NAVAL POSTGRADUATE SCHOOL

A Flotilla to Support a Strategy of Offshore Control

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ABSTRACT: Addition of a flotilla of small missile ships is recommended as a low cost, high reward component of the U. S. Navy. Emphasis is on the flotilla's complementary role in an affordable "Offshore Control Strategy" to maintain American influence with China and our Asian partners in the Western Pacific. The study also shows that as easily distributable assets, flotilla squadrons are particularly suitable for presence in other key regions of the world. It shows why flotilla ships have a combat advantage in the missile age. It demonstrates that logistic support, sea worthiness, and deployability need not constrain its versatility and utility. Representative missile ship characteristics and a force configuration are included that demonstrate the flotilla is a very affordable component while adding versatility to the fleet. The study also recommends (b) (5) r. The purposes range from serving as "coast watcher" monitoring stations to basing semi-covert, hard to attack land-to-sea missiles. (b) (5) are expected to be mutually reinforcing. (b) (5) serve to prevent Chinese occupation of strategic or economically valuable offshore locations in the East and South China Seas. The study also shows how the flotilla can team synergistically with LCSs and JHSVs to retain American influence in East Asia and help prevent or contain a conflict there.

A FLOTILLA TO SUPPORT A STRATEGY OF OFFSHORE CONTROL

Under no circumstances [should] big ships become big or expensive in equipment to the extent that their defense becomes a first priority requirement in itself. This would inevitably negate their offensive value.

Rear Admiral Benyamin Telem, IDF[1]

Study Purpose and Contents

A workshop sponsored by the Secretary of Defense's Office of Net Assessment on retaining American influence in East Asia led to a report published in October 2011.[2] The workshop participants advocated four force elements to reduce the chance of Chinese aggression and a shooting war. One component is a flotilla of small, highly lethal combatants that can be sent on the surface into the China Seas. Analysis at the Naval Postgraduate School and war gaming at the Naval War College independently saw the potential of such low-cost missile combatants and the need for a more detailed examination, since no such capability exists in the U. S. Navy.

Our purpose is to demonstrate the cost-effectiveness of a flotilla of such small combatants, specifically in East Asia but also in the Persian Gulf and in other *cul de sacs* around the world, such as the Black and Baltic Seas and Eastern Mediterranean. We address costs, logistics, supporting reconnaissance, and tactical adaptability. We show how the flotilla adds additional strategic choices in a flexible strategy to influence China, especially when positioned at Marine outposts located along the First Island Chain in a mutually reinforcing and interlocking system.

The study's emphasis is on operations and tactics. These are so multifaceted that no simple campaign analysis can adequately represent the several considerations or answer all questions pertaining to the flotilla. Nor can the historical record add much, because our navy has not fought a battle at sea since 1945. This is the penalty of success, because for 75 years the American navy's superiority has not been tested. Quite instructive is the similar 19th Century *Pax Britannica,* aided by the Royal Navy's supremacy at sea from 1815 to the rise of Imperial Germany and its High Seas Fleet, circa 1910. Between 1815 and 1890 a great technological transformation occurred in battle fleets that went untested until the Sino-Japanese, Spanish-American, and Russo-Japanese Wars. The absence of tests at sea during the 75-year *Pax Americana* has similarly limited the U. S. Navy's sea battle experience and skills. Like the Royal Navy before World War I, we have had to observe missile warfare conducted by other nations and learn vicariously.

"The flotilla" first came to prominence at the beginning of the 20th Century in the form of deadly torpedo boats, submarines, and mines. Battleships that ventured into littoral waters paid a dreadful penalty, notably illustrated by the loss of three of them and a battlecruiser to mines in March 1915 in the

[1] Telem, *Naval Lessons of the Yom Kippur War*, 1975, University Publishing Projects, Tel Aviv, Israel
[2] Hughes, *Report of a Workshop on Retaining Influence in the Western Pacific, 24-25August 2011,* Naval Postgraduate School October 2011, NPS-OR-11-006

Dardanelles. In 1898 the great Russian Admiral, S. O. Makarov, himself soon to die when his battleship struck a mine and sank off Port Arthur in 1905, wrote with droll wit:

> Up to the present [command of the sea] has been understood to mean that the fleet commanding the sea openly plies upon it and the beaten antagonist does not dare to leave his ports. Would this be so today? Instructions bearing on the subject counsel the victor to avoid night attack from the torpedo boats of the antagonist . . . [I]f the matter were represented to a stranger he would be astonished. He would probably ask whether he properly understood that a victorious fleet must protect itself from the remnant of a vanquished enemy.[3]

Thus, the first reason for an American flotilla is to fight symmetrically against small combatants where big ships should not go, in the waters off a coastline cluttered with fishing boats, coastal traffic, oil rigs, islands, inlets, and estuaries.[4] Such a flotilla ensures we need not cede the littoral waters to an enemy equipped and trained to operate there.

The second reason small missile combatants have come into prominence is the success of small warships with lethal salvoes fired at large ships. The first salvoes were with torpedoes. Then, starting with the sinking of the Israeli destroyer *Eilat* in 1967 by Soviet-built *Osas* and *Komars*, the salvoes became cruise missiles and navies entered the missile age of warfare.

The third reason was that it took only one or two hits from a salvo of either torpedoes or cruise missiles to put a large warship out of action. In fact, the weight of ordnance to put a warship out of action increases only as the one-third power of its displacement, making smaller missile ships a cost-effective offensive capability. In other words, the historical evidence is that if a 300 foot ship will be put out of action be a certain kind of missile or quantity or ordnance, then it takes only three hits with the same missile or three times the ordnance to incapacitate a 900 foot ship.[5]

Study Structure

Because no sea campaigns have been fought since the Falklands War in 1982, Chapter 1 will illustrate the advantages of a flotilla with an imaginary modern battle fought in the Mediterranean. It shows how a battle is tied to and complicated by strategy and national policy. In the example the national command authority wishes to avoid strikes on land, since that would surely expand the war. Instead the U. S. President wants to resolve the crisis with shooting limited to the Aegean Sea and Eastern Mediterranean.

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[3] S. O. Makarov, *Discussion of Questions in Naval Tactics, 1898,* republished in the Classics of Sea Power Series by the Naval Institute Press, 1990, where the quotation is on page 28.

[4] We define littoral waters non-technically but visualizably as "where the clutter is."

[5] For detailed wartime data see R. L. Humphrey, "Comparing Damage and Sinking Data for World War II and Recent Conflicts," presented to the 13th General Working Meeting of The Military Conflict Institute, McLean, VA, Oct. 1992; T. R. Beall, *The Development of a Naval Battle Model and Its Validation Using Historical Data*, Naval Postgraduate School Masters Thesis, Monterey, CA, 1990; and J. C. Shulte, *An Analysis of the Historical Effectiveness of Antiship Cruise Missiles in Littoral Warfare*, Naval Postgraduate School Masters Thesis, Sept 1994, Monterey, CA. Their results and BuShips data (on sinkings only) are summarized in Hughes, *Fleet Tactics and Coastal Combat,* Naval Institute Press, Annapolis, MD, 2000, pp. 156-164. Most of the data is taken from World War II battles when much attention and construction costs went into staying power as armor, compartmentation, and system redundancy.

In the mythical scenario, that is the problem the tactical commander must solve with a diminished Sixth Fleet. To do so he needs a flotilla of small combatants.

Shifting from complex to simple exposition, Chapter 2 first describes quantitatively the advantages of small combatants acting in concert. Then we summarize the historical record of over 200 anti-ship cruise missiles (ASCMs) fired in combat at sea to show their effects in the missile age. With one exception the battle venues were all in littoral waters, the attacks were carried out either by aircraft or relatively small combatants, and the ships that successfully defended themselves employed means other than surface-to-air missiles (SAMs).

Chapter 3 describes the role of the flotilla in a U. S. war at sea strategy which threatens to create a "no man's sea" in the China's home waters. We draw from three rich papers, one of which felicitously calls the war at sea strategy "offshore control." We describe how (b) (5) Such a (b) (5) s.

Having described the roles of a flotilla, in Chapter 4 we introduce illustrative missile ship characteristics and a tentative flotilla composition, while showing the very modest cost to build it. Two short paragraphs say the austerely manned flotilla ships are not cutting edge but remedial. Future flotillas will blend small manned missile combatants with even smaller unmanned vessels in greater numbers, just as is already happening in the aircraft and undersea communities.

In Chapter 5 we review four pertinent periods of salvo warfare, in 1942, 1971, 1973, and 1982. We amplify Chapter 1's "Battle of the Aegean" and further discuss what contemporary littoral combat would be like. We describe the current trends and processes of missile warfare. We contrast two different employments of the flotilla in the China Seas, first for peacetime influence, and second, in a time of conflict.

Chapter 6 concludes with actionable findings from the study and a summarizing conclusion.

CHAPTER 1 AN IMAGINARY CONFLICT

> *A navy's purposes deal with the movement and delivery of goods and services at sea; an army's purpose is to purchase and hold real estate. Thus a navy is in the links business, while an army is in the nodes business.*
>
> Wayne P. Hughes, Jr.[6]

Some Background from Real Naval Warfare

Seventy years ago the U. S. Navy became aircraft carrier and submarine centric. Carrier task forces plus submarines—acting independently or in wolf packs—had grown in importance after World War I. Simultaneously the "flotilla" was distinguished by leading strategists like Sir Julian Corbett as an entirely different fleet component distinct in function and capabilities from capital ships that gained command of the high seas, and submarines that conducted a *guerre de course* against shipping.[7] Surface combatants were mere "escorts" of carriers, amphibious ships, the combat logistics force, and vital shipping. Exceptions were destroyers that performed in the flotilla role, most prominently for eighteen months in the Solomon Islands campaign of 1942-43.[8] The carrier and submarine emphasis was natural because in World War II they were by far the most effective in sinking enemy warships and merchants vessels. But the U. S. and Japanese navy destroyers were irreplaceable in the restricted waters off Guadalcanal and then up "The Slot" in the central Solomons, because they could achieve surprise with a salvo of deadly torpedoes at close range, sacrificing themselves if needs be.

After World War II the Soviet Union planned to challenge NATO's vital use of the seas with submarines and land-based bombers. The first change to U. S. Navy roles came in the 1950s when carriers surrendered half of their capital ship responsibilities to forty-one SSBNs armed with Polaris medium range ballistic missiles. The second change, almost unnoticed in the U. S. Navy, came in the early 1970s when air, ship, and land launched missiles began to replace bombs or missiles delivered by aircraft. *This was so because a big salvo of missiles could be launched from a large number of small warships and, after a few years of development, could reach just as far and accurately as naval aircraft that had to fly from a much smaller number of large aircraft carriers.*

But evidence from actual battles at sea after 1945 is sparse. From 1950 to the present our Navy has been able to concentrate most of its efforts on projecting military power from sea to land and has done so with unrivalled success. In 1998 this study's co-author Hughes conceived and described an imaginary battle set in the eastern Mediterranean in order to illustrate features of

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[6] Hughes, *Fleet Tactics and Coastal Combat*, Naval Institute Press, 2000, p. 9

[7] See Corbett, *Some Principles of Maritime Strategy*. First published in 1911, the pertinent discussion may be found at pp. 121-123 of the 1988 republication of this masterwork by the Naval Institute Press.

[8] PT Boats were employed there, too, but for various reasons had mixed results.

modern missile combat. What follows is Hughes's description, found on pages 321-347 of *Fleet Tactics and Coastal Combat* and reproduced with permission of the Naval Institute Press. Although the book was published thirteen years ago, the vignette is remarkably relevant to East Asian waters today.

The Battle of the Aegean, 1998

I closed the first edition of *Fleet Tactics* with a purely tactical narrative, seen through the eyes of the victim. The purpose was to suggest the properties of modern missile combat. "The Next Battle of the Nile" was going to take place on the 200th anniversary of Nelson's great victory on 1 August 1798. I take only pleasure in knowing that the battle between American and Soviet navies cannot take place. On the other hand, the tactical implications live on, and I would wish that the insights of the tale will survive the date of it, as George Orwell's cautionary story of totalitarianism has endured long past his famous book's date, *1984*.

The subject of this edition extends to the operational level and campaigns in littoral waters. It is fitting to replace the tactical example with a scenario expanded to include a typically intricate campaign setting within which a commander must operate to achieve his tactical goal. I indulge in author's license to allow the tactical commander of the first edition to reappear, this time as the operational commander. I need him again, for his skills are going to to be tested to the limit. Intended to illustrate tactical simplicity amid operational intricacy, my fable is fiction in that it is seen through a commander's eyes in order to flavor the problem with the human aspects of what we analysts sometimes reduce to mere cold calculation. It is forecast in its description of the modern tactical environment, dominated by sensors, missiles, and information operations, with undercurrents of torpedoes, mines, and amphibious operations.

I confront my navy hero with the kind of operational problem and

tactical situation that the U.S. Navy will face when it is opposed by a respectable, integrated coastal defense, partly ship- and partly land-based. To create such an enemy I have risked offending a friend of the United States and the American navy. I would wish that my "opponent" sees the scenario as constructed for the same purpose that the U.S. Navy played its wargames against the British navy in the 1920s. He is chosen not because he is a likely foe but because his seaward-looking forces are a formidable test of the American navy's tactics, systems, and doctrine.

On the other hand, I am quite serious about one aspect of the scenario not found in contemporary U.S. military planning. That is the possibility of a *maritime* campaign in which all the fighting is confined to the seaward side of a coastline. The campaign is one in which any attempt to bring the whole weight of American military power to bear against the enemy homeland would be disastrously contrary to American interests. At the same time to allow the foe the unimpeded use of his home waters would be just as intolerable. The U.S. Navy must carry a maritime campaign all the way to the enemy coast because the United States is a maritime nation.

The narrative shows the extent to which warfare in coastal waters requires tactics, doctrine, and combat systems substantially different from those of the American blue-water navy. By a combat system I mean ships, aircraft, and sensors all connected for unified action by information technology and combat doctrine. The successful interweaving is to my mind the essence and intent of network centric warfare. At the same time the vignette is intended to show why an opponent who is fighting in his own waters does not need the same high technology to defend himself that we will need to penetrate his coastal defenses. Doctrine for semiautonomous operations combined with concealment and surprise will be sufficient for an enemy to challenge us to the utmost. Indeed, the circumstances facing my hero, Admiral Grant, are so severe that I have had to give him some forces not now in the American navy, for I do not think Grant can meet his challenge without them.

