as the SS-24 and SS-25, which are the targets of the B-2. And the orbital configuration of the space-based element of the anti-missile system can be optimised to deal with the predictable launch points of silo-based missiles. Mobile missiles are an effective countermeasure to the initial phase of SDI deployment, since they can be moved to unpredictable locations, and can be concentrated so as to locally overwhelm the space-based defense. Using the B-2 to target these missiles reduces the vulnerability of the SDI to this countermeasure.

If they could be assumed to work, the totality of American pre-emptive counterforce weapons, including the B-2, would make life easier for the SDI. The SDI Organization estimates that by the end of the century a space-based multi-layered Phase 1 Strategic Defense System could be deployed, but with the capability to intercept less than 3,000 Soviet warheads. In the face of the 10,000 warheads that the Soviets could launch currently prior to an American attack, this strategic defense system would provide no protection for American society. But if an American first strike, including B-2 attacks on 500 Soviet mobile ICBM's, destroyed 7,000 warheads on Soviet bombers, submarines and land-based missiles the number of surviving Soviet warheads could number in the range of the number of warheads the Phase 1 Strategic Defense System is intended to intercept. The fact that such a retaliatory strike might be poorly coordinated, and stretch over an extended period of time would in principle, further enhance the effectiveness of the defense.

Given this combination of forces with its hypothetical success would not completely deny the Soviets the ability to inflict fantastic damage on the United States, but in theory at least it could create a situation in which there were significant asymmetries in the post-war conditions of the two countries.

The United States might hope to maintain an asymmetry of strategic advantage by virtue of its current technological lead in strategic technologies. The recently unveiled Soviet Blackjack strategic bomber does not appear to possess significant stealth characteristics, and seems to be the technological equivalent of the mid-1970's vintage B-1A. The Soviets also lag the United States in the fielding of advanced reconnaissance satellites that would be needed to locate mobile targets, and certainly lag the United States in the development of the sophisticated computer hardware and software needed to identify mobile targets in a timely fashion. Certainly the Soviet Union cannot hope with foreseeable weapons to survive a U.S. retaliatory strike.

The Limits of Damage Limitation

However attractive for some Americans or fearful for some Soviets, the prospect of damage limitation is likely to prove a mirage. The United States is unlikely to achieve a really usable margin of strategic superiority. The Soviets have given notice that they will not acquiesce in the face of such an effort. And the experience of the first two decades of the nuclear era suggests that even if the US did achieve a major strategic advantage, it would probably find it difficult if not impossible to translate this nuclear edge into political gains.

Although the US might be able to steal a technological march over the Soviets for a period of several years, there is little precedent for believing that a condition of marked asymmetry would endure for very long. While the US has generally led the technological arms race, and has maintained an edge in the technical sophistication and "sweetness" of some of its deployed systems, the Soviets have consistently matched the American capability within a few years. It is difficult to believe that the political promises of a strategy of superiority could be realized during the fleeting window of opportunity that might briefly open, or that any such gains could be maintained once the Soviets managed to close the window.

From 1945 through the mid-1950's the US enjoyed a virtual nuclear monopoly, and yet found it impossible to derive any tangible political advantage from it. Until the early 1970's the US maintained a large margin of superiority, which was similarly impotent. Most of the political and military crises of the period were resolved without reference to nuclear weapons. The actual use of nuclear weapons was contemplated only rarely and never seriously. The threatened use of nuclear weapons was never a decisive factor in any conflict or crisis.

The B-2 And Stability

While the pursuit of strategic superiority will prove illusory, it is also highly de-stabilizing. Arms race and crisis

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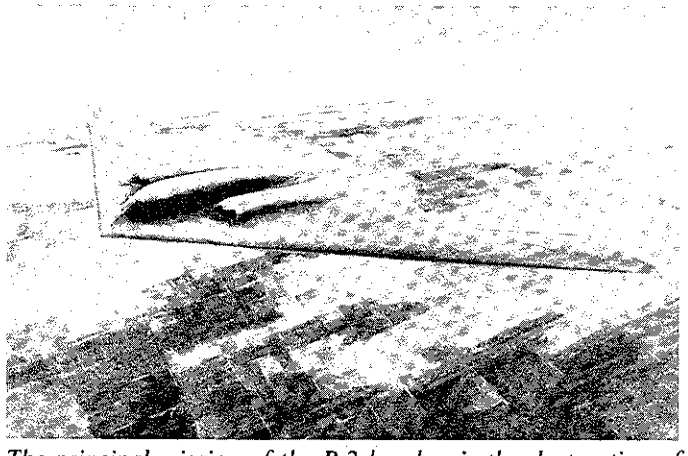

The principal mission of the B-2 bomber is the destruction of Soviet mobile missiles.

