

CHAPTER 3

THE U.S. NAVY'S FLEET BALLISTIC MISSILE PROGRAM AND FINITE DETERRENCE

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In their earliest incarnation Submarine Launched Ballistic Missiles (SLBMs) were the epitome of a Mutual Assured Destruction (MAD) strategy fully implemented in that they were second strike weapons that were mobile, invulnerable to enemy detection and destruction, and capable only of hitting soft urban/industrial targets. *Polaris* was the U.S. Navy's first SLBM. Given its limited accuracy, the *Polaris* could hit a Soviet city only if the city were big enough to make a miss unlikely. But technology, strategy and organizational opportunities change. There is little that is MAD in the *Trident D-5*, the Navy's current SLBM missile, because it is a very accurate system that is capable of destroying hardened missile silos and command bunkers.

Targeting policies for American nuclear weapons are a product of nuclear weapon capabilities, national strategy, and organizational interests. These policies are established through a largely unguided bureaucratic search for what is technically feasible, what is militarily desirable, and what is politically acceptable regarding the potential use of nuclear weapons. But they are also the nation's deepest, most well-guarded secrets, and thus on some level knowable to only a handful of government insiders. The public expression of these policies may be made intentionally misleading so as to protect the real policies from prying eyes, foreign and domestic. We can infer about motivations and try to understand actions, but we may never fully know what was intended or achieved strategically for nuclear weapons.

By any measure SLBMs were a significant innovation, affecting in important ways several dimensions of U.S. strategic policy. They helped kill as unneeded a vast bomber force (our own), helped save the Navy from being marginalized in the assignment of the nation's most vital security mission, and helped win the Cold War by making it impossible for the United States to lose. They also were largely unwanted both within and without the Navy. Civilians did not want the Navy to develop its own ballistic missile. The Air Force criticized

the effort. The Army had to be pushed out of the way. And much of the Navy dreaded SLBMs.¹ Today SLBMs are the key component of our nuclear arsenal.²

The Difficult Road to *Polaris*

The U.S. Navy had great difficulty gaining a significant role in the sponsorship of nuclear forces. The Navy had only minimum involvement in the project to develop the atomic bomb, the most important weapon advance to come out of the World War II. It also lacked a viable weapon platform with which to challenge the nuclear weapon dominance that the newly created Air Force had in the early years of the Cold War. And it found that civilian officials had little interest in making the strategic mission competitive among the armed services.

The Navy was essentially frozen out of the Manhattan Project, the bomb project, because of a conflict an admiral had with the scientists who were helping to organize the effort to mobilize civilian science for the World War II. As the war drew near, the scientists offered suggestions for ways to improve the Navy's anti-submarine capabilities through a committee of the National Research Council, but their ideas were rejected as superfluous by Rear Admiral Harold G. Bowen, who at the time was the technical aide to the Secretary of the Navy as well as head of the Naval Research Laboratory. Admiral Bowen told the scientists that the Navy already had a good plan to defeat the U-boats and, if they wanted to, they ought to put on uniforms. Offended, the scientists involved soon found an influential champion, Vannevar Bush, the key wartime advisor to President Roosevelt on science including the development of the atomic bomb. Bush saw to it that Admiral Bowen was relieved of his posts and given an unsatisfactory fitness report.³ When the time came to organize the atomic bomb project, Bush gave the task to the Army Corps of Engineers, even though the Navy in the form of the Naval Research Laboratory was already involved in atomic research. Bush justified this decision by saying that naval officers, and especially those associated with the Naval Research Laboratory, did not know how to work effectively with civilian scientists.⁴

After the war the Navy sought a role in the delivery of nuclear weapons by building carriers big enough to launch and recover

atomic bomb carrying aircraft, the so-called super carriers.⁵ The Truman administration in 1949, citing budget constraints, cancelled the program in favor of an increased investment in the Air Force's B-36 strategic bomber. When the Navy took its case for the carriers to the Congress and the public, including making unproven accusations about corruption by Air Force officials and the bomber's contractor, President Truman fired the Secretary of the Navy and the Chief of Naval Operations for insubordination in a scandal that became known as the Revolt of the Admirals.⁶