Beyond those things, I do not intend the tactics as lessons learned, except to illustrate that in combat the devil is in the details of the weapons, sensors, and doctrine employed. For instance, an influential feature of the scenario will be that all three countries involved

have large numbers of Harpoon missiles. Another fundamental characteristic is a variety of combatants small enough to risk in combat, using networking to concentrate fire in time and space. Nuclear-powered submarines are of little value at the climax, but they loom large at the onset of the crisis by playing their traditional role. Neither land- nor sea-based aircraft strikes contribute to the solution itself, but a perceptive reader will see that aircraft on *both* sides everywhere cast a long shadow over every tactical action.

The Crisis

Before him lies living proof, thinks Admiral Ulysses S. "Sam" Grant, that operations are more intricate than tactics. His battle plan depends on reducing all considerations to a set of simple tactical actions that everyone understands well enough to carry out in the midst of the confusion and uncertainty of the impending fight. But the operations now underway flow from layer on layer of national policy and military strategy. There will be a battle because of a sequence of deadly events that had not been pretty for the U.S. Navy. Sam Grant would give the battle his full and undivided attention soon, but first he goes over in his mind the multifaceted decisions that initiated the campaign now rushing to its climax.

The setting embraces not two but three antagonists, as well as vested interests of every country in Europe and most in western Asia. There have been more Byzantine circumstances than those surrounding him, thinks Grant, but his are sufficiently convoluted to make it fitting that ancient Byzantium is no farther from him now than the far side of the Aegean Sea. His mission is to cool the passions of the two ancient antagonists on each side of it.

Sam Grant's operational responsibility is to interpose between Turkey and Greece at this, the eleventh hour before all the dogs of war are unleashed. The United States' peacemaking endeavor is down to its last chance, a chance that rests on a battle by his forces alone. It is the American admiral's paradox that in order to restore peace he must shed blood. A battle is certain but the outcome is not, because the U.S. Sixth Fleet, unaided, faces the entire Turkish navy and more. Yet his battle plan can be successful because the mission is attainable by the tacticians under his command. With luck and skill and staunchness his forces will be just sufficient to the task. It is go-

ing to be the American navy's greatest challenge since the Battle of Midway.

How Admiral Grant came to wear the mantle of a combat commander is itself one of those marvels of strategic intricacy. U. S. Grant is CINCUSNAVEUR, who until just three days ago was subordinate to the American theater commander in Europe, USCINCEUR, the formidable four-star General E. F. "Famous" Grouse, up north in land-locked Stuttgart, Germany. Grouse was no friend of Grant's; in his mind all military decisions worthy of the name resulted from action on the ground. Yet after the opening violence, Grant found himself in command and taking orders directly from the secretary of defense and chairman of the JCS. The president, in his delicate calibration of the politics of violence, is committed to succeed or fail with the Navy alone. Using the modest forces of the Sixth Fleet and without the full weight of American might, Grant must bank the fires of the simmering feud between Turkey and Greece, so much in its passions like the ageless hatred between the Capulets and Montagues—or in American imagery, the Hatfields and McCoys.

In recent months Greek zealots fomented violence on Cyprus that was beyond containment by the small UN peacekeeping force. A week ago Greece used the violence as the reason to announce its intentions to introduce theater ballistic missiles into the island, missiles that in a matter of minutes could reach every vital center in Turkey. The Turkish populace was enraged. Uncharacteristically, the president and prime minister of Turkey both supported the popular anger and nurtured the swelling demand for action. As it came down to Grouse and Grant from the CIA through the Joint Staff, Turkish forces were about to effect a strategy they had prepared should Greece ever act on its threat to move missiles into Cyprus.

Publicly Turkey's minister of defense announced a quarantine to block the Greek movement to Cyprus by sea. Simultaneously, Turkey prepared to sail in force against Cyprus so ostentatiously that no official in Greece could fail to respond. For Turkey had a deeper motive. Far to the east of Greece and tucked less than 100 miles away from the Turkish mainland, Cyprus was bait in a trap. The Greek navy, supportable only weakly by the Greek air force, which must fly to the end of its tether, would have to run a deadly gauntlet. Turkish aircraft, surface warships, submarines, and land-launched

(1) Greece plans to move land-launched TBMs to Cyprus
(2) Turkey announces intention to move major forces into Cyprus, and then
(3) Crush the Greek navy

Greek Intentions and Turkish Response

missiles were poised to fight a littoral war that was vastly in Turkey's favor. As the climax and conclusion of phase one in Turkey's campaign plan, a fleet action was planned west of Cyprus which would reduce the Greek navy to impotence and lead to phase two, which would be centered in the Aegean Sea.

In the Aegean lay the true object of Turkish ambitions. Over many years Greece and Turkey had shaped their naval forces and tactics to confront each other. In Aegean waters the outcome of a fleet encounter was thought by both to be a toss-up, with perhaps the nod to Greece. Greeks owned (in their eyes) or occupied (as seen in Turkey) the many islands of the Dodecanese and Cyclades and expected to use them to ambush Turkish ships and aircraft in those confined wa-

ters with missiles and armed aircraft. But if Turkey destroyed the Greek navy first, then the islands could be isolated and all doors opened into the Aegean.

It had become intolerable for Turkey that with sovereignty over those islands Greece now dominated the Aegean. It was bad enough to suffer at the whim of a Greek government whose islands and navy could de facto close its vital sea lane through the Aegean into the Dardanelles and Black Sea. Then in 1995 Greece had extended its territorial waters to twelve miles in accordance with the UN's Convention on the Law of the Sea of November 1994. If Greece ever enforced the terms of the UN treaty—and it had never denied itself the right to do so—by international law it would de jure control access to the Black Sea and every port on Turkey's west coast.

Beyond that, the Greek Islands influenced—in some eyes determined—the demarcation of the continental shelf for the purpose of establishing underwater mineral rights. Attempts at oil exploration under Turkish auspices had led to protests of encroachment from Greece. Authority over airspace and air traffic in the Aegean and militarization of the Greek islands near the Turkish coast were other grievances still unresolved. From these many aggravations, the littoral waters off the west coast of Turkey took on the color of two armed camps. The final straw came when Turkish intelligence learned that Greece had surreptitiously introduced cruise missiles into Cos, Lemnos, and Chios. From that moment the armed forces of Turkey commenced to lay the plans now in motion to seize the islands and their missiles, as well as Samos and Lesbos. After that the government would strike the best bargain it could achieve in the courts of public opinion, striving for justice and a better balance in the Aegean.

It mattered not a whit whether the Greek navy understood the Turks' two-pronged strategy to fight first at Cyprus and then in the eastern Aegean, for no Greek government could survive if Cyprus was abandoned. The Greek navy would have to risk all in one throw of dice that would be loaded in Turkey's favor. NATO was appalled, for Turkey and Greece were both members. The crisis that the other NATO nations had sought to avoid for over fifty years was upon them and they were helplessly divided. The United Nations was caught in irons, too, split as they were between friendships on both

Amphibious operations against Limnos, Lesbos, Chios, Samos, and Cos from Ayvalik, Cesme, Izmir, Kusadasi, and Bodrum

Turkish Strategy, Phase 2

sides of the Aegean. If there was to be an enforced peace it would be by American action.

American Policy Decisions

When he learned the Turkish strategy, President Rainsford C. G. Harris, Princeton graduate and fervent admirer of Greek and Western civilization, was ready to intervene on the merits of the case: Turkey was the aggressor; Turkey must be stopped. At the same time Harris must persuade Greece, for its own good and the naval balance in the Aegean, to defer to U.S. diplomacy backed by the force of the Sixth Fleet. The State Department was more level-headed: democratic Turkey was a wedge of civilization reaching into the Asian continent. It was a country that understood and spoke the ethos of Islam while rejecting the zealotry of Moslem theocracies. It was a strong state, struggling for stability, hopeful of prosperity, that had sought and received the friendship of the United States and NATO during the years when it was the easternmost outpost of the West's confrontation with the Soviet Union. Secretary of State Dan M. Tinker's sympathies were with Turkey and its people who, he thought, had for years been more than patient over the many provocations heaped upon them by the Greek Cypriot majority.

The two views coalesced from opposite poles into one American action. In the eyes of the National Security Council this was a maritime crisis for which there should and would be a naval solution. For fifty years the U.S. Navy had interposed off Taiwan, the Levant, Africa, and Central America; in the South China Sea; and in southwest Asia. Though the Navy's effect on the landward side was imperfect, when a maritime issue was at stake, as was the case now in the eastern Mediterranean, the Navy could boast unblemished success since 1949. Nor had any attack been consummated against it except by accident or with that impersonal weapon, the mine.

Hence the NSC proposed to interpose two Aegis cruisers between Cyprus and the ports of Iskenderun and Mersin where Turkish soldiers would soon embark for a strongly protected move to Cyprus. The American ambassador in Ankara was instructed to carry a coldly correct diplomatic note to Prime Minister Yusuf Bey to the effect that any move toward Cyprus was a move against the United States of America. President Harris would publicly declare the single thing on

which he and Secretary Tinker were in accord: neither Greek nor Turkish ships and aircraft would be allowed to fire on the other, or alter the military balance in Cyprus, with missiles, troops, or anything else. To give this weight, Harris would speak by video teleconference to President Hatzopoulos of Greece to assure him that no ships would approach Cyprus until passed upon by the U.S. Navy. Hatzopoulos agreed to stand aside, but not cheerfully, for his own navy's passions were aroused. Meanwhile, in Ankara the interview had not gone well for the American ambassador. He could only report that his diplomatic note suffered curt dismissal by a stolid and stoic prime minister.

The Campaign Begins

Those difficult events had transpired by 26 July, only five days ago. As theater naval commander, Grant's views had been solicited, of course. When he heard the plan from General Grouse, he said COMSIXTHFLT, Vice Admiral Paul T. "Patent" Anchor, would direct Aegis ships to start eastward at once. But Grant asked for and was granted the following additional provisions:

—Four, not two, Aegis warships would interpose off Cyprus in pairs northeast and northwest of the island.

—Three submarines would move into the same waters, unannounced and invisible.

—The carrier battle force, one CVN and four escorts, would be brought to full readiness 150 miles from Turkey with sufficient sea room for defense in depth but close enough to cover the interposing American warships.

Meanwhile Grant moved the three-ship amphibious ready group well to the west. Afloat the Marines expeditionary unit should be protected, but all eight of his Aegis ships were committed. He contemplated but discarded the idea of moving the Marines ashore. Therefore he dispatched what was left: eight little 800-ton *Cushings* tied up to a short wharf next to the submarine tender at La Maddalena in Sardinia. Offensive ships, the *Cushings* were not configured for escort, but Grant wanted them underway, free of any Italian interference. They were to rendezvous with the three ships of the ARG and loiter in the Tyrrhenian Sea. *Cushings* are intended for short swift missions and not for sustained steaming. Grant was promised rein-

① DDGs *Arleigh Burke* and *John Paul Jones*

② CGs *Ticonderoga* and *Valley Forge*

③ SSNs *Annapolis, Chicago,* and *San Francisco*

④ CVN *Ronald Reagan* with CG *Gettysburg,* DDG *O'Kane,* and *DDs Leftwich* and *Harry W. Hill*

⑤ ARG moving west

[1] Turkish troops embarking

[2] Supporting airfields

U.S. Sixth Fleet Interposes

forcements from the Atlantic Fleet in ten days. Until then, the eight crews, sixty each, would have to tough it out with the ARG. But the corvettes had drilled for sustained crisis operations before and Grant had confidence that Commander Gridley,* the tactical commander, would keep them at the ready.

In the amphibious ships is a detachment of SEALs, experts in special warfare, for whom Grant envisioned a possible role. So he has ordered to sea the three operative PCs from their base in Rota, Spain,

* Fourth-generation descendent of the captain of Dewey's flagship at Manila Bay in 1898.

with instructions to pick up the SEALs from the amphibs north of Sardinia and then head east.

Also at Rota is a 40,000-ton mother ship capable of carrying eight 200-ton Killer-Scouts and ten STOVL aircraft at a speed of thirty-two knots. Altogether there are thirty of the lethal 200-ton vessels, configured variously for inshore missions and tasks. Twelve of the thirty, called *Phantom*s, are armed with tactical land-attack missiles. Grant ordered the mother ship to load eight *Phantom*s in its well deck and sail eastward into the Mediterranean, with the PCs in company.

The Shocks

As Admiral Grant feared, the Turks were not deterred. On 28 July, just before midnight, the first attack took place during the change of the watch in the USS *Ticonderoga*'s CIC. It came in the form of eighteen land-, air-, and sea-launched, American-made Harpoons missiles that approached from all points of the compass. The *Tico* and her consort, the *Valley Forge,* dealt with seventeen of them, but one of the ASCMs penetrated and struck the *Tico* amidships, putting her dead in the water and out of action. The *Valley Forge,* distracted while rendering assistance, was then struck in the next attack at 0025 on the twenty-ninth by one penetrating Harpoon, knocking out her missile battery. While the other two Aegis ships rushed to assist from sixty miles away, eight more Turkish Harpoons arrived. Five missed or were defeated by soft-kill, but two struck one ship and one the other, rendering both derelict. At 0230 the two undamaged DDGs arrived, circled, and sweated until fleet tugs could arrive from Naples. The attacks stopped. Turkey either had no other Harpoons at the ready, was husbanding those remaining, or felt that the destruction was enough. In the two crippled warships there were ninety casualties.

Immediately after that, the Turks, thinking the way was clear, sailed an army brigade in five LSTs and two transports heavily escorted with destroyers and frigates, all under intense air cover. But the three U.S. SSNs were lurking nearby. One detected, trailed, and called in a second. The two penetrated the screen in tandem and at 0410 sank an LST and both transports in six minutes. Seven hundred Turkish soldiers and sailors perished.

