F.A.S. PUBLIC INTEREST REPORT

Journal of the Federation of American Scientists (FAS)
Volume 40, No. 1 January 1987

THE FUTURE OF THE SPACE SHUTTLE

John E. Pike

The Challenger accident has provoked a broad reevaluation of America's space program, and particularly the policy of relying entirely on the Space Shuttle for access to space. In 1972 the Federation was one of the leading critics of the Shuttle program, and it is now generally recognized that the original decision to build the Shuttle was flawed. But decisions on how to structure the space program in the future may suffer from the same flaw as the original Shuttle decision. The Reagan Administration's program of a mixed fleet (using expendable rockets along with the Shuttle) as well as the original Shuttle decision both assume a major increase in future demand for launch services.

Over-Estimation of Demand—The Original FAS Objection to the Shuttle

In 1972 FAS released an analysis of the Shuttle program, prepared by Philip Morrison, Eugene Skolnikoff and Leon Trilling. This report noted that the case for the program "is based on assumptions for which there is little basis, and which in fact we believe are likely to prove seriously in error—particularly assumptions that there will be a substantial increase in the number of unmanned civil satellite launchings as compared with the present frequency." The analysis concluded that "we believe projections of a substantial increase in the number of launchings reflects wishful thinking on the part of NASA, and suggest that an analysis of the shuttle ought more reasonably be based on the assumption that traffic levels may remain about as they are now."

These concerns have been validated by history. In the early 1970's NASA was projecting a Shuttle flight rate of between 30 and 48 flights per year. While this high flight rate now seems beyond the capability of the system itself, it is also far beyond current estimates of demand for launch services.

Over-Estimation of Demand—A Continuing Problem

The problem of over-estimation of demand for launch services continued after the original Shuttle decision. The Carter Administration decided that expendable rockets should be phased out, and that the Shuttle should become America's sole means of space transportation. But prior to the Challenger accident, the Reagan Administration was beginning to reverse this policy, to continue a mixed fleet of the Shuttle and expendable rockets.

In the late 1970's and early 1980's proponents of expendable rockets were optimistic that the demand for launch services would continue to exceed the capacity of the Shuttle. Several major areas of significant growth were anticipated, including new types of communications satellites for broadcasting television programming direct from satellites to home viewers and for business teleconferencing, as well as satellites for materials processing and remote sensing of crops. It was thought that these new satellite services would create a continued market for American expendable rockets in the 1980's and 1990's.

However, by 1982 or 1983 it was becoming increasingly clear that these new satellite services were simply not going to materialize. To make matters worse, there was a growing surplus of existing types of communications satellites. And competition from the European Ariane expendable rocket further clouded the future of American expendable rockets.

Unable to find another market for their wares, American manufacturers of expendable rockets turned to the Defense Department, which became a purchaser of last resort. The military sponsored a competition for a Complementary Expendable Launch Vehicle, which was won by the Martin Marietta Titan 34D7 (since renamed the Titan IV). NASA was concerned by the loss of military payloads to the Titan IV, but this concern was assuaged by the agreement of the Strategic Defense Initiative Organization to use the Shuttle flights that would have been used by the payloads that were now assigned to the Titan IV. But this continued competition from expendable rockets probably contributed to the pressure on NASA that led to the Challenger accident. *(Continued on page 2)*

GORBACHEV AND SAKHAROV

In what appeared to be a trade off in internal Soviet politics, Mikhail Gorbachev gave up on his nuclear test moratorium—in the face of unrelenting Reagan Administration opposition to joining it—but won the right to release Andrei Sakharov from exile in Gorki and called upon him to return to Moscow to "work for the common good." These developments seem to reinforce earlier speculation that the main opposition to Sakharov's release came from the military. Gorbachev may find Sakharov useful in both of their efforts to encourage reform in the Soviet Union. Sakharov's opposition to the Afghanistan war, which led to his exile in Gorki, may also be shared by Gorbachev who recently called it an "open wound."

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Mixed Fleet Alternatives

There are at least three different potential rationales for a mixed fleet policy: to reduce risk; as an insurance policy; and to meet demand. The risk reduction rationale would restrict the use of the Shuttle to only those missions that demand the presence of a crew, thereby minimizing the risk posed by Shuttle accidents and the disruption that would result from such accidents. The insurance policy rationale would rely on the Shuttle as the principal launch vehicle, but keep expendable rockets available to launch important satellites, should the Shuttle be grounded due to an accident. And the demand rationale is based on the assumption that even a four-Orbiter Shuttle fleet would be inadequate to meet the demand for launch services.