The Navy also did not fare well six years later when the Eisenhower administration reviewed available ballistic missile programs. President Eisenhower's concern about winning the race to build strategic missiles was tempered by his fear that a prolonged mobilization of American society for the Cold War, as it seemed likely, might permanently harm the economy and create a garrison state unless weapon acquisition costs were limited.⁷ Three Air Force projects (*Atlas*, *Titan*, and *Thor*) and one Army project (*Jupiter*) were given priority development approval. The best the Navy could do was to team with the Army to develop a sea-based version of the *Jupiter* intermediate range ballistic missile. ⁸ Given that the Navy wanted to use submarines as the launching platform for its ballistic missile, a teaming effort with the Army seemed quite undesirable from the Navy's point of view. The *Jupiter* missile was both big and liquid-fueled. A big missile meant that few could be carried on a single submarine and that they would be difficult to launch. As later demonstrated in several Soviet disasters, volatile liquid fuels sloshing about on a submarine can create very dangerous conditions.

Missile advocates within the Navy wanted their own program, one to develop a small, solid-fueled rocket. Studies showed that such a system was feasible provided expected advances occurred in several technologies including the design of smaller nuclear warheads.⁹ But because the Eisenhower administration was determined for budgetary reasons to limit the number of priority ballistic missile programs to four, the only way the Navy could gain approval for an independent development project was to do in the Army. The Navy soon did just that by voting with the Air Force in the Joint Chiefs of Staff to prevent the Army from having an independent requirement for a strategic missile. The Air Force saw the Army rather than the

Navy as potentially the most difficult rival for the strategic mission. Once the Navy withdrew from the Jupiter program, the Army's missile effort lost its status as a priority project. In its place, the Navy was given approval for accelerated development of the solid-fueled *Polaris* missile and its associated submarine system. Approval came in 1956. Four years later the first *Polaris* armed nuclear submarine went to sea.¹⁰

The Navy took a risk in continuing to pursue the strategic mission. Some naval officers thought the Air Force was destined to dominate in ballistic missiles just as the Air Force had in aircraft delivered nuclear weapons. It was better, they believed, for the Navy to concentrate on conventional forces. Avoiding the competition for the strategic mission would avoid another political defeat. Admiral Arleigh Burke, the Chief of Naval Operations during the *Polaris* decision, however, thought that the Navy had to be involved in the development of ballistic missiles and gain part of the strategic mission if it wanted to protect its share of the defense budget and protect its conventional warfare role. Burke, right on so many other issues, may have been wrong on this one because much of the program's initial costs came out of the Navy's base budget. In any case, the nation benefited from his bureaucratic miscalculation.¹¹

Not surprisingly because of these internal fears, Fleet Ballistic Missile (FBM) proponents initially looked back at the U.S. Navy almost as much as they focused on the growing nuclear arms race with the Soviet Union in their statements about *Polaris'* deployment and purpose. Although they were totally committed to submarine basing for *Polaris*, they tried to reassure others in the Navy that opportunities for them were not being totally closed off. Thus, the initial design of the FBM system included provisions to place *Polaris* launch tubes on surface ships - aircraft carriers and cruisers specifically - as well as submarines.¹² This way, the major elements of the conventional navy could have a possible strategic role. Spreading *Polaris* missiles across the fleet might not be their best or most likely outcome, but such plans potentially could be used to justify the purchase of conventional forces in a policy environment that seemed certain to favor more strategic investments at the expense of conventional warfare investments.

Defending *Polaris*

Keeping the *Polaris* program viable in Washington's competitive budgetary environment meant that the Navy had to devise effective supporting arguments as well as effective development strategies. The U.S. was going to build ballistic missiles, but not necessarily *Polaris* missiles. Just as the Jupiter missile could be pushed aside so could *Polaris*. The Eisenhower administration sought to impose budget ceilings on the military in order to limit the impact the Cold War mobilization was having on the American economy.¹³ Submarines are not cheap. The cost of putting an equivalent payload at sea was initially estimated to be four times that of a land based force.¹⁴ If the Navy had not offered a persuasive case for its FBM Program, the Navy's formal name for its submarine launched ballistic missile system, Air Force ballistic missile programs would have been preferred to what could easily have been viewed as the Navy's wasteful duplicating effort to gain a share of the strategic mission.