After assimilating the facts of the disaster, at 0530 on 29 July General Grouse spoke personally to the chairman of the JCS, in the mid-

dle of the night in Washington. He demanded the removal of Admiral Grant and proposed to bring down the full weight of American firepower on Turkey with massive air and missile strikes. Further, he said, he had put U.S. Army forces on full alert. Grouse subscribed to JCS doctrine of full spectrum dominance through comprehensive situational awareness and precision strike. But the chairman reflected on the prudent measures Grant had taken and the fact that Grant was his best fighting admiral. He and the secretary of defense were as appalled at Grouse's heedless adherence to doctrine as they were at Turkey's deep-seated determination and the bloodshed of the stunning attacks. Five hours later, at 0600 Washington time, they met with the president and within the hour received his endorsement, first, to order Grouse to keep his planes on the ground and troops in their barracks. Second, they concluded that if there was to be any hope of the United States forestalling the outbreak of war, then the conflict must be confined to the sea. The chairman believed that this was feasible because it would be what Turkey wanted as well. Turkey had somehow to be stopped from moving into the Aegean, yet without hitting Turkish territory. Since the American role was to be strictly maritime, a skip-echelon command structure designated Admiral Grant the ad hoc combatant commander.

Concurrently the president and secretary of state had to move heaven and earth to bring the Turkish government to its senses. World opinion must be brought to bear, while Greece was kept on the sidelines with assurances that no Aegean island would fall to Turkey. A somewhat chastened president now agreed that Turkey could be told, through the Russians perhaps, that the world would look sympathetically on its frustrations once it abandoned its intention of forcible entry into the Greek islands.

Even before the NSC meeting, the commander-in-chief set the wheels in motion. Still in disagreement, Grouse resigned. At 1400 Naples time on 29 July, Grant was told his mission was to keep Turkish forces from seizing the Greek islands and without touching Turkish soil! In the fifteen minutes it takes the secretary of defense and chairman to outline the situation as seen from Washington, Grant has formulated a solution to his knotty problem. He asks, does "soil" exclude the Turkish transports in port? The secretary mumbles and the

chairman blinks. Grant concludes that he has all the official sanction he is going to get. They will have the details of his plan soon enough.

At once Grant summons his staff, outlines his concept, and asks for a swift estimate of the situation. The staff see a major alternative to the Turkish investment of the islands by sea to be airborne invasion. For various reasons Grant concludes that if the Turks do not believe they control the coastal waters to move safely by ship then they will not attack at all.*

That settled, next the staff makes the calculations for an operation order and rapidly feed it into a dynamic, geographical plot depicting a host of interlocking movements. By 1900 on the twenty-ninth these have been tweaked and approved by Grant and disseminated electronically to all NAVEUR ships and stations. The Joint Chiefs receive and quickly digest it. For information and in case the conflict escalates, USCINCEUR(acting) also has it.

Enemy Moves

By 2000 on the evening of the same day the Turkish high command accelerates its time table by issuing orders to move troops to the LSTs, LCTs, LCMs, and transports for the short run to the five Greek islands. Simultaneously the Turkish surface fleet is ordered to close on the five ports of embarkation, in order to screen the movement and support the landings. Air Force aircraft are shifted to western Turkey and search and covering tasks assigned. Six modern diesel submarines move into screen stations, and minecraft (unable to match the pace) prepare to lay minefields.

At first light on the thirtieth evidence of Turkish troop, ship, and aircraft redeployments is observed by American satellites. By midmorning clues to the imminent invasion are inserted in global command and control systems displays and text. In Naples via GCCS

* This is a cavalier dismissal of a real choice, for much of the Turkish army is air-mobile. I set it aside because I have already painted what seems a sufficiently complicated operational situation to make the point that tactics attempt to reduce operational considerations to a simple and straightforward combat plan. Among the many American actions when an incipient air movement was detected, one might be to insert the otherwise unemployed SEALs to perform their mischief at the airheads, which for fast turnaround Turkey would want near its west coast.

Grant has the same information held in Washington. Nine destroyers and fast-attack craft will be coming down from the Dardanelles. He estimates that some of these ships carry Harpoons but most will have shorter range Penguin missiles well suited for the cluttered waters of the northern Aegean. Though he cannot see them on the plot, the entire Ionian coast is blanketed with small patrol boats and fishing vessels employed to supplement Turkish air reconnaissance.

Moving west from the vicinity of Cyprus will be ten Turkish warships clearly identified by satellite as Harpoon shooters. About twenty more Turkish destroyers, frigates, and fast-attack craft are in the naval base at Aksaz on the southwest Anatolian coast. Grant expects all that are able to get underway to join the Cyprus contingent. Thus, he expects to face coming up from the south an enemy force of twenty-five or more destroyers and fast-attack craft, carrying among them about 180 Harpoon missiles. They will enter the Aegean on the evening of 31 July.

Even more crucial to his plan, the satellites have pinpointed the exact locations of the transports and larger amphibious ships in five ports of embarkation, Ayvalik off Lesbos, Cesme and Izmir near Chios, Kusadasi near Samos, and Bodrum adjacent to Cos. The troopship positions are known exactly and the precise latitude and longitude of individual targets have been passed to his ships so that the coordinates can be plugged into their missile guidance systems.

Which missiles? They must be the small ballistic missiles carried in the *Phantoms*. These are normally used for tactical support of Marines or soldiers fighting ashore. Harpoons and Tomahawks are next to useless, for one thing because most of the ports are deeply embedded in the Turkish coast behind terrain that is tricky for cruise missiles to traverse. For another, Turkey will be expecting cruise missiles and has the port defenses to take out most of them. On the other hand, the *Phantoms*' tactical ballistic missiles (TBMs) are so new that Turkey has no defense against them worthy of the name. A navy modification of the army's tactical weapon, they can be delivered with the greatest precision and with a time of flight of only a few minutes. From the outset, Grant had dismissed an air strike from the Sixth Fleet carrier USS *Ronald Reagan*, in part because there would be too much collateral damage to the port cities, in part because over two hundred Turkish fighters would be arrayed against

them. The Sixth Fleet's four submarines must stay in a blocking position between Turkey and Cyprus. They cannot cover all the ports in the Aegean, nor does he want SSNs tangling with Turkish mines and diesel submarines in the Ionian coast's shallow waters.

The Tactical Plan

To deliver their TBMs the *Phantom*s must not just survive to reach their launch positions within ninety miles of the targeted ports. They must do so before the Turkish transports and LSTs get underway. Movement, even slow movement, is the friend of surface ships and foe of long-range missiles, especially in the cluttered coastal environment. Furthermore, Grant's information is not firm as to where the Turks are headed. They have much better knowledge than he of the beaches and Greek defenses. Once the transports are underway his problem is unsolvable. That is what he saw instantly when his mission was briefed to him by the chairman, and why he needed passive acquiescence to hit the transports in their ports where their locations were known to within a few meters.

Grant long ago had concluded that without the new *Phantom*s he had no maritime solution. Eight of them, each with ten small TBMs, will be enough to neutralize nineteen transports and LSTs, ignoring the small landing craft that are too numerous to strike. He estimates that if he takes out half or more of the nineteen large ships, then the Turks cannot proceed and will have to delay long enough for the arrival of the full Atlantic Fleet.

Lieutenant Commander Genda, the tactical commander of the *Phantom*s embarked in his tiny flagship, the *Ninja,* will target all nineteen.* Even though there might be a few undiscovered troop ships, Genda's orders are to shoot the works: launch all eighty TBMs in one sudden pulse at the targets located by satellite.

Though eighty missiles against nineteen undefendable targets seem to be ample overkill, Grant does not expect 100 percent coverage. The missiles have bomblets that blanket an area of two football fields that is normally filled with enemy tanks. They are less than

* In his Naval Academy days Sammy (for Samarai) Genda was observed to be a master of creative mischief. He would never have survived to graduate if the Commandant had not persuaded the Superintendent that Sammy Genda's talents would some day bring rich rewards.

ideal ship-killers, but they will wreak havoc to the topsides, electronics, bridges and probably one deck down in each transport. If troops are aboard the carnage will be dreadful. Grant hopes to launch his strike before they embark. Of course the loss of life would seal the delay he seeks, but the bloody result of such an attack is hardly the way to soothe Turkish passion or evoke sympathy among the press and world opinion.

The problem is moot. The attack is scheduled for the earliest possible moment. The *Phantom*s' fast carrier is slated to pass south of the Peloponnesus at 1700 on the 31st, an hour behind the *Cushing*s. Since the passage will be in daylight and the weather clear, it could be spotted, but Grant thinks that until the *Phantom*s are launched no Turkish alarm bells will ring. The *Phantom*s will enter the water after dark, around 2100, just west of the Cyclades. It will take a courageous Turkish reconnaissance effort to reach across the Greek-dominated waters and a lot of Turkish faith in Greek restraint. From the *Ronald Reagan* an air screen will be flying between the Cyclades and Dodecanese until dark as a false indicator of American intentions.

The big hazard to the *Phantom*s is not the Turks but the Greeks. Will the word from Athens be disseminated? Will the Greeks eschew their own reconnaissance effort? Will scores of Greek ships and aircraft and missile batteries let unidentified ships pass unreported and unmolested? Grant did not reveal his plan to Athens; a leak was too likely. He can afford to lose some aircraft; he will surely lose *Cushing*s; he cannot afford to lose *Phantom*s.

After dark the *Phantom*s will glide through the Cyclades. Having no electromagnetic signature, they can only be detected by human eye. Low in the water, small at 200 tons, and stubby so as to fit in their mothership-carrier, even in daylight they are never easy to detect. At night in a state three sea under a waning moon that will not rise until 0100, there is a good chance that they can penetrate the Cyclades unnoticed by both Greeks and Turks. A chance fisherman or coastal trader will likely see dark shapes with no lights, but a report of their mysterious presence will take time. And no Greek or Turkish missile seeker head can detect and home on a *Phantom;* gunfire and cutlasses are the only weapons against them. They will report their movements and locations to each other covertly via satellite. It bemuses Genda to know his vessels will be almost side by side but vir-

tually invisible to each other. There will be no formation and no mutual support. Any one of them that is picked off must be abandoned, its crew of twelve left on its own.

Genda will take the *Ninja, Phantom, Ghost,* and *Furtif** northeast and, after clearing the islands, run the last fifty-five miles across open water, though to suppress their wakes the passage will be more like a tiptoe than a sprint. The four will take station just east of the little island of Psara and huddle almost against its coast. There they will rendezvous and await Grant's signal to launch, at 0400 on 1 August. Their targets are in Ayvalik, Cesme, and Izmir.

The second set of four *Phantom*s are under the senior CO, Lieutenant Stephanie Decatur embarked in the *Black Knight*. With the *Sting, Mist,* and *Silencioso* she will take a more southerly route, passing slowly, quietly, and separately through the Greek islands, gathering again at their launch point in the shadows of Dhenova north of Amorgos.† Their targets are in Cesme, in duplication of the northern task element, and in the ports of Kusadasi and Bodrum alone.

Everything else in the Sixth Fleet is in support of the intended 0400 attack, but the *Cushing*s play the indispensable role. Their task, though simple to signal and straightforward, is tactically demanding, hazardous in the extreme, and one for which no other U.S. Navy warship is suited. The eight *Cushing*s' task is draw attention and, no doubt, missile fire from up to twenty-five Turkish warships.

They Are Expendable

Grant had ordered the eight old *Cushing*s from their base at La Maddelena to screen the three amphibious ships. Once he saw there would be fighting in the Aegean, he ordered them east. There are seven of them now, because one corvette broke down. They must be at the entrance to the Aegean between Crete and Kithra an hour ahead of the *Phantom*s' mother ship, so he ordered them to arrive

* In navy tradition warships carry names even when they cost only $60 million; stealthy U.S. Air Force bombers do not, even when they cost twenty times more.

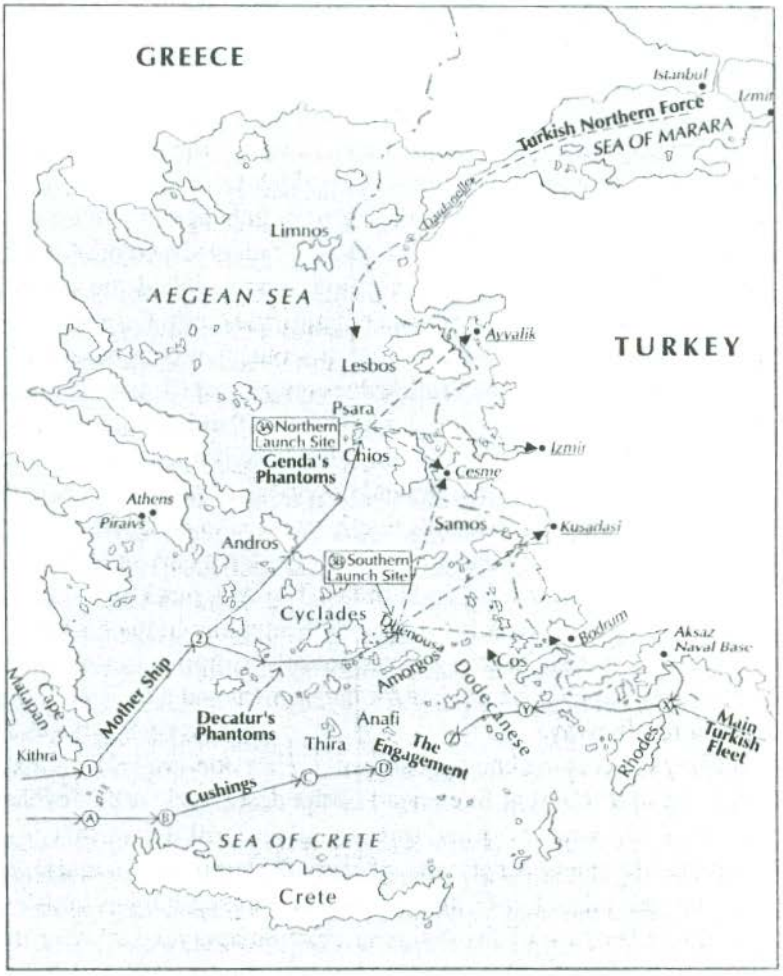
† In her veins flows the blood of the officer who in the dead of night on 16 August 1804 cut out and burned the American frigate *Philadelphia* that had run aground and been captured by Tripolitanian pirates. Decatur was later killed in a duel. Stephanie having a temperament to match her ancestor, it is probably well that dueling is passe in her modern, more civilized navy.

there at 1600 on 31 July. They have 500 miles to travel, but because of Grant's foresight they have ample time. He sent them through the Strait of Messina to shorten the distance and also to *increase* the chance that the Turkish navy would know they were coming. For the *Cushings* are his bait; some and perhaps all seven will sacrifice themselves to draw attention from the *Phantoms*.