These differing rationales produce different types of mixed fleets, and the Reagan Administration has chosen only one of them. The Administration has decided to replace the Challenger, continuing a four-Orbiter Shuttle fleet. It intends to add several Expendables as well. By the early 1990's, this policy will result in annual expendable rocket launch activity of at least four Titan IV's, two Titan II's, four Medium Launch Vehicles (a new rocket that will be based on the Atlas Centaur or the Delta), all carrying military payloads, and perhaps three to six additional launches of these vehicles carrying commercial and scientific payloads. To support the development of a commercial expendable rocket industry, the Administration has decided that NASA will no longer seek commercial payloads for the Shuttle, and that a number of communications satellites previously booked on the Shuttle will have to seek other launch vehicles. And the Defense Department is developing two new types of expendable rockets (the Titan IV and the MLV) that can also be used to launch these foreign and commercial payloads.

The Administration's mixed fleet policy is predicated on the assumption that over the long run there will be sufficient demand for space launch services to support an American expendable rocket in addition to the Space Shuttle. This assumption is almost certainly wrong.

The original decision to build the Shuttle was flawed by over estimated demand for launch services, and the recent decision to pursue a mixed fleet is flawed for the same reason. It is ironic that James Fletcher was Administrator of NASA when the flawed Shuttle decision was made, and he has returned to NASA to preside over an equally flawed, though different, policy.

Mixed Fleet to Minimize Risk

One possible rationale for a mixed fleet is that the Shuttle should only be used for those missions that require a crew, and that all other missions should use expendable rockets. This option may be attractive in principle, since one might argue that human lives should not be risked unnecessarily, and that the delivery of satellites into space does not require the presence of a crew. In some sense this is an esthetic question that goes beyond rational argumentation. Or one might contend that we should not risk human life in the service of mere economic ends such as

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.

placing satellites in space to relay television broadcasts. However, society is willing to risk human life in the form of the miners who dig the coal to generate the electricity to power television, or the truck drivers who deliver television sets. But this then becomes not an argument in principle but rather a question of relative risk and the value of a human life. Thus the case against using the Shuttle to deploy commercial satellites may not be obvious.

However, this rationale may be attractive in practice, given the experience of the Challenger accident. The Shuttle has been grounded for at least two years, although the vehicle is probably safe to fly today, if the launch were conducted on a warm dry day. The decision to ground the Shuttle is largely based in the politics of perception and risk management, rather than engineering or technical requirements. But if the presence of a crew on the Shuttle means that it will be grounded for several years after each accident, versus the half year to a year that an expendable rocket might be grounded, then the Shuttle may be much more vulnerable to political catastrophes than it is to technical ones.

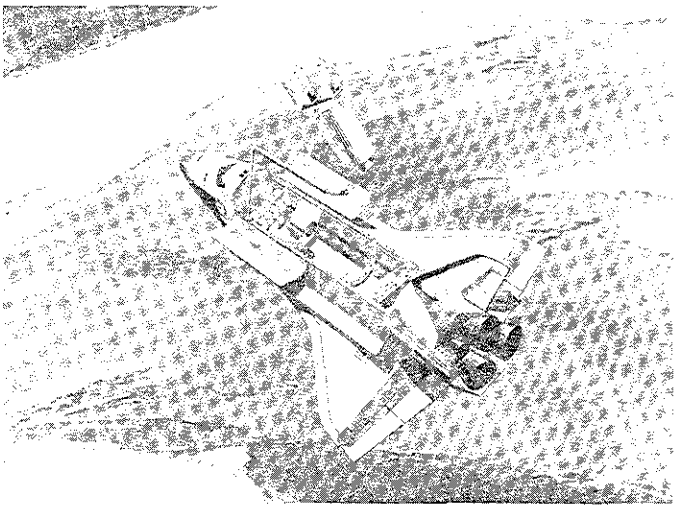
Challenger Loss Had Unprecedented Impact

The loss of the Challenger had an unprecedented impact on the nation. This was the first loss of astronauts in flight, demolishing the myth that America had a special relationship with the cosmos. The Teacher is Space program was intended to demonstrate that space was no longer the preserve of dare-devil test pilots, and that ordinary people could go into space. And the accident took place in full view on live television, further magnifying its impact.