Polaris was built primarily on arguments that stressed the Navy system's unique contributions to national security. Ballistic missiles, whatever their basing modes, were certain to be targets for enemy nuclear weapon attacks because of the threat they posed to an opponent. The blast and fallout effects of these attacks could be devastating to civilian populations and vital national infrastructure. Sea-basing, FBM advocates stressed took missile targets away from American shores, reducing the damage that an attack could inflict on the American homeland. Thus, the FBM system was sold in part on its unique damage limitation feature.¹⁵

Submarine basing has particular advantages for strategic systems, not the least of which is that submarines are extremely difficult for opponents to counter. Submarines are mobile, stealthy platforms that are hard to locate and track.¹⁶ Nuclear-powered ones can stay submerged for months at a time. Defenders must be able to identify, follow and destroy missile carrying submarines in literally millions of square miles of ocean, much of which is likely to be patrolled by U.S. warships and aircraft.

Oskar Morgenstern, the great nuclear strategist, described the Navy's position succinctly and positively in 1960, writing: "The United States can make its force invulnerable by hardening....But

this has the simple consequence that these sites will come under correspondingly heavier attack...Indeed, we must go further and place the major part of the retaliatory force outside our country... on the vast expanse of the world's oceans, in fact under the waters. We then combine through the use of nuclear-powered, missile-firing *Polaris* submarines the tremendous advantages of mobility with invisibility; and we can distribute individual units randomly, thereby making surprise attack on any substantial part of that force impossible."¹⁷

The survivability of the system was also described as an advantage because it meant *Polaris* was unlikely to be viewed by the Soviets as a first strike weapon. A more vulnerable system could cause the Soviets to fear that it would be used preemptively and therefore could provoke their own preemption. Lurking safely in the depths, *Polaris* was the assured retaliation for an attack against the United States that underlay the mutual assured destruction doctrine and was vigorously promoted as such by some of its early naval advocates.¹⁸

Even the technical limits imposed by submarine basing of *Polaris* were used to promote the FBM system. Accurate targeting of a ballistic missile requires accurate information about its precise launch point as well as the location of its target. Although improvements were made, navigation at sea was an imprecise science when *Polaris* was being developed. At that time, missile guidance systems could not compensate for the inevitable errors. Also communication with submerged submarines was very difficult, ruling out the close coordination required for preemptive attacks.¹⁹ Taken together the accuracy limits and the communications problems meant that *Polaris* was inherently a second strike weapon.²⁰ Rather than a limitation, the retaliatory nature of *Polaris* was described as a strategic virtue. *Polaris*, the argument went, would help stabilize the arms race by its inability to do disarming attacks.

As a retaliatory system, FBM could be finite in scale and thus limited in cost. Proponents argued that this would free resources that conventional forces (especially the rest of the Navy) needed to meet likely Soviet inspired global probes that sought to extend the Cold World competition into other arenas.²¹ This assertion helped reassure skeptics in the Navy who worried that the expanding strategic forces would absorb most of the service's budget and officer promotion opportunities as they were already doing within

the Air Force. Staking out the retaliatory position signaled that the *Polaris* proponents had moderate ambitions. It also helped avoid continuing investments in strategic counterforce systems, such as the Air Force promoted, which fueled a wasteful arms race with no upper bounds.²² *Polaris* made nuclear deterrence finite both in terms of its impact on the Navy and its impact on society.

As America's ultra secure second strike, its invulnerable deterrent, the *Polaris* system was a significant constraint on Soviet nuclear aggression. If the Soviets wished to counter it at sea, they would be forced to build a navy of a scale to rival that of the U.S.. The resources required to do effective antisubmarine warfare were vast, especially against a technologically advanced opponent like the U.S.. Moreover, the Soviet Union, because of its geographic isolation from the sea, was at a particular disadvantage in any attempt to counter directly the *Polaris* threat. Pushing *Polaris* could push the Soviets financially, and certainly might entice them to allocate resources away from building and defending their own strategic forces.²³