Years ago twelve *Cushings* had been homeported in the Mediterranean at Grant's insistence when he was Commander Sixth Fleet. They had been crucial in defeating the Soviet fleet on 1 August 1998 in the 1986 edition, which did not foresee the collapse of the Soviet Union. Of the ten now remaining, all eight not in upkeep had put to sea, and seven are coming. Of 800 tons with a crew of sixty, the main armament of each consists of eight Harpoon missiles and a seventy-six-millimeter gun. They have meager ASW capability, but that is irrelevant. Each carries a Lamps helicopter. They are similar to dozens of the older designs among the world's best coastal navies. Seven will be enough to play their sacrificial role.

Commander "Ready" Gridley, Grant's own choice, has been in tactical command for a year and has the *Cushing* commanding officers bonded as a team in which each knows what to expect from the others. The tactical execution of the operation that will ensue will be Gridley's, but the tactics are an extension of Grant's own, worked out years ago. The *Cushings* are obsolescent for this mission, because there is a big question whether their Harpoons will penetrate the defenses of Turkish warships. The Turks are similarly armed with their own Harpoon variant. Moreover, the Turkish navy has trained assiduously to defend against Harpoon attacks because that is the principal threat in the Greek surface navy. Turkish skill with and against Harpoons is the penalty of American foreign aid, thinks Grant wryly.

Gridley will pass north of Crete and until dark steer slowly along the coast with radars on and radios blaring tactical signals to assure that the Turks and everyone else knows where he is. Carrier aircraft scouting between the Cyclades and Dodecanese will see any Turkish formation and forestall an ambush. The aircraft will also confirm the satellite information of the enemy's composition. At dusk around 1900 he will alter course radically to port, step up speed to 31 knots, and head for the little island of Anafi. At 2100 the *Cushings* will form two very ragged lines abreast of four and three corvettes. Lat-



① ② Movement of Phantoms' mother ship
② 3A, ② 3B Movements of Phantoms
Ⓐ Ⓑ Ⓒ Ⓓ Movement of Cushings
Ⓧ – Ⓨ – Ⓩ Expected movement of main Turkish fleet

Grant's Battle Plan

eral spacing between ships is an imprecise five miles. The two lines will leapfrog alternately, on signal via laser lamps. Each line in turn will sprint ahead at thirty-five knots plus, while the other dawdles at six in an attempt to look like small, innocuous shipping. Near Anafi at around 2300 they will shape a course eastwards toward the best estimated position of the twenty-five Turkish warships.

On a rotational basis, two of their Lamps helicopters will fly south to near the coast of Crete, flying high with radars turned on, for a deception within a deception. If the Turks have studied the *Cushing* tactics, they will expect them to be hugging the coast. On another occasion, the helicopters would be crucial scouts, but tonight with confusing contacts all around, Gridley does not expect them to add much information. He does not know whether the Turkish fleet will have helicopters up and scouting at night. Their role is not a crucial factor, because the enemy has operational knowledge of his presence, and it is only the details of his tactics that he wishes to conceal. If a helicopter approaches from the east to investigate his corvettes, their orders are to shoot it down at eight miles. The American night combat air patrol from the carrier is to intimidate anything in the air moving at fifty knots or greater, everywhere but off the north coast of Crete. Gridley only depends on the jets for harassment and perhaps to chase search aircraft away.

Gridley expects the enemy's screen of Harpoon-armed fast-attack craft to be in a scouting line ahead of the destroyers. If any of their radars are on, then his ships, running silent, will detect first, well within missile range. American and Turkish Harpoons can reach seventy nautical miles, but Gridley expects to launch his weapons at a third of that because of the incipient electromagnetic duel over first detection, tracking, and targeting. Harpoons home with great precision, but the *Cushing*s will be shooting where neutral traffic and innocent fishermen can be unintended targets. One *Cushing* only will fire a salvo of not more than three Harpoons down the bearings of any intermittently radiating screen ship. The shooter will then attempt to clear laterally away from a predictable return salvo at high speed and use passive antimissile defenses. The other corvettes will slow and wait for another radiating target. The reason for the puny salvo is because Gridley must attempt to survive as long as possible

and drain the Turkish ships of as many missiles as he can. If the Turks approach with radars off, then sharp eyes will determine who sees and shoots first and how well, and guns will be as deadly as missiles. With radars off on both sides it will be an ugly melee, and the smaller force—the *Cushing*s—will do less damage to each other!

These actions are well-drilled tactics, the major difference being that the seven *Cushing*s with fifty-six Harpoons cannot defeat twenty-five skillful Turkish warships carrying 180 similar missiles of their own, and who are practiced at fighting in their home waters. The *Cushing*s must, atypically, husband their missiles in the hope of stretching out the battle. Though always wary, Gridley hopes, even expects, first contact to be east of Astipalaia sometime around midnight. He will draw the enemy west among the islands for as long as the surviving corvettes have the means to fight. Each captain knows he must keep the attention of the Turkish force south of Amorgos, where the four southerly *Phantom*s will be heading.

The chief of staff reminds Grant that Gridley is going to have a fuel problem. Grant is abashed; by such oversights are plans destroyed. But Gridley reports that he will arrive with enough fuel to operate wide open for perhaps three hours and his ships will not be at full throttle all the time. The ships that survive need only limp to the nearest Greek island inlet or harbor.

Grant Moves Aboard

Around noon on 30 July, Grant and his battle staff depart CINCUSNAVEUR headquarters in Naples in two tilt-rotor V-22s, leaving instructions to arrange an emergency meeting with the Greek minister of defense in Athens on the 31st. After landing on the Sixth Fleet flagship, he discusses the electronically transmitted battle plan with Vice Admiral Anchor. His old friend Patent tells Sam he wants a bigger role but concedes that if the *Phantom*s fail he will have more than enough to do in dealing with about 200 enemy aircraft. Grant plays best-of-five acey-deucy with the air wing commander, visits the chaplain, eats mid-rat soup and sandwiches with the aviators, showers, and registers a nap in the flag cabin.

At 0700 on the 31st he has the satellite imagery update via GCCS. It confirms the locations and numbers of Turkish warships in motion.

At 0900 he takes off in an escorted S-3 for his meeting in Athens, set for 1300. En route the jets pass the V-22s who are also cleared to land in Athens. On arrival, he devotes his thirty minutes with Defense Minister Loucas to emphasize the message already transmitted from Naples: "If you please, do your utmost to tell everyone with a weapon to hold fire until a Turk tries to land on Greek soil. Strange ships may be sighted almost anywhere. They will be American or Turkish. Please leave them be. Everything depends on every Greek soldier and sailor holding fire." In actuality, Grant's plan does not stand or fall on Greek discipline, but if it breaks down he foresees chaos that will confound his own intentions and could open the floodgates of the war that he is trying to prevent.

At 1400 his staff ostentatiously boards the S-3, which takes off under a flight plan filed for the carrier. Minutes later Grant departs unobserved in one V-22, taking only his flag lieutenant (and communicator) and his operations officer. Grant may be the only one in his command who thinks so, but he is firmly convinced that the battle plan now will survive without him. The crucial action will be by the *Cushing*s, and so he has arranged a rendezvous with them south of Cape Matapan. At 1500 the hovering V-22 lowers the three NAVEUR officers to the deck of the flagship, USS *Victory*.

Grant's fear is not that Ready Gridley will be timid; just the opposite, for the tactics they had worked out were all designed to attack effectively first and win. This time success depends on husbanding weapons so that enough *Cushing* firepower survives for an hour or more to sow confusion and draw the enemy's attention away from the *Phantom*s until their eighty tactical ballistic missiles are launched and they clear away to westward. Gridley has his orders, but in the flush of first battle, passion and his killer instinct might take over. Weighing the risks, like an old warhorse Grant believes he should be at the point of attack in the *Victory*. In Naples he is superfluous. His chief of staff is the perfect campaign manager to keep Washington informed and fend off the second-guessers, and the staff does not need him to sort out the inevitable problems of broken parts, emergency supply, or a missed rendezvous.

In the *Victory*, Admiral U. S. Grant sits in the familiar squadron commander's station just behind the pilot and copilot seats. Gridley has the copilot's seat normally occupied by the OOD. Lieutenant

Commander Ray Bernotti, the captain, sits at the pilot's console, which controls all operational aspects of the flagship.* The OOD has a fold-down seat normally occupied by the Boatswain's Mate of the Watch, while the boatswain's mate stands watch on his feet, the old-fashioned way. The CINCUSNAVEUR ops officer and flag lieutenant sit on campstools. It is a bit of a squeeze.

One of the terrible things about this war is that he, Grant, is fighting an old friend. He first met and played squash with the present Commander-in-Chief of Turkish Naval Forces, Mehmet Abdul, in a port visit to Izmir when they were lieutenants. Their families grew close when Mehmet attended the Command and Staff course at the Naval War College fifteen years ago. Later, as staff officers they plotted and schemed how they might coordinate a NATO operation against the Soviets in the Black Sea. The personal side of it is painful, but in addition both friends know how the other thinks about tactics. Mehmet will know Sam had something up his sleeve. There are not many opponents as mentally prepared to combat Grant and the Sixth Fleet as Admiral Abdul.

Sam Grant regrets an oversight: he might have disembarked some of the *Cushing*s to save lives, for not all sixty of each crew will be needed to serve the guns this night. He muses over the personal risk. If the plan fails, Grouse will get his wish after all; Grant will be relieved and court-martialed. If it succeeds there will still be raised eyebrows because he did not manage the battle in the conventional way. If he has misjudged the skill of Commander Gridley's captains and crews or underestimated the enemy, then they will all soon be dead. The crews know the odds in a detached way, but they have never been in battle and with the optimism of youth think they are immortal.

Besides, the *Cushing*s trust me, Sam Grant, who beat the Soviets and has never lost a battle. This time, if I have assessed the battle correctly, more than half the *Cushing*s will be sunk or out of action; and a quarter of these sailors, the best anywhere, will be casualties.

* Bernotti is the great-grandnephew of Romeo Bernotti, Italy's leading writer on the tactics and operations of his day. Ray has absorbed his ancestor's penchant for mathematical analysis as well as his familiarity with operations in the Mediterranean.

That is the personal side. As combatant commander the important operational question is, will my plan work? If not, it will be because the *Phantom*s have also suffered severely, for there is enough overkill in their firepower that only a strange, unfortuitous event can defeat the attack. The TBMs have been tested, but never in battle. The intelligence is the best in the world, but it could have been deceived in plotting the Turkish ships. Grant's assessment must be right that the troopships will still be pierside at the time of the TBM attack.

If the *Phantom*s fail, then there will be bloody war. The rest of his Sixth Fleet, at the point of the sword, will be punished. Worse, the prestige of the United States will be in shambles, the Greeks will fight, the weakened Turks will be caught in a disaster of their own making, and the potential chaos in the eastern Mediterranean and southwestern Asia is incalculable.

All will be revealed in six hours, thinks Grant. Yes, the operation will succeed because it is sound. I didn't join this profession for its certainties. The life is sweet if not assured. Truly few things are safe and sure in war, yet the pieces are in place. He has assembled the forces to execute a good plan. The young commanding officers of the *Phantom*s and *Cushing*s are well trained in sound doctrine and the ships manned by crews able to stay up with swift and sudden warfare in these confining, confounding coastal waters.

Grant turns to the tactical commander and says, "Your weapons are free, Gridley."

Denouement

In one aspect only can the outcome of Grant's battle plan be reasonably forecast. It is that the *Phantom*s will launch their missiles on time and knock out enough Turkish amphibious capacity to fulfill the mission.

A novelist would be obligated to produce the rest of the story—the battle itself. The author would create an aura of inevitability about the results. If she aspires to contemporary mores, then Grant must have feet of clay. He will err but die a hero's death. In rebellion, if I narrated the battle, Grant would live with honor unblemished. But insofar as the morals of this fable are concerned, Admiral Grant's life or death is irrelevant.

Grant's putting himself at the heart of the decisive tactical action will be jarring and unrealistic to some readers, but it fulfills the long-standing naval tradition that a commander leads his forces from afloat. E. B. Potter, the eminent naval historian, said that on arrival at Pearl Harbor Admiral Nimitz only reluctantly decided that he would never be able to accompany his fleet to sea.* Nimitz had to stay ashore for access to sensitive intelligence and for freedom to communicate up and down the chain of command. Nimitz was going to lead a very long campaign. Grant does not have these problems, for his short campaign must result in one successful battle or fail. In that it is fair to predict that he will succeed; this is so in part because he is in the thick of it at the decisive point. But in most contemporary circumstances the fighting fleet is better served if the operational commander stays at headquarters while the tactical commander fights. Grant is nearly unique because I have embodied the requisite tactical skills in him.

A novelist would also tell us whether the American fleet's tactical victory led to successful negotiation and peace restored. I offer the reader no assurances about this. I can only assert that the president saw his best chance, the chairman of the Joint Chiefs gave the job to the best man, and American forces contributed everything that military action could do to give breathing room for negotiations.

A detailed description of the fighting would center on the *Cushings*' brave deception. The seven little combatants take on a force three times larger numerically and five times larger in displacement in order to draw some Turkish fangs. Neither side can do what every modern force armed with missiles wishes to do: stand off and deliver a decisive attack first. The battle is a purposeful melee, similar to the circumstances created by Rear Admiral Dan Callaghan, (though probably inadvertently) in his night battle of Guadalcanal on 12–13 November 1942. Callaghan lost control but so confused both sides that one Japanese battleship was sunk and the other retreated. He died fulfilling his mission to protect Henderson Field at the climax of the campaign.

* Potter, *The Battle of the Coral Sea*, in Sweetman, p. 244.