These unique aspects of the loss of the Challenger are unlikely to be repeated. The second loss of a flight crew will be less traumatic, particularly if it involves only a military crew or if the accident is not recorded on television. The fact that the Challenger accident was seen on live television, and that the accident was re-broadcast repeatedly, surely magnified its impact. The impact of the Hindenberg accident was much greater than the loss of the R101, the Shenandoah, the Akron or the Macon, because only the Hindenberg was broadcast live and recorded for the newsreels. But it must be acknowledged that over the life of the Shuttle program, at least one more such accident is quite likely.

The goal of relying on the Shuttle as sole means of access to space may be unattainable from a bureaucratic and political point of view, even if it can be achieved technologically. If the NASA bureaucracy is unable to avert another accident (as seems all too likely) and if the political reaction to another accident parallels the reaction to the Challenger accident, it may be unwise to depend on the Shuttle, even though the case for the Shuttle may be quite compelling from a narrow technical, programmatic or economic standpoint.

This rationale for the Shuttle would produce a mixed fleet in which the Shuttle flew only a few times a year, with several dozen expendable rockets launched annually to place satellites into space. In addition, this rationale might argue against the Space Station, which also poses the political hazard of crew fatalities. If the Space Station does proceed, its components would be launched on expendable rockets, and the Shuttle's primary mission might be to rotate crews to and from the Station. This would provide the minimum presence of astronauts that many believe is needed to maintain public identification with and support of the space program, without exposing crews to such a high level of danger as to risk public alienation from the space program following a fatal accident.



The Space Shuttle will increasingly be used to carry military satellites since the Reagan Administration has barred most commercial satellites from the Shuttle.

Although the case for this option may be quite compelling, either in principle or in practice politically, this is not the mixed fleet option that the Reagan Administration has selected, and the Administration's decisions cannot be justified on this basis. The Administration proposes to continue to rely on the Shuttle as the primary means of access to space, without significantly reducing the risk to the Shuttle crews or the political risk that this entails.

Mixed Fleet as an Insurance Policy

The second rationale for a mixed fleet is as an insurance policy. While the Shuttle would continue as the primary means of access to space, expendable rockets would be held in reserve to avoid disruptions in the event of another major accident with the Shuttle.

Although there may be a need for such an insurance policy, it is not obvious. While the two year stand-down of the Shuttle has caused considerable turbulence among various satellite operators, it is unlikely to result in any interruption in services provided by satellites. This is due to the large number of satellites that the United States has in space, and the long operational life of these satellites. While the delays caused by the grounding of the Shuttle and expendable rockets are inconvenient for satellite operators, they are not catastrophic for the nation.

Indeed, one reason that the Shuttle has been grounded for such a long time is that there is little urgency associated with placing its payloads into space. For the past several years there has been a substantial surplus of communications satellites in orbit. The International Telecommunications Satellite Organization (INTELSAT) has been leasing some of its spare capacity to member countries. And the communications satellites that the Shuttle launched for Mexico and Canada in 1985 will be stored unused in orbit for several years, since it was cheaper to store them in

space than to store them on the ground. Most of the turbulence in the Shuttle's payload schedule noted by the Rogers Commission was the result of communications satellites being taken off the Shuttle since there was no need for them to be launched.

This is in contrast to the situation faced by the Soviet Union. The Soviets operate a slightly larger number of satellites than does the United States, but their satellites have significantly shorter operational lives. If the Soviets were faced with a similar loss of launch capacity (with their large Proton down for two years and their other launchers grounded for a year) they would lose all of their low altitude photographic and electronic intelligence satellites, and many of the other communication and early warning satellites.

The two areas in which an interruption of services is a danger—weather and photographic reconnaissance—are a result of problems with expendable rockets rather than the Shuttle. The GOES high altitude weather satellites have demonstrated very poor reliability in recent years, and only one of these satellites is currently operational, rather than the normal complement of two. The launch of another GOES, to bring the constellation up to full strength and to have a satellite on orbit in case the current satellite fails, has been delayed because of the loss of a Delta launch vehicle this summer.

KH-11 Photographic Reconnaisance Satellite

The KH-11 photographic reconnaissance satellite system normally has two satellites in orbit. Today there is only one satellite in orbit, as a result of failures with the satellite's Titan 34D launch vehicle, which resulted in the loss of replacement satellites in August 1985 and April 1986.

These problems would likely not have occurred in an environment in which the Shuttle was the primary launch vehicle. The greater reliability of the Shuttle (which is generally regarded has having a reliability of somewhere between .99 and .999, compared to the .85 to .95 reliability of expendable rockets) permits more expensive and thus more reliable satellites to be launched than can be accommodated on expendable rockets. This might have avoided the reliability problems of the GOES weather satellite. The KH-11 will be replaced in a few years by the KH-12 photographic reconnaissance satellite, which will be launched by the Shuttle. The KH-12 constellation will probably consist of four satellites, each with an operational life of from four to ten years, in contrast to the two KH-11's with a three year life. Thus the KH-12 system using the Shuttle will be much more resilient in the face of launch vehicle problems that the KH-11 which relies on expendable rockets.