Technology and Morality

During public debates about the relative merits of buying Super Carriers versus the B-36 bombers, naval officers raised questions about the morality of the Air Force position. By advocating the deployment of the B-36, they argued that the Air Force was advocating killing civilians because the B-36 would not be able to deliver bombs accurately. The B-36 would repeat the city destroying attacks of the World War II, but this time the near random devastation of strategic bombing would be greater because the B-36 would be dropping nuclear bombs. The intentional targeting of civilians, which a B-36 raid necessarily would be, they noted, was immoral and harmful to national interest. In contrast naval aircraft attacking from the new carriers would be fighter-bombers capable of striking military targets with some precision.²⁴ Naval officers did not mention that the Navy wanted the Super Carriers to launch larger aircraft needed for nuclear strikes of their own which were likely to cause considerable civilian casualties as collateral damage.²⁵

But because *Polaris* like all early ballistic missiles was a city killer by necessity, naval officers advocating the development of the *Polaris* had to ignore the moral objections to city attacks that the Navy made

in the debate over the Super Carrier. To be sure, they cited *Polaris*' potential for attacking military targets, specifically mentioning submarine pens and airfields, but this was in part to justify an independent naval requirement for a nuclear weapon delivery system and in part to mollify critics within the Navy who preferred conventional capabilities.²⁶ The serious discussion of targets for *Polaris* quickly turned to the list of Soviet urban/industrial targets, cities and civilians.

The retaliatory /deterrent aspects of *Polaris* were more than acknowledged, they were championed. The moral arguments were reversed. With *Polaris* it was virtuous to threaten the annihilation of civilian populations because the ability to cause such destruction would prevent war, not expand it.²⁷ *Polaris*, the invulnerable deterrent, would be the most effective way to do this. There was no need for a doctrine of massive retaliation. With a secure second strike, nuclear war would never pay.²⁸ As Rear Admiral I. J. Galantin, later head of the FBM development effort, said: "[*Polaris*] will give assurance of retaliation and fulfill the new function of military force - that of preventing war - by being so attuned and adjusted to grand strategy requirements that battles do not occur."²⁹

The Slide Away from MAD

Although a Joint Targeting Planning Staff for nuclear weapons was established in August 1960, the shape of the U.S. nuclear weapon programs remained very much influenced by uncoordinated service initiatives.³⁰ The Navy in calculating the number of SLBMs (submarines) to acquire sought enough to attack all potential Soviet targets irrespective of the coverage of same targets by Air Force land-based ballistic missile and bombers.³¹ Both the Air Force and the Navy planned follow-on strategic systems independently of each other. And both services pursued vigorous technology improvement efforts to make their systems more survivable and more accurate.

The *Polaris* had A-1, A-2 and A-3 versions and was succeeded by first the *Poseidon* and then the *Trident* D-4 and D-5 missiles. The *Polaris* A-2 achieved the range goals originally set for *Polaris* while the A-3 had increased range and multiple nuclear warheads that could thwart early Soviet anti-ballistic missile defenses. *Poseidon* increased the range still further, had improved accuracy, and added multiple

independently targetable warheads that assured penetration of more advanced Soviet defenses. The *Trident* versions improved range and accuracy still further. By the time *Trident* D-5 was deployed, the hard target capabilities of the FBM, achieved gradually, were generally acknowledged.³²

Within the Navy there was a debate between those who wanted technology improvements in the FBM system merely to protect its assured destruction role and those who wanted the Navy to gain significant counterforce capabilities.³³ The long time director of the FBM's development agency, the Navy's Special Projects Office (later the Strategic Systems Projects Office), Vice Admiral Levering Smith, in particular, sought to constrain the push toward a hard target killing requirements for SLBMs that was advocated within the Navy's staff and Secretariat. Smith thought that an invulnerable and guaranteed to succeed second strike was sufficient to prevent a Soviet attack.³⁴

But not everyone agreed that Mutual Assured Destruction was the most desirable strategic doctrine. From the beginning, there were officers and officials in and out of the Navy who did not want to trust the nation's fate to the logic of mutual hostage taking and the rational calculations of the Soviet leadership.³⁵ Although debates raged over every effort to build ballistic missile defense, the Navy quietly pursued anti-submarine warfare with apparently great and persistent success. The Navy achieved operational dominance over Soviet submarines in the early 1960s and maintained it for more than two decades.³⁶ Nominally focused on keeping the sea lanes to Europe open, this anti-submarine warfare capability obviously could be used against Soviet ballistic missile submarines; and it was. Here the argument was that our bombers and command facilities had to be protected against a surprise Soviet SLBM attack. As a Soviet ballistic missile submarine retreated under pressure back toward the apparent protection of Soviet shores, the U.S. anti-submarine effort followed. Indications are that the effort remained successful despite Soviet attempts to create Bastions for the safe operation of their missile carrying submarines. The Soviet submarines were in jeopardy no matter their mission. Although unadvertised, the Navy, in essence, had developed the ability to place the Soviet's second strike continually at risk.³⁷