We saw in the previous chapter how to appraise the combat potential of two missile forces in opposition. We saw that if both sides are able to engage, the circumstances will be so unstable that a small change in the hit probabilities, the distribution of fire, defensive effectiveness, or the thwarted detection and tracking of all the enemy will create wide swings in the resulting damage. We saw why this was so and that the instability is inherent in missile warfare.

The only way to avoid the extreme uncertainty of outcome is to attack effectively first. A battle of exchange will be confused and unpredictable, yet Gridley's orders from Grant are to *force* an exchange. Despite coherent fighting instructions, after only a few salvoes he will lose control and the result will depend on the wits, discipline, and sang froid in each *Cushing*. The same is true on the Turkish side. I have given the American side an edge in the first encounter (I don't know whether this is reasonable), but any application of the analytical technique in the previous chapter will conclude that the Turkish fleet can absorb an initial American success and still destroy the American force.

The Turks would fight differently if their purpose was simply to sink American ships. But the Turkish tactical commander has a higher responsibility to protect the beachhead, that is to say, to secure the safety of the amphibious operation. He must also husband his forces because the Greek navy lurks just beyond the metaphorical horizon. At the operational level it is almost always the case that a victory at sea is a means and not the end, and external considerations abound.

There is another reason I do not choose to narrate the night engagement by which Gridley will empower the *Phantoms*' attack. A narrative would imply too much power of tactical analysis to trace the probable course of events and foresee the outcome in detail. For what it is worth I calculate that the *Cushings* might be expected to take down (put out of action) an equal number of the enemy—about seven. I calculate that the Turkish fleet would expend a half of its 180 missiles in the confusion. The *Cushings* should expect to put more tonnage out of action and inflict more casualties because the enemy's ships are larger. If skillful in the opening moves, Gridley's seven corvettes might hit at most twelve enemy warships with the fifty-six harpoons they carry. If the Turks are quick to react, they might suffer the loss of only three or four ships.

An interesting possibility is that countermeasures against the Harpoons are unexpectedly so successful that many ships are untouched after both sides' missiles are used up. The battle might conclude with gunfire. In a gunnery duel the Turkish force has a greater advantage still. Only the possibility of confusion could help the Americans to hurt and distract the Turks.

It is reasonable for Grant and Gridley to expect that when the battle is over few, if any, *Cushing*s will limp away. Applying both the history of missile combat and the quantitative analysis in chapter 11, there is no way for the American *Cushing*s to defeat the Turkish battle force opposing them. The uncertainty of outcome is not *that* great. The Turkish fleet is quite competent, as are the coastal forces of many states when fighting in their home waters.

Gridley's *Cushing*s are old ships similar to smaller, older combatants among most of the world's navies. The newness and the surprise are in the *Phantom*s. The *Phantom*s' TBMs, in combination with overhead sensors and a modern networked command and control system, comprise Grant's decisive combat system.

Though the circumstances of the Battle of the Aegean are unique, every battle in coastal waters will be unique. Many nations have well-conceived, tightly drawn, intensely practiced coastal defenses. In a more extended littoral conflict, land-based sensors, missiles, and aircraft will all be prominent. Depending on the geographical center of interest, coastal submarines and mines will be important. Based on the composition of coastal navies and their articulated strategies, small surface combatants, usually carrying missiles, will always participate. Coastal commercial vessels on the surface serving as scouts will also be important players. I believe to reduce casualties the U.S. Fleet must have numbers of small fighting ships that can be lost in combat without aborting a mission along a treacherous coast. It is for these reasons that I gave Grant the *Phantom*s and the *Cushing*s. I do not think the existing American navy, even with all of its firepower, can fight unbloodied in the home waters of states with strong coastal defenses, including Turkey.

Implications

When we address the strategy for East Asia in Chapter 3, the reader should be alert to the following similarities and differences from the Battle of the Aegean.

Similarities

1. Turkey's interior lines of communication, sea-shore support structure, and local command and control are similar in important respects to China's posture, though on a smaller geographical and military scale.
2. Flotilla ships and submarines are useful to operate within the enemy's inner sea lines of communications.
3. There are places that scarce and expensive submarines shouldn't be put at risk but flotilla ships can operate when the stakes are high enough.
4. The value of numbers.
5. Designed stealthiness can be enhanced by geographical clutter.
6. To keep a conflict from expanding, try to keep it at sea.
7. Air attacks from land or sea bases are sometimes undesirable.

Differences

1. In the Aegean Admiral Grant's *Cushings* and *Phantoms* are serendipitous and essential to success—with a bit of a nudge by the author to make them so. In the China Seas the flotilla must be a designed to be one part of a comprehensive strategy to keep the peace, or serve as a cost-effective component should local conflict ensue at sea.
2. In the eastern Mediterranean the small combatants operated from existing bases; in East Asia they will be most effective if they are based well forward and inside the enemy's attack envelope.
3. In the Aegean, Turkey could not attack the small combatant bases. To operate inside China's threat envelope, the flotilla must have mobile or concealed bases to survive, or take the risk knowing that a Chinese attack against allied territory serves as a *de facto* warning that she is expanding the war.
4. In the Battle of the Aegean, *Cushings* and *Phantoms* are the indispensable and decisive fighters. In East Asia, they are merely the lowest-cost component of an affordable maritime strategy.

CHAPTER 2 MISSILE WARFARE AT SEA IN THEORY AND PRACTICE

A country can, or will, pay only so much for its war fleet. That amount of money means so much aggregate tonnage. How shall that tonnage be allotted? And especially, how shall the total tonnage be invested . . . Will you have a very few big ships, or more numerous medium ships?

Alfred Thayer Mahan[9]

Theory: Quantitative Analysis With Salvo Equations

What were the theoretical advantages that have caused the other navies of the world to build smaller missile combatants? The salvo equations describe the advantages of a more distributed fleet simply and clearly. Developed twenty years ago, they show mathematically that in combat between missile-armed warships, the number of vessels is the most important property a fleet can have. This general conclusion does not depend on geography or fleet size.

The equations with terms defined are in Appendix A, along with some validations and applications of them. Here is a qualitative description of them.

- There are two symmetrical equations representing the case in which two opponents "simultaneously" detect the enemy and fire missile salvoes at the other.
- If one side detects the enemy, fires, and the missiles arrive before the enemy can fire, then the enemy must suffer the effects before shooting back.
- The maximum possible number of missile hits in the attack is the number fired by each ship times the number of ships launching the attack.
- The maximum number is reduced by the number each defender defeats (by hard kill, soft kill, stealth properties, or maneuvers) times the number of defenders.
- In the model the fiction is maintained that attacking missiles are distributed evenly across all defenders and each defender defeats the most it can of those targeted on him.
- The result is the total hits achieved distributed evenly. The number of ships incapacitated by the attack is the hits divided by the missiles it takes to put one ship out of action (but not necessarily sunk).

Among the citations in Appendix A are two evaluations by scholars in the People's Republic of China. One Chinese technical paper evaluates and embellishes the basic equations. The second one extends a thesis by LT Casey Mahon that uses salvo equations to explore missile combat between a land power and warships, presumably to test the efficacy of China's Anti-access, Area-denial strategy.

The equations are the successors to Lanchester Equations whose square law was applied to a formation of battleships.[10] Specifically the salvo equations apply when missiles or torpedoes are fired in batches

[9] Mahan, *The Lessons of the War With Spain*, Boston 1899, p. 37.

[10] The square law was discovered by two American naval officers a decade before Frederick W. Lanchester. Lieutenant (later Rear Admiral) Jehu Valentine Chase invented the differential equations, but in a more sophisticated form. Unlike Lanchester, Chase took account of the fact that most warships were not put out of action by one hit. Commander (later Rear Admiral) Bradley A. Fiske described the square law in a difference-equation

instead of "continuously." The salvo-like phenomenon was also seen in the five big Pacific carrier battles in World War II in which each side endeavored to detect and attack first with all its air wings simultaneously in a single pulse, or "salvo," of aircraft attacking as a coordinated unit.

The salvo equations show that if your fleet has three times as many combatants as mine, then for parity in loss ratios (in other words, which side will have ships remaining when all of the opponents are out of action), to overcome your numerical advantage each of my ships must have thrice the offensive power, thrice the defensive power, and thrice the survivability (the "staying power") of yours. Brief reflection shows why. If you put one of my big ships out of action, I simultaneously lose its remaining offensive missiles, its power of defense, and its contribution as a target that the enemy now no longer needs to shoot at.[11]

Another general truth quantitatively demonstrated by the salvo equations is the advantage of out-scouting the enemy and launching a first effective attack. This phenomenon first occurred in the aforementioned Pacific carrier battles of World War II, but the payoff of an unanswered first attack is even more pronounced in the missile era.

The third general property of missile warfare shown by the equations is that if ship numbers and staying power are both small, then an unstable combat situation arises, in which the shift in results of an exchange moves from total victory to total loss within a small change in the number of ships on either side. This is to an extent an artifact of the equation structure, but it is a warning that a fleet of big surface warships can be put out of action with a small number of missile hits in 21st Century combat.[12]

The salvo equations teach more by saying less—by shucking off the chaff of less important factors in order to concentrate on the kernels that describe what is most important in a sea battle. Like other useful combat models, they are valuable because a knowledgeable tactician will notice what they don't describe. A thesis student, LT Jeffrey Cares, used a simulation to test the salvo equations. Among several insights, he demonstrated "the sump effect," in which the distribution of attacking missiles is not spread evenly

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form in the *Naval Institute Proceedings'* Prize essay of 1905. Both American naval officers showed the special advantage of numerical superiority. Lanchester thought the square law would apply in aerial combat. It did not; Morse and Kimball in 1953 concluded air-to-air combat followed a linear law which says numbers and individual aircraft performance have equal value. This conclusion was confirmed by Niall Mackay of the University of York quite recently using data from the 1940 Air Battle of Britain. Mackay shows that this was of great practical significance because it affected a debate among the British Air Marshals over the best tactics for deploying fighter defenses. U. S. Army operations analysts have tried to apply the equations to ground combat and found they seldom match casualty outcomes of actual battles. An obscure Russian officer named Osipov independently discovered the square and linear law forms about the same time as Lanchester. Unlike Lanchester, Osipov tested their applicability with historical battle data and concluded that for ground combat the casualty generation rate on the two sides lies more or less half way between the square and linear laws. For the full text see M. Osipov, *The Influence of the Numerical Forces on Their Casualties 1915*, translated with an introduction by A. S. Rehm and R. L. Helmbold, Concepts Analysis Agency Research Paper CAA-RP-91-2, 1991

[11] Studies with salvo equations may be found many places, including the Wikipedia under "Salvo Combat Model." The root document is W. P. Hughes, Jr., "A Salvo Model of Warships in Missile Combat Used to Evaluate their Staying Power," *Naval Research Logistics*, March 1995.

[12] A good quantitative description of this phenomenon using the salvo equations is in M. J. Armstong, "Effects of Lethality on Naval Combat Models," Naval Research Logistics, Vol 51, Nr 1, 1954, pp. 28-43

and efficiently over all defenders, which is implicit in the model.[13] That does not affect the general truths that come from the equations, and moreover if one hopes to know how the missiles will be distributed, then he must estimate the effects of different radar cross sections, near-side attraction of ships by the missiles, and the tendency of a burning ship to draw fire and suffer disproportionate hits—thereby preserving the combat capability of the undamaged ships—and further enhancing the advantage of more distributed forces at sea.

The equations may be modified to show the effect of surprise. Sometimes we enrich them to show the effects of soft kill and countermeasures which, as will be shown below, have dominated successful defender effectiveness. The equations only describe firepower's effects and so the study of the often dominant effects of first detection and superior scouting must receive separate attention. Nevertheless, none of these or other considerations have upset the three general conclusions: (1) numbers matter most; (2) getting off an unanswered first salvo has special value unless one's own defenses are impermeable; and (3) a fleet with small numbers of very potent ships that can only take a few hits must be made aware of its unstable status in a battle.

Three Extensions Pertinent to a War at Sea Strategy Against China

In 2001 Singapore Navy Lieutenant Keith Jude Ho wrote an expansive thesis on the advantages of small combatants.[14] Among his extensions of the salvo equations, LT Ho applied two stochastic models to explore the uneven distribution of missiles on enemy targets. This probabilistic approach complemented LT Jeff Cares' simulation approach. Among his conclusions Ho wrote: "Results of both [stochastic models] show that when total firepower, offensive and defensive, is held constant [in a total force] the fleet significantly improves its chances of winning merely through distribution of its combat potential among more units. In some simulations of the salvo models, results indicate that there are specific instances when force concentration is preferred over force distribution. The ability of the distributed fleet to disperse or concentrate on demand makes it extremely adaptable to these instances."