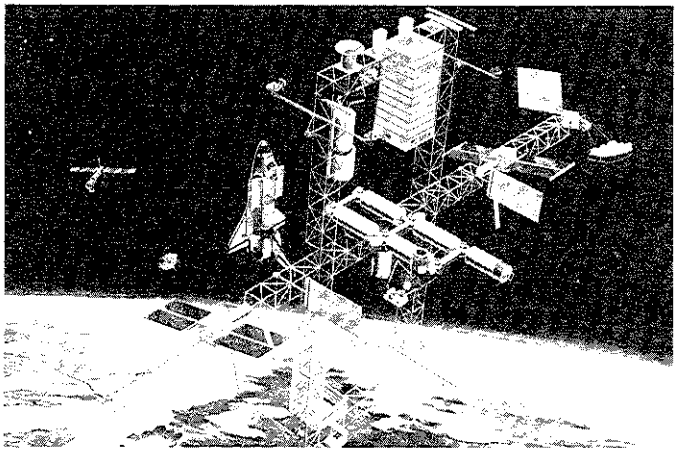
Space Station Rescue Module

The Space Station would clearly be vulnerable to interruptions in the availability of the Shuttle, since the crew might find itself stranded in space. But unmanned expendable rockets would be of little use in solving such a problem. As noted previously, even today the Shuttle is probably safe enough to fly such a mission. A rescue module on the Station would allow the crew to bail out and return to Earth if needed, and should probably be included in the design of the Station anyway, given the risk of accidents on the Station and the risk that even in the best of times the Shuttle might not be able to effect an emergency flight. It would probably be prudent for both the United States and the Soviet Union to make technical arrangements (such as compatible docking adapters) that would permit one country to rescue the other's space crews. And by the late 1990's the European Hermes shuttle would provide a backup rescue capability that might prove more politically palatable.

If the demand for an insurance policy mixed fleet is questionable, so is the supply. The question is really one of how much insurance can one afford. A potentially prohibitive number of expendable rockets might be required to provide insurance for all the payloads that would have been launched on the Shuttle. Making the not unreasonable assumption of fifteen Shuttle flights per year and a Shuttle down time of two years, an insurance policy might consist of thirty Titan IV's at $250 million each, or $7.5 billion. It is also important to note that not all Shuttle payloads could fly on the Shuttle and that not all payloads would need to fly during the time the Shuttle was grounded. However,the cost could still run into the billions.

Although the case for some variant of this option may be compelling, this is not the mixed fleet option that the Reagan Administration has selected, and so the Administration's decisions cannot be justified on this basis. The Administration proposes to operate the mixed fleet without holding any expendable rockets in reserve. Thus, in the event of the Shuttle being grounded again, the only recourse offered by the Administration's policy would be either to take payloads off of expendable rockets to make way for higher priority payloads displaced from the Shuttle, or to increase expendable rocket production rates in order to work off the backlog created by the delay in the Shuttle.

It is not clear that there would be much to be gained by this ability to launch a small number of high priority payloads during the Shuttle down-time, given generally robust satellite constellations. And as previously noted, the one system in greatest need of insurance, the Space Station, would not benefit from backup expendable rockets.



The Challenger accident has resulted in significant delays in scientific experiments that were to have been carried on the shuttle. This may lead to a major reduction of the scope and pace of the space station in the 1990s, reducing the demand for launch services.

An existing expendable rocket production line does not buy very much time in terms of responding to the grounding of the Shuttle. To produce an expendable rocket takes almost three years, which is not significantly better than the four years needed to produce an additional Shuttle Orbiter. And at $250 million each, production of ten Titan IV's would equal the capital cost of producing a new Shuttle Orbiter. Indeed, one of the major problems facing the Administration is inducing the expendable rocket companies to produce enough expendable rockets soon enough to make a difference.

Mixed Fleet to Meet Demand

The Reagan Administration proposes to operate a mixed fleet of the Shuttle and expendable rockets for the indefinite future to meet normal space transportation requirements. The question that now arises is whether there will be sufficient demand for launch services to support this mixed fleet.

An analysis of the launch services situation can be divided into three periods: late 1980's; early 1990's; and late 1990's. Each of these periods is characterized by unique space transportation supply and demand conditions.