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stability have long been a central concern of strategic analysts and the arms control community.

Arms race stability refers to the extent to which the characteristics of a particular weapons system, such as the relative cost of the weapons versus the cost of potential countermeasures that could reduce its effectiveness, increase or decrease the incentives for further proliferation of additional weapons systems.

Crisis stability refers to the extent to which the charac teristics of a particular weapons system, such as its basing mode, intended targets, or other technological or operational elements, increase or decrease the incentives for early or first use of the weapon in a time of crisis, or provoking the other side to pre-emptive attacks in a time of crisis.

The acceptability of weapons that might be de-stabilizing in a time of crisis is in part a function of perceptions of the likelihood of nuclear war. Those who are persuaded that the underlying risk of war is quite low are generally concerned with the added risk of war that de-stabilizing weapons produce. On the other hand, those who have concluded that alleged factors such as the innate aggressiveness of the Soviet Union significantly increase the risk of general war are much more prepared to accept the increased risk created by de-stabilizing weapons, since this additional risk is perceived as small relative to the underlying risk of war, and since these weapons might dissuade the Soviets from initiating a conflict (given the potential contribution of such weapons to enabling the United States to "prevail" in such a conflict).

History Offers Little Comfort for B-2

On balance, the history of the nuclear era suggests that the underlying risk of nuclear war is low, and declining over time. While nuclear threats were brandished rather frequently by both superpowers in the 1950's, there has been a progressive decline in the frequency of such threats. The conclusion of the territorial settlements following the Second World War and the successful completion of the decolonization process have reduced the sources of superpower conflict, and even the energy disruptions of the 1970's have subsided. Furthermore, the progressive changes in the Soviet Union (and in it's relationship with Eastern Europe) in recent years appears to have fulfilled George Kennan's forecast of the eventual success of the containment process, to the point that even a veteran Cold Warrior like Ronald Reagan has concluded that the Cold War is over.

Under these circumstances of low and declining risk of superpower conflict, it seems appropriate that concerns over the de-stabilizing consequences of new weapons systems should take priority. New weapons systems that increase the risk of war in a time of crisis or that encourage a further buildup in weapons should be avoided.

Bombers have traditionally been regarded as less destabiliz ing (particularly in terms of crisis stability) than ballistic missiles. President Reagan's simplistic distinction between "bad" fast-flying missiles, and "good" slow-flying air-breathing systems such as bombers, has been largely accepted by the strategic community.

The arms control community has further distinguished between new weapons systems that were actively pernicious, such as the MX and SDI, and those that were merely wasteful, such as the B-1A. Confronted in recent years by an avalanche of new weapons that clearly increased the risk of war, little attention has been paid to new weapons systems that appeared to be merely wasteful. A combination of strict secrecy and a presumption of innocence in the case of bombers have resulted in very little public discus sion of the strategic risks of the B-2.

In fact, the Stealth Bomber is as much a first strike weapon as the MX. Both systems are intended to destroy Soviet missiles before they can be launched against the United States. Indeed, the various threats to crisis stability posed by the B-2 create a greater risk of war than the MX.

It is clear that the B-2 is a first strike weapon, since it can only succeed in destroying those missiles that the Soviets have not launched by the time the bomber enters Soviet airspace. Counterforce weapons like the MX and B-2 only work when used preemptively. Unlike the MX, which has a thirty minute flight-time that might be shorter than the time needed by the Soviets to decide to launch under attack, the B-2 will take many hours to reach the Soviet Union from bases in the United States. While Soviet air defenses may have difficulty localizing individual B-2's, it is doubtful that a massed raid by these bombers would escape their notice. The subsonic flight of the B-2 would provide the Soviets with ample time to consider their response.

Like the MX, the Soviets have incentive to preemptively attack the B-2 before it can be launched against the Soviet Union. Although the use-it-or-lose-it dilemma faced by the B-2 may not be quite as stark as that of the silo-based MX, the dilemma is nonetheless real. The B-2 will be deployed at three SAC airbases in the central United States. The Soviets could easily destroy bombers on the ground at these bases with comparatively small collateral damage. Although alert bombers could probably escape before Soviet warheads landed, they would be faced with the choice of proceeding to their targets in the Soviet Union, or recovering to dispersal airfields.