A second extension is in the thesis by LT Casey M. Mahon, who explored the possibility that the truism, "A ship's a fool to fight a fort," should be modified and softened in the missile era.[15] First, precision guided munitions will now be more effective against fixed, land-launched missile sites than were guns against forts. In effect, a fleet's offensive term in the salvo equation will be a bigger number. Second, a modern missile ship can defend itself against incoming missiles. In the gunnery era there was no defensive term in the fleet's combat equation like there is today. His thesis is particularly pertinent because of the long range of Chinese aircraft and weapons in the missile age. When he was done, Mahon thought he had demonstrated the truth of his thesis: the salvo equations show that a modern fleet is much more able to fight a "fort" of land based missiles and aircraft. His thesis advisor was not so sure. The situation has improved for modern warships but they can still be subjected to significant, and harder to

[13] J. R. Cares, *The Fundamental of Salvo Warfare*, Naval Postgraduate School Masters Thesis, March 1990
[14] K. J. Ho, *An Analysis of Distributed Combat Systems*, Naval Postgraduate School Masters Thesis, December 2001. Ho was participating in a student research team that designed an inshore task force as a mix of small missile combatants (Sea Lance) and small aircraft carriers (Sea Archer) that could operate unmanned aircraft and helicopters. He helped to evaluate their performance in a littoral environment.
[15] C. M. Mahon, *A Littoral Combat Model for Land-Sea Missile Engagements*, Naval Postgraduate School Masters Thesis, Sept 2007.

replace, losses! Our point here is not who is right but that the salvo equations could inform a campaign planner with quantitative insights that affect Air-Sea Battle planning. There is enough uncertainty in the mere ten inputs for salvo modeling to cast doubt on the dependability of results from more detailed simulations with hundreds of inputs, many of which are just as imprecise. It is noteworthy that Chinese scholars have picked up on Mahon's application of the equations. By using the salvo model for land-sea combat they can reach their own conclusions about whether China or the U. S. will have the advantage against China's anti-access capability, the modern version of forts defending critical harbors.[16]

The third pertinent extension of the salvo equations is a recent application by Commander Philip Pournelle. His study, not yet published, is SECRET because he draws from many classified sources for data and scenarios. In his application he pits different U. S. Navy task force combinations against a fixed enemy surface task force composition, in which both sides are sufficiently competitive that they decide to fight each other. In one part of a much more extensive quantitative analysis, he augments the defensive term in the equations to measure ASCM leakers (leakers being the small number of incoming missiles that penetrate a capable defense). More importantly, he counts both offensive and defensive missile expenditures. A stark and seemingly realist outcome is that frequently one side expended all its defensive missiles and was denuded of active defenses. This and other evidence suggest that it is very important to determine the sufficiency of (1) the missile load out in a single Aegis ship, (2) the missile mix in a task force, and (3) the total inventory of all categories of missiles in the entire fleet, when compared with our best estimate of enemy inventories of missiles such as DF-21s. In the missile era no strategy, campaign plan, or tactical doctrine is worth very much without an estimate of which side and under what circumstances is likely first to be drained of its missiles of any kind. Need we add that a substantial margin for error should be built into inventories at every level—from task force, to theater, to total stockpile? But once again, our point here is that one needs no more complexity than the salvo equations to make estimates that are sufficient to show whether we are likely to run out of weapons in any level of conflict.

Practice: The Record of Missile Attacks on Warships Since 1967

A good way to summarize the record of known attacks with missiles is by examining their hit probabilities against three target categories. The data that follows is taken from a thesis by LT John C. Schulte published in 1994. Schulte's data is not quite complete but is accurate enough to make the case that we are in a missile era of warfare at sea.[17]

First, and an argument in favor of small combatants, the hit probability of missiles fired at targets that defended themselves is 0.26. There were 32 hits achieved by 121 ASCMs, resulting in 13 ships sunk and

[16] Wu Jun, Yang Feng, Cheng Yong-mei, Pan Quan: "Land-Sea Combat Model for Littoral Engagement in High-Tech Warfare," College of Automation, Northwestern Polytechical University, Xi'an 710072, China, 2011

[17] J. C. Schulte, *An Analysis of the Historical Effectiveness of Antiship Cruise Missiles in Littoral Warfare,* Naval Postgraduate School Masters Thesis, September 1994. More attacks than Schulte found have been uncovered by M. S. Navias and E. R. Hooten and reported in *Tanker Wars: The Assault on Merchant Shipping During the Iran-Iraq Conflict, 1980-1988,* New York: I. B. Taurus 1996. Another reference is L. A. Zaterain, *America's First Clash with Iran: The Tanker War, 1987-1988.* Captain (Retired) Steven Woodall is an authority on attacks against warships. Woodall has the advantage of having participated in the tanker wars.

16 put out of action. Most of the ships attacked were small—under 1,500 tons—and those that successfully defended themselves did so mostly with soft kill defenses and probably—the evidence is uncertain—with point defenses. Over 80% of the missiles fired when the attacker attempted a defense were in the 1973 Arab-Israeli War. The average of 26% success conceals the fact that the 250-ton Israeli *Sa'ar* boats were 100% successful in defending themselves and all losses were suffered by Egypt and Syria. A defender was either highly effective or highly ineffective. In only one instance has a SAM ship shot down a missile in combat. That was during Desert Storm in 1991. Iraq fired two obsolescent Silkworm missiles at USS *Missouri* while it was conducting shore bombardment *eighteen miles* off Kuwait. One Silkworm failed on launch. The second was badly aimed, but HMS *Gloucester* shot it down after it missed the *Missouri* and was outbound.

Second, the hit probability of missiles fired at ships that might have defended themselves but did not do so was 0.68. A total of 27 hits were achieved by 40 missiles fired at ships capable of defending themselves. The result was 6 ships sunk and 14 put out of action. These include USS *Stark*, HMS *Sheffield*, and the Israeli corvette *Hanit*.

Third, a large number of missiles were fired against defenseless ships. Using what unclassified data he could find in 1994, Schulte calculated the hit probability to be 0.91, in which 57 ½ hits were achieved of 63 missiles fired. The hits resulted in 12 ships sunk and 42 damaged. Schulte's count of total hits and missiles fired is low—Navias and Hooten tabulate more attacks—but his hit probability is sound, and it is still a very high percentage.[18]

[18] The "one-half hit" is a curiosity. The Egyptians feared their big Styx missiles would not home on a vessel as small as a *Sa'ar* boat, so they conducted a live fire test against the Israeli fishing boat *Orit*. Of four Styx missiles shot at it, none hit but the boat sank anyway. Schulte counted the result is a half-hit.

CHAPTER 3 "OFFSHORE CONTROL" IN EAST ASIA USING A WAR AT SEA STRATEGY

> *Put in the broadest terms that we use today, the fundamental strategic role for navies to prevent any opponent from blocking the safe passage of any friendly craft on, over, or under the sea and to deny passage to any force that interferes with safe passage to its intended destination.*
>
> John B. Hattendorf[19]

The findings of the workshop reported in October 2011 both motivate development of a flotilla for fighting on the surface and adumbrate the characteristics of the missile vessels. The findings make clear a flotilla's ships must be ready to go in harm's way so that blue water ships with large crews performing multiple missions will not be lost. The workshop results have been expanded and published in an essay by this study's authors in the Autumn issue of the *Naval War College Review*, entitled "Between Peace and Air-Sea Battle: A War at Sea Strategy." An independent study by T. X. Hammes reaches complementary conclusions but emphasizes policy and strategy. He infers that offshore control of the China Seas is necessary and sufficient to retain U. S. influence in East Asia and keep the competition peaceful.[20] We use in our study's title his descriptive term, "Offshore Control." Laudably, Hammes pays particular attention to *war termination*, with some astute comments. This is the first time we have observed anyone introduce this important aspect of our strategy against China. The workshop also drew from an insightful paper by Robert D. Kaplan in which he writes, "Because of the way geography illuminates and sets priorities, the physical contours of East Asia augur a naval century."[21]

Worth pondering is the reasonable conclusion that China itself is conducting a very astute campaign of offshore control right now! Recent actions in the vicinity of the Senkaku Islands, the Paracels, the Spratlys, Vietnam, and elsewhere in the South China Seas resemble a war of intimidation at sea against our Asian allies and friends, hence the need for a U. S. strategy to keep the competition peaceful and in accordance with international law and conventions.

Here are the workshop's assumptions and findings, concisely expressed and updated:

- (b) (5) [redacted]
- (b) (5) [redacted]

[19] Hattendorf, "The Past as Prologue: The Changing Roles of Sea Power in the Twentieth Century," essay in *Talking About Naval History: A Collection of Essays*, Naval War College Press, 2011, p. 285.
[20] T. X. Hammes, "Offshore Control: A Proposed Strategy for an Unlikely Conflict," in the National Defense University's *Strategic Forum*, June 2012
[21] R. D. Kaplan, "The South China Sea is the Future of Conflict," in *Foreign Policy*, Sept-Oct 2011, pp. 76-85.

- (b) (5)

(b) (5) [redacted]

Operations in East Asia

The emphasis in this study is on the third and fourth naval components. A (b) (5) [redacted] Together they greatly complicate China's planning, yet constructing the flotilla and planning for Marine outposts adds little cost to the U. S. defense budget and manpower.

Flotilla operations are intended to be *symmetric*, (b) (5) [redacted] The flotilla can respond directly to PLAN actions there that restrict, restrain, or deny freedom of the seas for all shipping. Thus, the flotilla complements U. S. maritime interdiction and submarine operations that are basically *asymmetric*, indirect responses.

The Marine outposts play a similar symmetrical role. They would be established at strategic locations only in time of crisis *and only in collaboration with a host government*. (b) (5) [redacted] [2] The island is strategically located and relatively easy to defend—by either side—having dense forests, caves, and only a few beaches. A (b) (5) [redacted] A third prospective location is a (b) (5) [redacted] because, first, the land to sea missiles can reach in three directions instead of one, and second, because their strategic value would be immediately evident to China.

In classroom work students at the Naval Postgraduate School have examined in a preliminary way these and other candidate locations. Specific places should not be public knowledge, but we believe the JCS should encourage planning now by PACOM to specify operational roles: covert ISR listening posts; small and mobile bases for flotilla operations—once the vessels are commissioned—and aerial reconnaissance

[22] See for example, Li Jinming and Li Dexia, "The Dotted Line on the Chinese Map of the South China Sea: A Note," School of Southeas Asian Studies, Xiamen University, Fujian, China, published in *Ocean Development and International Law*, 34: pp. 287-295, 2003

vehicles that are neither easy to identify nor attack; covert locations to deploy large unmanned undersea vehicles; and in a category by itself, sites for batteries of land-to-sea medium range missiles.

The Navy flotilla and Marine outposts in (b) (5) [redacted]. A five step program to develop this flexible, low cost option is:

- (b) (5) [redacted]

Operations in Other Regions

The next most important role for the flotilla is in the Arabian Sea and Persian Gulf. Low cost deployment of one or two squadrons home ported at Bahrain, Jubail, or another friendly port seems preferable to exposing a CVBG in the Gulf. If Iran chooses to close the Strait of Hormuz, a flotilla of two or more squadrons on point to clear the way would be a great comfort to the U. S. blue water navy and mine clearance vessels. Currently the only small combatants in the Gulf are lightly armed U. S. Navy and Coast Guard patrol craft.

Small missile combatants, probably accompanied by LCS's, are better suited than blue water ships to operate in *cul de sacs* or confined waters elsewhere in the world. Joint operations with South Korea in the Yellow Sea to constrain North Korean mischief is a prominent example. Collaboration with Turkey, Bulgaria, Romania, Ukraine, and Georgia in the Black Sea is another. The Baltic Sea is another obvious location where the flotilla is better suited for cooperative action than a carrier battle group or expeditionary strike group.

The flotilla is not intended to substitute for Offshore Patrol Vessels that are designed and better suited for maritime interdiction, drug interception, and anti-piracy patrols. Nevertheless, flotilla vessels are more affordable and better assigned to these tasks than the large blue water combatants currently being employed.

Each region would entail a different kind of reconnaissance and logistic support, but in each case these aspects seem relatively easy to work out affordably.

Summation

Amidst a plethora of strategy books and policy documents in circulation today, how shall we give summary context for our war at sea strategy in which a flotilla and marine outposts play their low cost, high reward roles? The late RADM (Retired) J. C. "Bill" Wylie wrote late in life a never-published companion to his well-known, highly readable, and compact treatise on *Military Strategy*.[23] Completed in 1990 and entitled *The Evolution of Maritime Strategy,* the manuscript covers the period from the Middle Ages to post-World War II. Wylie's purpose is to show which strategies worked and why. Appraising the Seven Years War, 1756-1763, he sums up with: "As long as he [Prime Minister William Pitt, the elder] was in power the British never let up on either control of the French main fleets or control of the world's trade and the money that that trade produced. In this war the key to sea power became clear: control of the main fleets; control of trade and money; and the recognition that both, not only the one or the other, are necessary." In his published book, *Military Strategy,* Wylie concludes that the general aim of strategy is to control something. In his unpublished work he traces the advance from incoherent strategies in the Middle Ages to the successful ones in which explicitly or implicitly the winner knew what to control to win and then stuck to the winning strategy.[24] As a sailor, Wylie came to appreciate control of the seas—Mahan and Nicholas Spykman over Mackinder and Karl Haushofer—and he makes the case with demonstrations, as in the quotation above.

The parallels must not be pressed. When T. X. Hammes speaks of offshore control he has one state in mind, China, and one set of partnerships in East and South Asia. Were our subject control as the aim of strategy in general, we must show the *limits of maritime* control as being necessary but not sufficient in, for example, the American Civil War and both World Wars. We would have to address the threat of nuclear weapons to which offshore operations contribute very little. We would recount in detail how a war at sea strategy against the Soviet Union was tested in the 1960s and why it failed. Secretary of the Navy Paul Nitze sponsored a campaign analysis to test whether an asymmetric response to another Berlin blockade or suppressions in Hungary could be to exploit our naval preponderance. But the war at sea strategy didn't serve. NATO depended on control of the Atlantic sea lanes for commercial and military purposes whereas the Soviet Union had no such critical vulnerabilities at sea and could build "cruisers"—submarines and land based bombers—to disrupt or sever the critical Atlantic connection between North America and Western Europe.

But Wylie's emphasis on control of trade, money, and the Chinese navy threatens Chinese prosperity and plays to American strengths. The offshore control strategy proposed in our Kline-Hughes essay, "Between Peace and Air-Sea Battle: a War at Sea Strategy," does not examine the Sino-American competition as comprehensively as Wylie's *tour de monde*, nor has anyone else described the strategic purposes and policy rewards that accompany each of our choices from pacifism to strikes on mainland China. We think, however, that when this is done, the preference should be expressed as the best chance to "keep control" in the Western Pacific before a confrontation disintegrates into World War III. The best

[23] Originally published in 1967, *Military Strategy* was republished in the Naval Institute's *Classics of Sea Power* series in 1989, along with a Postscript written by Wylie and three other short works. An additional insight of Wylie's we teach to our Naval Postgraduate School students is that there are two kinds of campaigns, *sequential* and *cumulative*. A sequential one is like the 1943-44 Pacific fleet's island hopping in which each hop depended on the success of the previous island seizures. A cumulative one is a series of many events, none consequential in itself but decisive when taken together, like the U. S. submarine campaign against Japanese shipping in 1943-45.

[24] Naval commentator Herbert Rosinski also emphasized control as the aim of strategy.