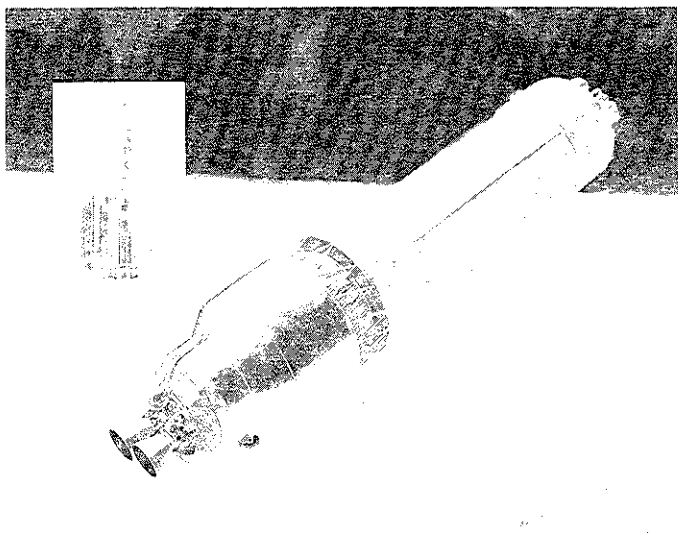
It is very clear that, from 1986 through 1990, the United States will continue to operate a mixed fleet. The supply of space transportation services will include three Shuttle Orbiters, anticipated to have 11 flights in 1990, four new Titan IV's each year beginning in 1988, four Medium Launch Vehicles (based on either the Atlas Centaur or the Delta) beginning in 1989, as well as two to four annual flights each for the older Atlas, Titan II and Delta expendable rockes. The demand for Launch services will largely be driven by the backlog created by the Challenger accident.

The limited supply of space transportation services is unlikely to be significantly augmented by non-US suppliers. The manifest for the European Ariane is already full, and Arianespace has indicated that it does not intend to increase the its launch rate beyond that planned prior to the Challenger accident. Despite aggressive marketing, the Chinese and Soviets are unlikely to achieve significant market penetration.

During the early 1990's, from 1991 through 1995, the continuation of the mixed fleet policy may be called into question, due to major uncertainties in both supply and demand.

The supply of launch services will be augmented by the introduction in March 1991 of a new Shuttle Orbiter replacing the Challenger. There is considerable uncertainty surrounding the flight rate that can be achieved using a four-Orbiter fleet. Prior to the Challenger accident, NASA projected an operational flight rate of 24 launches per year, and this was generally accepted as not implausible, (although the Congressional Budget Office also conducted an analysis of Shuttle pricing policy based on a more conservative flight rate of 18 launches per year.) More recently, the Congressional Budget Office estimated that a four Orbiter fleet could maintain a flight rate of 16 flights per year. And the National Research Council has estimated a flight rate of only 12 flights per year.

Major uncertainties also exist on the demand side. The Strategic Defense Initiative program projects a requirement for one flight annually through 1991, building to five flights annually in 1994 and 1995. The Space Station program requirements could peak with about eight flights in 1994 alone. However, it is far from clear that these two programs will actually materialize. The SDI has encountered significant Congressional skepticism, and is unlikely to receive the funding that would be needed to support such an ambitious flight rate.



The Titan 4 is one of several expendable launch vehicles currently under development by the Air Force.

Space Station Problems

The Space Station is also facing funding problems that may force a restructuring on more modest lines, or at least require a much slower buildup to the full operational capability. One of the generally under-appreciated impacts of the Challenger accident is the major delays faced by the science user communities that are the principal justification for the Space Station. Most of the Spacelab flights have been cancelled outright, and experiments that will remain attached in the Shuttle's payload bay are facing delays of about three years. These Spacelab and payload bay experiments were to have provided the experience needed to develop experiments to be flown on the Space Station. Now it appears questionable whether these experiments will be sufficiently mature to require the infrastructure that the Space Station will provide. Doubts about the scientific justification for the Space Station, always significant, will be magnified as the impact of the Challenger accident is fully appreciated. This could increase pressures to alter the construction sequence of the Space Station. The current plan calls for the entire Station to be built in about two years, with activity peaking in 1994. A more gradual approach, with an initial "man-tended" facility that would be gradually expanded as maturing user community requirements dictated, would have much lower initial space transportation needs.