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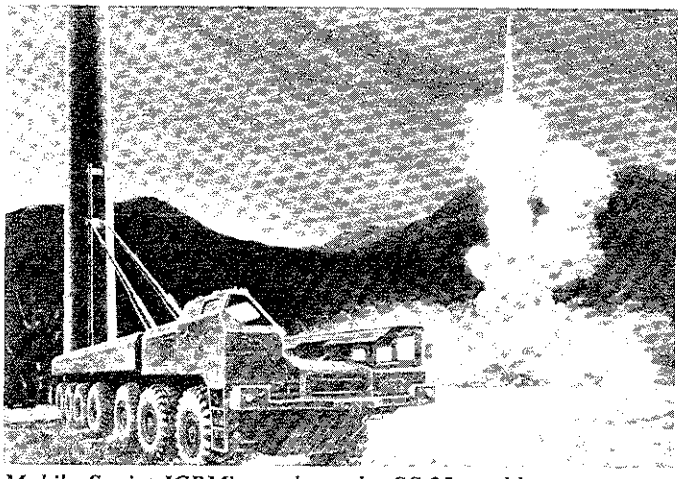

Mobile Soviet ICBM's such as the SS-25 could pose a major problem for the SDI, which could be reduced by the B-2.

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As previously noted, the B-2 force requires an unusually elaborate support infrastructure, including a large force of tankers for refueling. Dispersal of B-2's to a large number of military and civilian airfields, either before or after an initial Soviet attack, would deprive the bombers of their needed support equipment. Selected attacks on some of these dispersal fields could deprive the bombers of tanker support. At some point, the maintainability of the bombers, and the availability of tankers, would pose a use-it-or-lose-it dilemma.

More serious crisis stability problems arise from the dependence of the B-2 on the KH-12 and its successors for target location information. This dependence, coupled with the relative vulnerability of low-flying reconnaissance satellites, would provide the Soviets with an almost unbearable incentive to attack these satellites at the early stages of a superpower conflict. Such an attack, at any time, would probably be viewed as a most profound provocation by the United States, and as a signal by the Soviets that nuclear escalation was inevitable.

An additional crisis stability concern flows from the incentives the B-2 gives the Soviets to escalate a strategic conflict by launching at least some of its mobile missiles against American cities before they are destroyed by the B-2, in order to discourage the United States from completely negating the Soviet's retaliatory capabilities. There is nothing the B-2 can do to prevent this, and these use-it-or-lose-it incentives for the Soviets to launch under attack raise the risk of provoking precisely the counter-value attack the B-2 is intended to defend against.

In principle, an anti-missile defense system could potentially negate this Soviet response. But this simply transfers the crisis instability to concerns about the vulnerability of the strategic defense system.

The B-2 also provides incentives for further escalation of the arms race. While the Soviets are unlikely to respond directly to the B-2 by building up their air defenses, the high cost of the B-2 relative to the cost of mobile ICBM's may encourage the Soviets to proliferate SS-24's and SS-25's. While the cost of Soviet weapons systems is difficult to estimate, the costs of comparable American systems are suggestive. The rail-mobile MX will cost about $10 billion, and the road-mobile Midgetman perhaps $30 billion. Under current plans both of these systems will be deployed in numbers that are roughly equivalent to projected deployment levels of the SS-24 and SS-25. Against a roughly $40 billion dollar investment in mobile missiles, the United States plans to spend some $60 to $80 billion dollars on the B-2, as well as additional tens of billions for supporting systems such as the KH-12, the Milstar communications satellite, and tanker aircraft.

This rough calculation suggests that the Soviets could build additional mobile missiles at less cost than the United States could build additional B-2's to counter these missiles. Thus the B-2 fails the Nitze Criteria of cost effectiveness at the margin that has plagued the SDI program.

Additional incentives for escalating the arms race derive from the vulnerability of the KH-12 and thus the B-2 to Soviet anti-satellite weapons, as well as the dependence of the effectiveness of the B-2 on the deployment of an anti-missile Strategic Defense System, both to negate Soviet launch-under-attack tactics, as well as to mop up those mobile missiles that the B-2 misses.

Even if the B-2 would work to destroy mobile missiles, which we doubt, the deployment of the B-2 will either be rendered ineffectual by the failure to deploy a strategic defense system, or will confound arms control efforts by encouraging the deployment of strategic defenses to back B-2 up.

Thus B-2 poses the same dangers as the MX and the SDI: increased risk of nuclear war; further escalation of the arms race; and complication of arms control and reduction. The B-2 should be opposed with equal vigor. ■

REFUSENIKS SCIENTIFIC SEMINAR

Scientists in Moscow, December 8 to 11, are invited to an 8th International Scientific Conference of Refuseniks entitled "The Frontiers of Science." Interested persons can contact Dorothy Hirsch of the Committee of Concerned Scientists in New York City.

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