Without public declaration or full internal debate, the Navy had given the nation strategic options beyond MAD. The improvements obtained in SLBM accuracy, advances achieved in submarine communications, and the significant anti-submarine warfare advantage achieved by the Navy provided preemption and war fighting possibilities that earlier in the Cold War simply did not exist. Because MAD remained the official policy, it was quite rare and controversial for officials to discuss these new options openly and clearly.³⁸ Yet, any fair assessment of the capacity of American strategic forces from the 1970s on could not ignore the reality. The U.S. had the capability to do more than absorb a nuclear attack and retaliate with a devastating counter strike.³⁹

Technological opportunities were seized. *Polaris* was a very secure retaliatory system, the key component of a MAD strategy. *Trident* is all that plus the formerly unthinkable - the possibility of throwing a disarming first blow - a coordinated, preemptive strike against all Soviet strategic systems. The Soviet Union was attempting to respond by building quieter submarines and mobile land-based missiles when the Cold War ended with the collapse of Communism and the disintegration of the Soviet empire.

ENDNOTES - CHAPTER 3

1. For a detailed history of the *Polaris* development and the politics that lay behind it, see my *Polaris System Development: Bureaucratic and Programmatic Success in Government*, Cambridge, MA: Harvard University Press, 1972.

2. David Mosher, "The Hunt for Small Potatoes: Savings in Nuclear Deterrence Forces," in Cindy Williams, ed., *Holding the Line: U. S. Defense Alternatives for the Early 21st Century*, Cambridge, MA: MIT Press, 2001, pp. 119-140.

3. Harvey M. Sapolsky, *Science and the Navy: The History of the Office of Naval Research*, Princeton, NJ: Princeton University Press, 1990, pp. 11-19.

4. *Ibid.*

5. For a discussion of the Navy's initial attempts to have a nuclear bomber, see John Hayward and C. W. Borklund, *Bluejacket Admiral*, Annapolis, Naval Institute Press: 2000.

6. Jeffrey G. Barlow, *Revolt of the Admirals: The Fight for Naval Aviation, 1945-1950*, Washington, DC: Naval Historical Center, Department of the Navy, 1994; Paul Y. Hammond, "Super Carriers and B-36 Bombers: Appropriations, Strategy, and Politics," in Harold Stein, ed., *American Civil-Military Decisions*, Birmingham, AL: University of Alabama Press, 1961.

7. Andrew P. N. Erdmann, "‘War No Longer Has Any Logic Whatever’: Dwight D. Eisenhower and the Thermonuclear Revolution," in John Lewis Gaddis, ed., *Coldwar Statesmen Confront the Bomb: Nuclear Diplomacy Since 1945*, New York, NY: Oxford University Press, 1999, p. 109.

8. Sapolsky, *The Polaris System Development*, pp. 7, 21-24.

9. Sapolsky, *The Polaris System Development*, pp. 28-29; William F. Whitamore, "Military Operations Research—A Personal Retrospect," *Operations Research*, Vol. 9, March-April, 1961, p. 263.

10. Captain Dominic A. Paolucci, USN, Ret., "The Development of Navy Strategic Offensive and Defensive Systems," *U.S. Naval Institute Proceedings*, May 1970, p. 215.

11. Desmond J. Ball, "The Counterforce Potential of American SLBM Systems," *Journal of Peace Research*, Vol. XIV, No. 1, 1977, p. 25, citing interview with Admiral Burke. Also Sapolsky, *The Polaris System Development*, pp. 160-191.

12. The idea of surface ships as ballistic missile carriers persisted into the 1960s. See Thomas Connolly, "The Ballistic Missile Surface Force," *U.S. Naval Institute Proceedings*, June 1964, pp. 41-47.