However, this incremental approach to building the Space Station would render it less attractive to the Europeans, since the independent European Columbus space station, supported by the Hermes shuttle, would become operational in the mid-to-late 1990's, about the same time as the American Space Station would become fully opera-

tional. Thus political considerations—the desire to retain European participation in the Space Station— may dictate a faster buildup rate (and thus a higher demand for launch services) than would be justified on the basis of the maturity of American scientific user communities.

Thus these two programs—SDI and Space Station—with a requirement for 13 flights in 1994, could nearly preempt or actually exceed the capacity of the Shuttle fleet, even when augmented by a fourth orbiter. In this case, demand for expendable rockets would remain strong throughout the early 1990's. Alternatively, if one or both of these programs is significantly delayed or reduced in scope, or if actual Shuttle flight rates approach those anticipated prior to the Challenger accident, the market for expendable rockets may vanish almost as quickly as it emerged. In any event, it is clear that the mixed fleet policy of the Reagan Administration faces an uncertain future in the early 1990's.

The forecast for expendable rockets in the late 1990's, from 1996 through the end of the century, is even less promising. The supply of launch services will increase with the addition of the European Hermes shuttle. And demand for launch services will probably decline. The backlog of the late 1980's will have been worked off, and the potential Space Station / SDI traffic jam of the early 1990's will have resolved itself. TheCongressional Budget Office estimate of a Shuttle flight rate of 16 launches per year is roughly equivalent to their estimate of the number of launches that would be required annually in the late 1990's. The prospect is for a somewhat delayed return to the situation anticipated prior to the Challenger accident, where the demand for launch services can be met using only the capacity of the Shuttle and that provided by Arianespace.

Deployment of the SDI may generate launch demand far in excess of the capacity of the Shuttle fleet. But this would be met using a new heavy lift launch vehicle. Since the SDI would be the sole user of this new vehicle, the fate of the SDI (one way or the other) is largely irrelevant for other supply and demand calculations.

Conclusion

While it might be possible to justify continuing a mixed fleet composed of the Space Shuttle and expendable rockets into the late 1990's either to minimize risk to astronauts or as an insurance policy against failure of the shuttle, the mixed fleet design chosen by the Reagan Administraion does neither, nor can this fleet be justified in the long run in order to meet demand for launch services, which is the rationale offered by the Reagan Administration. ■

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POST-ICELAND: TRIUMPH OF ORTHODOXY IN NATO

Daniel Charles

Last summer, a West European official who is responsible for arms control policy was privately asked what his government thought of the "zero-zero option," the official NATO negotiating position that proposes withdrawing U.S. long-range missiles from Europe in exchange for the dismantling of Soviet SS-20 missiles.

"We think it's a bad idea," he said. "But we have to act like we think it's a good idea."

He and others like him within NATO were convinced that the Pershing II and cruise missiles now in Europe strengthened the bonds that keep the United States committed to the defense of Western Europe against any potential Soviet attack. For this reason, and not because of Soviet SS-20 missiles or the balance of nuclear forces in Europe, the new NATO missiles had to stay. Arms control negotiations were important to this official for political reasons, to keep communication lines open to Moscow and quell public fears of an unrestrained arms race. But he privately opposed any agreement that would severely limit NATO's own nuclear arsenal.

One was reminded of his statement when listening to European reactions following the Iceland summit. NATO defense ministers publicly welcomed the prospect of dramatic reductions in nuclear stockpiles. But behind the scenes, there have been shocked cries from the European foreign policy establishment, and efforts to place limitations and conditions on the U.S. negotiating position that may effectively block any agreement. In an article headlined "Europe Loves the Bomb," *Washington Post* National News Editor Robert Kaiser described the reaction:

> "At Reykjavik we have come very close to a catastrophe," in the words of a famous European commentator on world affairs, referring to the Soviet and American leaders' apparent flirtation with eliminating many or most nuclear weapons from Europe.

European criticism of Iceland's "potential agreements," as Secretary of State George Shultz called them, is partly fueled by a sense that U.S. allies were cut out of the decision-making process on negotiations involving their security interests. Deals made without prior consultation, in the view of European officials, are probably bad deals, and are also embarrassing, for they highlight the dangers of Western Europe's political and military dependence on the United States.

Yet this is not the primary cause of the European protest. NATO leaders seemed frankly upset at the idea of getting rid of nuclear weapons in Europe.

Americans, who just three years ago were reading press reports of dramatic European protests against deployment of these same missiles, have a right to be confused. Do West Europeans love the bomb, or hate it?