U. S. strategy against China will look much like William Pitt's strategy in the Seven Years War. The Kline-Hughes essay makes a similar case for sea power to focus on the "control the world's trade and the money that trade produces." We think China will be wiser than France in 1756 and, seeing our advantage at sea, will not test—in Bill Wylie's terms—who will control the situation.

CHAPTER 4 SHIP AND FLOTILLA PROPERTIES

> *Spruance believed a goal of perfection stifles timely decisions and inhibits the pace of action, whether in himself, his staff, his subordinates, or his peers. He had low regard for anyone who when judging effectiveness could not distinguish molehills from mountains.*
>
> Wayne P. Hughes, Jr[25]

The salvo equations, being generic, do not tell us the size of the ships being compared. The equations can be used to estimate the relative worth of striking power, defensive power, and staying power, but not ship size and cost. Insight into flotilla ship characteristics must come from their employments described in Chapter 3. The overriding capabilities are to *confront the PLAN directly in its own seas, and if necessary fight* on the surface in China's waters. In a war, the small combatants will try to conduct missile attacks against bigger warships. The combat crews must be as small as possible. Flotilla ships when put out of action will normally be abandoned and should be designed without emphasis on damage control. Their concerted offense must be formidable and individual defenses affordable. Because combat missions are short and intense, full offensive targeting and defensive alertness can be assumed. In salvo equation terms:

Offensive and defensive alertness coefficients = 1.0.

Offensive power = 8 Harpoon-like missiles per ship with an expected hit probability of 0.8.

Defensive power = 2 or 3 missiles defeated per defender. See a further discussion below.

Staying power = 1 hit by any ASCM will put a ship out of action.

Design of a Flotilla Warship

Small missile ships—shall we call them *Cushings*?—can fight symmetrically against Chinese *Houbeis* and asymmetrically against larger warships.[26] To win, they must out-scout the enemy and strike effectively first.

One way to describe relative combat worth is by simple comparison of a *Cushing* with a big enemy combatant, similar to a DDG. To do so we must know its size and SCN cost. In Chapter 1's imaginary 1998 Battle of the Aegean, the then 15-year-old *Cushings* displaced 800 tons and the newer *Phantoms* 200 tons—the size of the first USS *Cushing* (TB-1) commissioned in 1890, or a modern PLAN *Houbei* [27]. Our initial design will split the difference and assert that a 2012 *Cushing* displaces 500 tons. Thus, it is

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[25] Hughes, "Clear Purpose, Comprehensive Execution: Raymond Ames Spruance (1886-1969)," a chapter in *Nineteen-Gun Salute: Case Studies of Operational, Strategic, and Diplomatic Naval Leadership During the 20th and Early 21st Centuries*, Naval War College Press, p. 62.

[26] *Cushings* were the key to victory in the imaginary "Second Battle of the Nile" and also were crucial to mission accomplishment in the "Battle of the Aegean." The first American torpedo boat was *Cushing (TB-1)* named after the Civil War hero, William B. Cushing. Study contributer Hughes' first assignment was to DD-797, the fourth ship to carry the name, and the fifth one, DD-985, was commanded by Jeffrey Kline, the principal investigator of this study. See Appendix B: Real and Imagined *USS Cushings* in History.

[27] TB-1displaced 120 tons but the second generation American torpedo boats grew to around 250 tons.

comparable to the Naval Postgraduate School's *Sea Lance* design of 600 tons.[28] The *Sea Lance* was rather carefully costed at $60 million in 2001 dollars. Today the same design would probably cost $75 or $80 million, but the *Sea Lance* has expensive features, including a low observable, wave piercing catamaran hull and 45 knots of speed. Our 500 ton *Cushing* will have a simpler hull and 30 knots of speed and eschew NAVSEA specifications required in bigger warships, and so it would probably cost the same as an average American warship, which is $115 thousand per ton.[29] Therefore we estimate the U. S. Navy can procure each ship in series production for $60 million.

A large enemy missile ship of 8,000 tons built at the world wide average shipbuilding cost of not $115 thousand but $92 thousand per ton would cost about $730 million. If we pit equal cost forces of *Cushings* against these big missile ships, the *Cushing*s' numerical advantage would not be 3:1 but closer to 12:1. If the enemy ship costs as much as an *Arleigh Burke* class destroyer, i.e., $1.8B of SCN, then the equal-cost numerical relationship would pit one destroyer against 30 small missile ships.[30]

There is no good reason to design a *Cushing* to perfection, as long as the aim is to keep the cost low, the crew small, and the offensive potency high. The design can take advantage of past surface missile battles by observing that the winners protected themselves successfully with soft kill and point defenses alone. Our Navy can exploit the design experience gained from the NPS *Sea Lance*, observe the features of the Chinese *Houbei's*, and learn from the new 500-ton ROC missile ship, *Hsun Hai* (Swift Sea). The battle-tested first generation Israeli *Sa'ar* boats of 250 tons designed in 1970 are worth close study, not only to see why the original design was so combat-effective but to observe the rapid learning and development processes in the Israeli navy before and after it fought in 1973.[31] Among many other designs to guide us are the Finnish *Hamina's*, (250 tons), Greek *Roussan's* (600 tons), Swedish *Visby's* (650 tons), French *La Combattante* FS-56 (400 tons), Norwegian *Skjold's* (280 tons), Singaporean *Victory's* (600 tons), and the U.S.-built Egyptian *Ambassador III's* (500 tons).

Composition of the Flotilla

Hand in hand with individual ship design is the composition of the entire flotilla. We espouse a mutually supporting pair as the smallest tactical unit, a division comprising four ships, and a squadron of two divisions—eight vessels—as the basic building blocks. How many squadrons in the entire force? That depends on two things. First, how much of the U. S. fleet budget should go to coastal missile vessels? We suggest 2 or 3% of annual SCN as the investment's upper limit. Second, how long will it take to become tactically and technologically proficient, so that we can proceed with affordable second and third generation designs? We think at most five years for a second generation design and ten for the third generation.

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[28] See C. Calvano and F. Papoulias, *"Sea Lance" Littoral Wafare Small Combatant System,"* NPS Technical Report NPS-ME-01-001 dtd January 2001

[29] Taken from a presentation by AMI International: "Global Naval Investment: The Hi-Lo Mix, Shipbuilding Trends, and Future Fleet Structures," 4 July 2012. (Slide 6 has the raw data)

[30] Because the multi-purpose *Arleigh Burke* is dense with equipment, its construction costs $225 thousand per ton.

[31] The *Sa'ars* grew in size because the Israelis need to deploy farther and carry a helicopter aboard for scouting. Currently the Israeli navy is contemplating a 2,800 ton German design, but for distant blue water deployment, not for flotilla operations. The U. S. Navy's problem is the opposite. We have blue water warships with ample range and air capabilities for distant operations but need small combatants to fight and sometimes suffer losses in confined waters.

We suggest a tentative fleet goal of eight squadrons, half of which would be based in East Asia. A force of 32 ships there will carry over 250 updated Harpoon- or Exocet-like missiles, numerous additional short-range surface-to-surface and surface-to-air missiles, and 32 medium caliber, rapid-fire guns. The deployed vessels would be inefficient for land attack, but superb to create a no man's land in the adjacent seas. A squadron or two of these vessels thrust into a hazardous peacekeeping operation would have a formidable tempering influence on Chinese hegemonic ambitions in the South and East China Seas.

If conflict ensues, the flotilla's purpose would change at once. The little ships would stalk and attack big PLAN surface warships and commercial traffic, probably with deadly effect.

An entire flotilla of 64 *Cushings* should cost about $3.8 billion to build. That is the cost of two DDGs or half of one CVN air wing. If we specifiy a mere 16-year operating life, the 64 ships could be sustained indefinitely by building four *Cushings* per year at an annual SCN of $240 million. That is less than two percent of the announced SCN budget in the Navy's 30-year shipbuilding program. We reiterate that we would not build 64 *Cushings* of one design. After experience in tactical training and deployed operations, the Navy will build second and third generation designs that are affected by new technologies. Some of these technologies may be in response to surprise developments by the enemy. The introduction by the PLAN of small, inexpensive, radiation seeking, autonomous aerial vehicles called Harpies is an example. The reason we want 16-year service lives is for rapid improvements not possible in big warships that must amortize their large construction costs over 30 and 40 year service lives.

Deployment and Endurance

There are several ways a squadron can be deployed. One is to carry it in a large commercial vessel. The MV *Tern* recently carried four 1,400 ton *Avenger* class mine countermeasures ships to the Persian Gulf. The same ship could easily lift eight or more *Cushings* of 500 tons when circumstances precluded their crossing the ocean. The MSC class minesweeper of 450 tons (crew 35) is of a different design and era, but in the 1950s it easily sailed independently, for example, from Charleston SC to New London and back in both fair and foul weather. A division of MSCs sailed from Charleston to Guantanamo Bay, Cuba, for refresher training with a fuel stop in Fort Lauderdale. These were routine sailings. More unusual was the deployment of a squadron of five-MSOs and MSCs from Long Beach to Pearl Harbor, thence to Midway Island, thence to Yokosuka without refueling at sea. After voyage repairs, one MSC, the *Cormorant*, sailed to Iwo Jima, conducted a mine clearance exercise, and then went to its new home port in Sasebo without refueling. These are reminders of the range of operations "small" U. S. ships commissioned in the 1950s were capable of.[32] German 500-ton U-boats sailed across the Atlantic in January 1942, sank shipping off Halifax, Boston, and New York, and returned to their bases on the Bay of Biscay without refueling. Within a few months U-boats of 750 tons operated as far south as the Florida Strait and made Cape Hatteras a tanker graveyard until we commenced convoying off our East Coast.[33] These events all

[32] Hughes personal recollections and that of Naval Academy classmate, VADM William Rowden.

[33] We belabor transits here because we have often heard officers of all ranks say small ships do not have the range and cannot stand the weather for long transits. Here is one more anecdote from a book by E. Renner and K. Birks, *Sea of Sharks: A Sailor's World War II Survival Story*, Naval Institute Press, 2004. YMS 472, a 130 foot minesweeper designed for harbor protection, of 210 tons with a crew of 36, had endurance for eight days of steaming without refueling. In 1945 it transited with other minesweepers from New York via Miami and Guantanamo Bay to the Panama Canal, thence to Long Beach with two fueling stops; thence via Pearl Harbor, Eniwetok, and Saipan to Okinawa—only to be sunk in a typhoon soon thereafter.

took place more than 50 years ago. Can we not exploit modern technology to enhance the range and self-deployability of small combatants now? This might carry bigger rewards than 45 knots of speed.

In any event, we expect that 500-ton *Cushings* will have the range to self-deploy to significant distances at economical cruising speeds.

Sustainment and Seakeeping

The New Navy Fighting Machine Study derived an affordable fleet of over 600 ships, about one third of which were for green water operation, most of them small in size and tailored for specific tasks.[34] The study, wisely as it turns out, did not add ships to combat logistics support force (CLF), but retained the U. S. Navy's existing force composition of about 30 CLF ships. We are now seeing the consequences of building LCSs and JHSVs for the fleet. Both classes are six times larger in displacement than flotilla vessels, yet because of their high speed, fuel consumption, and limited range, past methods of sustaining them do not work well for these and other small, deployed vessels such as PCs. We quote from a recent article by Captain David Meyers and Commander Jason Fitch in the *Naval Institute Proceedings.*[35]

- "Sustaining a steady production of both vessels in the years thereafter, this [existing] plan will culminate in a total of 66 LCSs and 41 JHSVs built by 2040 with planned replacement for their 25- and 20-year service lives, respectively. These new, smaller ships will represent as many as 100 of the projected 301 ships in 30 years—a third of the Navy's future fleet."
- "Because it is available and cost-effective, in-port replenishment, especially for refueling, is destined to be the foundation of logistics support for tomorrow's small, high speed vessels. There are many options, however, for providing in-port support."

The Meyer-Fitch essay goes on to illustrate the choices of in-port sustainment at length. We think the addition of two or three tenders to support flotilla combatants would be prudent for versatility, but our survey indicates that in most instances host nation support, piggy-backing onto their existing in-port replenishment facilities, will suffice. An article in the *Naval Institute Proceedings*, "22 Questions for Streetfighter," shows why sustainment should be carefully thought out. The article addressed the procurement of tenders for an entire flotilla of 100 "streetfighters" that cost $80 million each for a total of $8 billion. It says if a tender supports ten deployed combatants and each one costs $500 million, then all ten tenders' procurement cost would be $5 billon. The article does not address manning, but a reasonable estimate is that ten missile combatants will take 250 personnel, yet their tender might take up to 400 personnel.[36] Therefore we favor a flexible approach similar to that of Meyer and Fitch, rather than a rigid plan to support all the flotilla with tenders.

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[34] Hughes, et al, *The New Navy Fighting Machine: A Study of the Connections Between Contemporary Policy, Strategy, Sea Power, Naval Operations and the Composition of the United States Fleet*, Naval Postgraduate School Technical Report NPS-OR-002-PR, August 2009

[35] D. C. Meyers and J. B. Fitch, "Rethinking Littoral Logistics," *Naval Institute Proceedings*, August 2012, pages 69-72.

[36] W. P. Hughes, Jr., "22 Questions for Streetfighter," *Naval Institute Proceedings*, February 2000, pp. 46-49. For comparative purposes we assume manning of 25 for peacetime operations that include personnel for shipboard upkeep and training. For combat operations we would reduce the manning to about twelve key personnel.

Further indicating the importance of logistics and sustainment, Keith Ho points to them as a potential Achilles heel. Unlike Meyer and Fitch, Ho assumes conventional underway replenishment and derives the need for three 25,000 ton multi-product CLF ships, called Sea Quivers, to support twenty Sea Lance and eight Sea Archers each carrying ten aircraft. He adds a fourth Sea Quiver as the prudent number to sustain a 28-ship littoral task force. Ho suggests that the Sea Quivers, being few in number, easy to find, and less well defended may be where an enemy should attack to neutralize the force.[37] At the Naval Postgraduate School, "Red-Cell" students in the Joint Campaign Analysis class more than once have come to the same conclusion about the Blue fleet: the Combat Logistics Force (CLF) is a critical vulnerability.