13. Robert R. Bowie and Richard Immerman, *Waging Peace: How Eisenhower Shaped an Enduring Cold War Strategy*, New York, NY: Oxford University Press, 1998, pp. 41-52; Erdmann, "‘War No Longer Has Any Logic Whatever’: Dwight D. Eisenhower and the Thermonuclear Revolution." Note the objections, Commander Laurence. B. Green and Commander John H. Burt, "Massive Retaliation: Salvation or —?" *U.S. Naval Institute Proceedings*, October 1958, pp. 23-28.

14. Captain Dominic A. Paolucci, "Poseidon and Minuteman: Either, Or; Neither, Nor?" *U.S. Naval Institute Proceedings*, August 1968, p. 49.

15. Roy Beavers, "Seapower and Geopolitics in the Missile Age," *U.S. Naval Institute Proceedings*, June 1959, p. 41; Hanson W. Baldwin, "Stalemate—Or? *U.S. Naval Institute Proceedings*, April 1964, pp. 48-55. "This line of argumentation continued even as SLBMs evolved. See Paolucci, "The Development of Navy Strategic Offensive and Defensive Systems," p. 223.

16. Owen R. Cote, Jr., *The Third Battle: Innovation in the U. S. Navy’s Silent Cold War Struggle with Soviet Submarines*, Newport, RI: Naval War College Press, 2002; Paolucci, "Poseidon and Minuteman: Either, Or; Neither, Nor?"; Admiral Claude Ricketts, "Naval Power—Present and Future," *U.S. Naval Institute Proceedings*, January 1963, p. 38. Some claimed the advantage for all sea based weapons, those delivered by carrier aircraft or seaplanes as well as submarines, James H. Smith, Jr., "Mobile Sea Base Systems in Nuclear Warfare," *U.S. Naval Institute Proceedings*, February 1955, pp. 131-135.

17. Quoted in Norman Polmar and Captain Dominic A. Paolucci, USN, Ret., "Sea-based ‘Strategic’ Weapons for the 1980s and Beyond," *U.S. Naval Institute Proceedings*, May 1978, p. 107.

18. Commander P. H. Backus, "Finite Deterrence, Controlled Retaliation," *U.S. Naval Institute Proceedings*, March 1959, pp. 23-29; Commander Paul H. Backus, USN, Ret., "The Vulnerable Homeland," *U.S. Naval Institute Proceedings*, December 1970, pp. 19-22.

19. Sapolsky, *The Polaris System Development*, pp. 238-240.

20. Backus, "The Vulnerable Homeland"; Ball, "The Counterforce Potential of American SLBM Systems," p. 24.

21. Commander Ralph E. Williams, "Task for Today: Security Through Seapower," *U.S. Naval Institute Proceedings*, March 1958, p. 24.

22. Backus, "Finite Deterrence, Controlled Retaliation,"; Lieutenant George E. Love, "Deterrence—The Next 20 Years," *U.S. Naval Institute Proceedings*, November 1961, pp. 51-59. Naval officers were eager to take the challenge that a more flexible response strategy embraced. See Commander Malcolm W. Cagle, "Sea Power and Limited War," *U.S. Naval Institute Proceedings*, July 1958, pp. 23-27; Captain George L. Rearing, "The Atom, the Navy and Limited War," *U.S. Naval Institute Proceedings*, February 1962, pp. 50-57; and Captain Carl H. Amme, "Naval Strategy and the New Frontier," *U.S. Naval Institute Proceedings*, March 1962, pp. 23-33.

23. Rear Admiral I. J. Galantin, "The Future of Nuclear-Powered Submarines," *U.S. Naval Institute Proceedings*, June 1958, p. 23, expresses an early version of the so-called competitive strategy of forces the Soviets to spend scarce resources on defensive measures. See also testimony of Rear Admiral Levering Smith, U.S. Congress, Senate, Committee on Armed Services, *Undersea Long Range Missile: Hearings before the Ad Hoc Research and Development Subcommittee*, 92nd Cong., 2nd Sess., March 23, 1972, p. 3211; testimony of Vice Admiral Philip Beshany, U.S. Congress, Senate, Committee on Armed Services, *Undersea Long Range Missile: Hearings before the Ad Hoc Research and Development Subcommittee*, 92nd Cong., 2nd Sess., March 22, 1972, p. 3143.