The key to this riddle is the failure of peace and disarmament movements to penetrate the small, but tightly-knit policy elite that dominates transatlantic discussion of Western foreign and military policy. Peace movements were able to grab headlines for a brief period in 1982-83, but they remained outsiders, without tangible political power. Left-leaning political parties in a number of European countries adopted many opposition movements' de-

mands, but these parties lost national elections in the United Kingdom (1983), West Germany (1983), and the Netherlands (1986). The NATO policy elite was left shaken, but intact, and ready to reassert its dominance of foreign and military policy. Only in the United Kingdom, where Margaret Thatcher's popularity has been slumping, does the opposition appear to have a good chance of gaining at least a share of power in the near future.

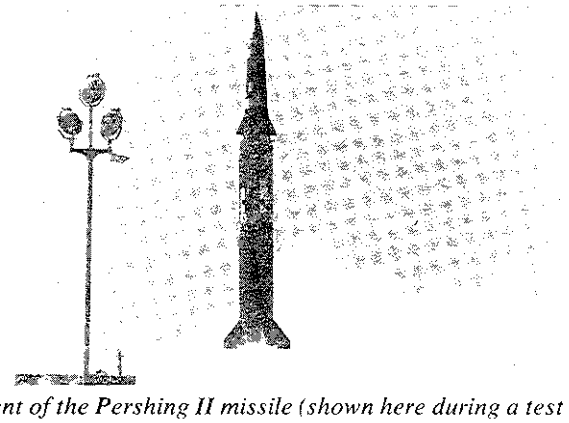
With dissenting voices relegated to the opposition benches in parliaments from the Baltic to the Mediterranean, the West European response to Reykjavik has come from the traditional defenders of NATO's nuclear status quo, who rarely wavered in their commitment to deployment of NATO's new nuclear missiles. As British peace activist E.P. Thompson put it, referring to this reaction from Europeans: "For 'Europeans,' read 'European military-political establishments.' " European disarmament advocates have been silent, uncertain of Reagan's and Gorbachev's intentions, and skeptical in particular of Reagan's willingness to eliminate any significant part of the U.S. strategic modernization program.

NATO's Nuclear Orthodoxy

Among the crucial tenets of NATO's strategic orthodoxy is the following set of assumptions: Soviet conventional forces in Europe are superior to those of NATO; this conventional superiority is a potential threat to Western Europe; and NATO's nuclear weapons are needed to help convince the Warsaw Pact not to attack Western Europe.

Revisionist analysts such as Jonathan Dean, the former U.S. Ambassador to the Mutual and Balanced Force Reduction talks, and Joshua Epstein of the Brookings Institution have challenged these assumptions on both political and military grounds. Members of the NATO policy elite, however, have generally succeeded in fending off these challenges.

They were stunned, therefore, when Secretary of State George Shultz, while defending the administration's Iceland proposal to eliminate medium-range missiles in Europe, told the editors of the *New York Times* that "American and allied conventional forces [in Europe] could handle that situation well." Members of NATO's foreign policy elite have tolerated President Reagan's rhetoric about ridding the world of nuclear weapons, dismissing it as the idle vision of an old man whose actions reliably belied his words. They became alarmed, however, when it appeared that Reagan had tried to take his own rhetoric seriously and turn it into reality.



Deployment of the Pershing II missile (shown here during a test launch) is now complete. 108 of the controversial weapons are in West Germany.

Selling the Missiles: NATO's Bait-and-Switch

Ironically, the argument Western officials now use to demonstrate NATO's need for medium-range missiles—that the missiles reinforce the "coupling" of the United States to its European allies—was not mentioned in 1979 to justify the original decision to deploy the Pershing II and Cruise Missiles. When announcing their decision, NATO Foreign and Defense Ministers declared that they had been forced to take this step as a result of Soviet theater nuclear modernization. Specifically, they portrayed NATO's new missiles as a counter to the Soviet SS-20 missiles then replacing previously-deployed SS-4 and SS-5 missiles.

With this rationale, NATO proposed arms control negotiations covering both the SS-20s as well as the new U.S.-controlled missiles, in order to "achieve a more stable overall nuclear balance at lower levels of nuclear weapons . . ." The United States proposed equal levels of U.S. and Soviet medium-range missiles, preferably zero on both sides, but the Soviet Union insisted on excluding SS-20 missiles in the Far East, and on counting comparable British and French missiles. When the United States deployed its missiles in late 1983, the Soviets walked out of the talks.