24. Rear Admiral R. A. Ofstie, "Strategic Air Warfare," *U.S. Naval Institute Proceedings*, June 1951, p. 59. These arguments persisted among naval officers well into the 1950s, see Commander Malcolm A. Cagle, 1957 Naval Institute Prize Essay, "A Philosophy for Naval Atomic Warfare," *U.S. Naval Institute Proceedings*, March 1957, pp. 249-258, which quotes favorably Rear Admiral Ofstie's famous 1949 testimony attacking Air Force strategy as immoral.

25. The quest for a nuclear capacity for naval aviation is described by participants in Jerry Miller, *Nuclear Weapons and Aircraft Carriers: How the Bomb Saved Naval Aviation*, Washington, DC: Smithsonian Institution Press, 2001; and Hayward and Borklund, *Bluejacket Admiral: The Navy Career of Chick Hayward*.

26. "Navy Views Polaris As Support Weapon," *Aviation Week*, June 17, 1957, pp. 31-32.

27. Galantin, "The Future of Nuclear-Powered Submarines." Note also Admiral H. D. Felt, "The Potential of Our Nuclear Age Navy," *U.S. Naval Institute Proceedings*, January 1958, pp. 110-113; Bernard Brodie, "Influence of Mass Destruction Weapons on Strategy," *Naval War College Review*, June 1956, pp. 27-41.

28. Lieutenant George E. Love, "Neither Humiliation Nor Holocaust," *U.S. Naval Institute Proceedings*, June 1963, p. 63.
29. Galatin, "The Future of Nuclear-powered Submarines," p. 32.
30. Henry S. Rowen, "The Evolution of Nuclear Strategic Doctrine," in Laurence Martin, ed., *Strategic Thought in the Nuclear Age*, Baltimore MD: Johns Hopkins University Press, 1979, pp. 131-156. Note also Captain Linton F. Brooks, "Dropping the Baton," *U.S. Naval Institute Proceedings*, June 1989, p. 34, who notes the Air Force dominance of the Joint Strategic Targeting Planning Staff.
31. Sapolsky, *The Polaris System Development*, p. 161.
32. Trident accuracy is discussed in D. Douglas Dalgleish and Larry Schweikart, "Trident and the Triad," *U.S. Naval Institute Proceedings*, June 1986, p. 76; D. Douglas Dalgleish and Larry Schweikart, "One Missile for the Triad," *U.S. Naval Institute Proceedings*, August 1989, p. 74; Brooks, "Dropping the Baton," p. 35.
33. Graham Spinardi, *From Polaris to Trident: The Development of U.S. Fleet Ballistic Missile Technology*, London, UK: Cambridge University Press, 1994. Also Graham Spinardi, "Why the U.S. Navy Went for Hard-Target Counterforce in Trident II, And Why It Didn't Get There Sooner," *International Security*, Vol. 15, No. 2, Fall 1990, pp. 147-190.
34. This position is reinforced in John Craven, *The Silent War. The Cold War Battle Beneath the Sea*, New York: Simon and Schuster, 2001.
35. John Lehman, *Command of the Seas*, New York: Charles Scribner's Sons, 1988, pp. 198, 202; see also Scott D. Sagan, "SIOP-62: The Nuclear War Plan Briefing to President Kennedy," *International Security*, Vol. 12, No. 1, Summer 1987, pp. 22-51.
36. Cote, *The Third Battle*; Tom Stefanik, *Strategic Antisubmarine Warfare and Naval Strategy*, Lexington MA: Lexington Books, 1987.
37. Contrast Rowen, "The Evolution of Nuclear Strategic Doctrine," p. 153. See also Barry Posen, *Inadvertent Escalation. Conventional War and Nuclear Risks*, Ithaca: Cornell University Press, 1992. Our significant ASW capabilities were not usually acknowledged. See James L. George, "START & the Navy," *U.S. Naval Institute Proceedings*, April 1986, p. 38.
38. Ball, "The Counterforce Potential of American SLBM Systems," in Spinardi, "Why the U.S. Navy . . .".
39. Brooks, "Dropping the Baton," p. 36.