Now, however, the Soviet Union has given in, largely accepting the U.S. bargaining position. An agreement lies on the table that would clearly move the theater force comparison in NATO's favor, particularly compared to the situation in 1979. Instead of over 400 SS-4 and SS-5 missiles, or a similar number of multiple-warhead SS-20s, the Soviet Union would have no long-range missiles in Europe at all, although it would retain several hundred shorter-range missiles and its nuclear-capable aircraft. Compared to 1979, NATO would give up only the 108 U.S. Pershing Ia launchers that were withdrawn when the Pershing IIs came in. The West German-controlled Pershing Ia force would stay, as would the British and French forces and NATO's dual-capable aircraft.

Yet the NATO policy elite, in what must be considered a betrayal of the objective it set itself in 1979, seems inclined to shove the agreement aside in deference to an essentially theological and unconvincing "coupling" argument.

The shifting rationale for the Euromissiles illustrates a phenomenon one might call NATO's revolution of rising requirements. Various U.S. strategists had advocated deployment of longer-range nuclear missiles in Europe during the 1970s, but such a deployment became politically feasible only after the start of the Soviet SS-20 deployment. A key element in the concern voiced by West German chancellor Helmut Schmidt, among others, was that these missiles were unconstrained by any arms control framework.

By the time an arms control solution to this problem appeared, however, NATO's leaders appeared to have discovered a new requirement for their missiles that no arms control measure could solve. For the U.S. Euromissiles, the bottom line is Thomas Wolfe's: you can't go home again. ■

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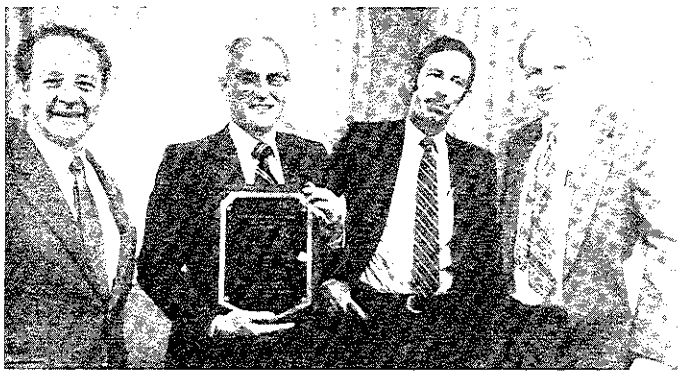
AWARD TO ARCHAMBEAU, EVERNDEN, AND SYKES

On December 13, 1986 at the FAS Annual Council Meeting, FAS Chairman Matthew S. Meselson and FAS Fund Chairman Frank von Hippel presented the FAS Public Service Award for 1986 to seismologists Charles B. Archambeau, Jack F. Evernden and Lynn R. Sykes for their work in reviving the possibility of nuclear test ban through the application of seismology. The plaques presented to the three scientists asserted:

Creative in utilizing their science.
Effective in educating their nation.
Fearless and tenacious in struggles within the bureaucracy.



Left to right: Matthew Meselson, Jack Evernden, Charles Archambeau, Frank von Hippel.

AWARD CITATION

Charles B. Archambeau
Jack F. Evernden
Lynn R. Sykes

Working as seismologists, Archambeau, Evernden and Sykes revived the possibility in the 1980s of a Comprehensive or Low-Threshold Test Ban. Working as public interest scientists, they have educated the Congress and the public on the verifiability of an underground test ban through popular articles, through extensive testimony before Congress and by providing scientific support for the NRDC-Soviet Academy in-country monitoring demonstration project.

Along with their collaborators, Evernden and Archambeau carried out an arduous and remarkably successful research program on the detection of concealed ("decoupled") low-yield underground nuclear explosions. This laid the basis for seismically verifiable test-ban agreements with threshold as low as one kiloton.

These three seismologists led the successful challenge to the U.S. government's erroneous calibration of seismic signals from the Soviet test sites, an error that prompted accusation of Soviet Threshold Test Ban violations. They showed that ultimately even a stubborn government bureaucracy can be forced to bow to the verdict of scientific peer review. It is important to note that the seismologists persisted in their efforts even though doing so imperiled a significant part of their research funding.

Archambeau recruited the high quality team of U.S. seismologists that set up monitoring stations around the principal Soviet nuclear test site in Eastern Kazakhstan. This initiative has dramatized for Congress and the public, as no paper study could, that in-country monitoring arrangements can now be built into U.S.-Soviet arms control agreements.

One testimony to the importance of this work was recently provided by a high Reagan Administration official. When he was apprised of the conclusion by Sykes and collaborators that, based on a careful recalibration of seismic data, the multiple warheads on Soviet ICBMs have a yield significantly less than the 750-1000-kt previously assumed, he exclaimed: "It can't be true. If it were, there would be no window of vulnerability!"

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