Here is one highly flexible solution for flotilla support and Marine operations in the China Seas and elsewhere. Team an LCS with every four *Cushings* and exploit the JHSVs' lift design to move the Marine detachments swiftly into forward outposts along with their gear. Using such basic building blocks, a suitable number of mutually supporting ships and ground forces can be deployed very quickly. Two LCS with each squadron of *Cushings* adds aerial reconnaissance that ought to suffice for *peacetime* surveillance.

Why the great cost advantage of small combatants when conventional wisdom is that big ships enjoy economies of scale? A small, short range ship's advantage comes from avoiding the need to build in the endurance that each DDG, LHA, and CVN enjoys. Long endurance and replenishments at sea from the CLF is the hallmark the U. S. Navy, but the advantage adds substantially to warship construction and operating costs without adding anything to their combat capabilities.[38]

Operational Adaptability

It is important to remember there are two sides to policy negotiations that tend to be wheels within wheels of complex verbal maneuvers and posturing. A long-lived navy must be prepared to serve satisfactorily, whether the Sino-American relationship at the time is cooperation, competition, confrontation, or one that may lead to conflict. An American flotilla will be especially adaptable to the different policies.

In times of *cooperation* China can evidence good will with invitations for various sized U. S. Navy warships to visit mainland ports and Hainan. Port calls by small ships in suitable numbers accompanied by an LCS or two will be particularly congenial toward fostering warm relations, performing most of the usual activities associated with friendly international "engagement."

In periods of *competition*, the flotilla would be exploited in joint exercises with allies like Japan, Australia, Singapore, and South Korea, and other East Asian countries whose friendships we value, to include the Philippines, Vietnam, Malaysia, and Indonesia.

Should a *confrontation* arise, divisions or squadrons of missile combatants enhanced by aerial surveillance and often by Asian partners can demonstrate a firm commitment to enforce international law.

[37] Ho, op. cit., pp. 71-75.

[38] Nor does size add much to staying power in a battle. This is a change from when armor, compartmentation, and sheer size were expected to increase staying power. The evidence today is that it will only take one or two missile hits to put a 10,000 ton combatant out of action.

Flotilla ships are the best ones to risk when a surprise attack is possible and our forces are constrained to operate under strict Rules of Engagement.

Flotilla employment during *conflict* would be radically different. Short duration surprise attacks on large ships at times and places of our choosing, using target detection and tracking from a variety of sources.

Technological Adaptability

Because flotilla ships have narrower and more focused tasks, they will be easier to modify or replace when new technology offers room for improvement, or an adversary's technology leap confronts us with a surprise. If replacement is more cost-effective than a conversion, it is far easier to replace flotilla ships than large, multipurpose ships with planned service lives of 30 or 40 years. The ships being replaced will probably be suitable in less critical operations with allies such as South Korea and the Baltic states. They can also be used for offshore patrol, maritime interdiction, anti-piracy, and other less demanding operations.

Summary of Ship and Flotilla Properties

A littoral combatant should have the following properties:

a. Principal Armament. About eight surface-to-surface missiles with a range of at least 60 nm. A longer ASCM range at low additional weight and cost is desirable, but we think for littoral waters the clutter of all descriptions will require sorting. Missiles must not be squandered on innocent traffic, and rapid, reliable identification and targeting contributes more to attacking effectively first at sea than sheer weapon range. (This would not be true of offensive missiles in blue water frigates that fight on the open ocean. Their ASCMs should have a range of 100 nm or greater.)

b. Staying Power. One missile hit will put the vessel out of action. If the ship is immobilized, then the surviving crew members must be rescued by the ship's consort, sometimes in very hazardous conditions. No damage control will be attempted because the loss is affordable and additional crew members may be lost while trying to save their ship. We think there will be instances, perhaps a surprisingly large number of them, in which missiles are expended and a gun duel ensues, or a battle is fought at short range against a swarming attack at short range with gunfire a critical part of it. Staying power for a *gunfight* is valuable.

d. Defense Capabilities. Point defense missiles and gunfire are the best *active* defense. But most successes in combat have been with *passive* defenses—decoys, jamming, and stealth properties—and by evasive maneuvers. As a prospective new technology, we think "electronic smoke screens" developed by the U. S. Army are promising and should be pursued for obscuring ships from missile seekers. Of course, the smaller the ship being screened, the easier it is to cover it with electronic smoke.[39]

[39] (b) (5) [redacted]

A *Cushing's* characteristics and functions in peace and war have been narrowly defined. Other green water operations around the world will often need different functions performed, but not by the flotilla of missile combatants.

- Inshore combatants that sometimes also serve in the riverine force. These vessels are currently being built, quickly added to the inshore fleet, and experience is being gained.
- Offshore patrol vessels to conduct patrol, interdiction, and anti-piracy operations more economically than by a blue water ship. A *Cushing* is imperfect for the role but it is much less expensive than a DDG. We can also solicit assistance from our friends in some places around the world.
- Mine clearance is in flux. It is an important capability we must have, but cost-effectively.
- Naval gunfire support will need to be reviewed in the light of 21st Century technologies and tasks. The NGFS mission should not be piggy-backed on missile ships but should have its own dedicated gunships, well trained and equipped with modern means of supporting ground operations, such as rail guns.
- Air operations for reconnaissance, close air support, and strike are essential complements to the flotilla, just as they are for blue water warships.
- Inshore antisubmarine warfare is a heavy burden that has been put on the LCS and may need to be reviewed. The need may be less critical when flotilla-sized ships are the only shallow water targets while the submarine threat is being reduced by U. S. submarines and ASW aircraft.

Impending Roles for Unmanned Surface Vehicles in the Flotilla

Aerial unmanned vehicles are being infused in all aspects of 21st Century military operations. Experimentation at the Naval Postgraduate School extends to the hardware and software of autonomous vehicles with emphasis on autonomous aircraft that cooperate with each other. The experimental evidence is consistent with the salvo equation conclusion that smaller, less expensive, and more numerous autonomous aerial vehicles offer the best single reward for combat and other operations. Advances in control systems, accompanied by cost reductions, are being made so swiftly as to boggle the mind. One prominent goal at NPS is to offset the threat of inexpensive swarms of Chinese Harpies with rapidly deployable counter-swarms to destroy them in the air. Undersea experimentation in autonomous vehicles for a variety of purposes is also being vigorously pursued.

Thus, one must not think that a manned U. S. Navy flotilla is cutting edge. It is in fact remedial—a program of catch up that the Navy has talked about for at least 20 years without taking action. Experience with 500 ton, austerely manned missile combatants is the first step, but very soon—within a decade—part of the mix of offshore combatants can very easily include unmanned systems, including those that decoy, scout without risk to humans, carry medium and short range missiles, and sometimes operate autonomously.

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sized ships in a tactical formation would rarely need to radiate through the "cloud" and probably can be covered well enough to give an enemy a sense of doubt and insecurity.

CHAPTER 5 OPERATING AND FIGHTING A FLOTILLA

> *To attack effectively (by means of superior concentration) and to do so first (with longer-range weapons, an advantage in maneuver, or shrewd timing based on good scouting) have been the warp and woof of all naval tactics.*
>
> Wayne P. Hughes, Jr.[40]

Battle History as Laboratory

The Battle of the Aegean in Chapter 1 shows the complexity and uniqueness of every real battle. The stylized salvo equations in Chapter 2 show that even in a sea battle's simplified essence a tactical commander must monitor ten key decision variables over which he has influence of (at best) only five.

The salvo equations are descriptive. They do not tell a tactical commander how to act. To introduce the precepts of successful flotilla operations and tactics, we must describe the *processes* of combat. Unlike ground combat, the essential processes of modern navy combat are only two: Scouting and Shooting. The two processes are governed by a third, the command and control (CC) process. The enemy must also carry out the same three processes: scout, CC, and shoot. Both sides also attempt to interfere with the enemy—slow or break his chain of actions—by "anti-scouting," CC-countermeasures, and a complicated set of defensive actions Hughes calls "counterforce."[41] The tactical goal is to attack the enemy first and do sufficient harm that he cannot win, or in the best of circumstances, cannot do us any harm at all. Thus we see that the two simple processes, scout and shoot, in comprehensive tactical execution become twelve in all. A CC network attempts to oversee six processes, including itself, more effectively (not necessarily faster) than the enemy.

Milestones in Salvo Warfare

1942-43: The Guadalcanal-Solomons Campaign is one of the most instructive examples in all naval history of ground-air-sea warfare between two accomplished opponents. Among the campaign's many lessons, it first exhibited the decisive use of destroyer torpedo salvoes, frequently when fighting against cruisers six times bigger. To summarize what was a long series of night surface battles, first, in 1942 during the pivotal fight for Guadalcanal, in each battle the IJN repeatedly won or held their own, often with astute use of very large torpedo salvoes, despite the fact that the USN forces usually gained first detection and often shot first—with gunfire. Throughout the six month struggle we were forced to assemble pick-up forces that were seldom led twice by the same tactical commander. It is no exaggeration to say under these circumstances we were doomed to use repeatedly the only tactics we were practiced at, a long column of ships intended for long range daylight surface actions between capital ships. Moreover we had not learned to use our radar advantage efficiently. Then, after the pause between the end of the Guadalcanal campaign in January 1943 and the beginning of our swift march up the Solomon Island chain through the latter half of 1943, we had time to bring in a new set of leaders with continuity, notably Admiral "Tip" Merrill and Commanders Arleigh Burke and Frederick Moosbrugger. Burke is credited

[40] Hughes, op cit., p. 43

[41] Not to be confused with the peculiar use of the term in nuclear war planning, when "counterforce" means an offensive strike to destroy an enemy threat.

with perceiving that our radar advantage could best be exploited in surprise attacks by employing torpedo salvoes as the decisive weapon. He developed two-prong tactics that won two near-perfect battles at Vella Gulf, 7 August 1943 and at Cape St. George, 25 November 1943. The Battle of Empress Augusta Bay, 2 November 1943, is instructive because when the U. S. force of cruisers and destroyers under Merrill was split in *three* components the battle deteriorated into a semi-melee. The Japanese were surprised and confused and the result was an American strategic victory, but the battle is a reminder that with salvoes of torpedoes in the water or in prospect, order can deteriorate into chaos, in which large combatants are more likely to be victims than successful with their large gunpower. The Guadalcanal-Solomons campaign is worth careful study to this day, not least because it is a case study in what it takes for the command process to blend the processes of scouting and shooting into a deadly, decisive tactical system.[42]

1971: Indo-Pakistan War indicated that a fleet in port is no longer safe from surface missile attack. The Royal Navy's aerial torpedo attack on battleships at Taranto in 1940 and the IJN's s aircraft attack on Pearl Harbor in 1941 demonstrated that ships were no longer safe in port. Now we know they can be attacked by surface ship and submarine launched missiles as well. On 4 December 1971 at the outbreak of the war three Indian missile patrol boats escorted by destroyers bombarded the port of Karachi in a surprise attack. Seven Styx missiles were fired toward the port and six found targets. Two Pakistani destroyers on patrol near the entrance were hit. One was sunk and the other was severely damaged. A minesweeper was also sunk and fuel tanks and command facilities destroyed. These modern vulnerabilities make "a fleet in being" a questionable strategy for an inferior navy.

1973: Arab-Israeli War was the most intense period of fighting between small vessels that included missile combat. A summary of fourteen incidents between 5 and 21 October has been compiled by one our foremost authorities on inshore combat, Captain Benjamin Yates, USNR.[43] The Israeli navy dominated by comprehensive training, preplanned tactics, well thought out doctrine, and effective softkill systems tailored to the SS-N-2 Soviet missile used by Egypt and Syria, this despite the fact that the Styx severely outranged Israel's Gabriel ASCMs. Scouting was sometimes enhanced by land based radar but co-author Hughes found no evidence of aerial scouting on either side, nor was participation of aircraft mentioned in his discussions with the Israeli navy.[44] An excellent appraisal of the lessons learned is found in the thesis by Singapore student, LT Keith Ho.[45] Among his observations are:

- Larger ships with longer-range weapons and standoff capability are not invulnerable to attacks.

[42] There are many superb accounts of individual battles each well worth reading, but the best comprehensive look at the entire campaign with emphasize on the U. S. and Japanese tactics and containing estimates of torpedoes fired in each battle is by T. J. McKearney, *The Solomons Naval Campaign: A Paradigm for Surface Warships in Maritime Strategy*, Naval Postgraduate School Masters Thesis, September 1985.
[43] B. S. Yates, *David vs Goliath: Small Boat Challenges to Naval Operations in Coastal Waters*, Marine Corps Command and Staff College Masters Thesis, 1998.
[44] One of the commanding officers showed Hughes a 35mm motion picture of a two-Styx attack from an *Osa* or *Komar* at night near Port Said. His ship having been detected by Egytptian shore based radar, the action starts with two bright bursts when the ASCMs are launched from over 25 miles away. The traces of the missiles can be followed as streaks of light as they approach, serving as a vivid reminder of what it is like to experience "rounds incoming." The missiles exceeded their nominal 25 mile range but missed their target.
[45] Ho, op cit., pp. 89-93

- Risk is inevitable in every battle. The Israelis treated their ships as "combat consumables." The same cannot be said of fleets structured around a few platforms comprising all the fleet's fire power.
- Numbers reduce the possibility of catastrophic loss.

Any tactical training course to prepare an American flotilla for combat operations should include a comprehensive review of navy tactics in the Yom Kippur War.

1982 Falklands War was not about flotilla actions, but it deserves close study as the most significant recent maritime campaign. The campaign is notable for the dominance of very effective Exocet missiles launched by aircraft or from land, and also the disproportionate influence of a very small number of submarines on both sides. A superb memoir of the campaign is *One Hundred Days*, by the operational commander, Admiral Sandy Woodward, who often served as his own tactical commander.[46] It is a personal description of the constant tension and pressures on a theater commander in the missile age of naval warfare at sea and on land.

Present Day: North Korea/South Korea skirmishes are not salvo warfare, but have many characteristics of flotilla combat in a war at sea. Part fury, part frustration, the extended series of clashes exhibit two nations attempting to protect sovereignty claims in the Yellow Sea, and South Korean actions to block North Korean attempts to infiltrate South Korea by sea on both sides of the peninsula. This extended undeclared conflict is worth study of sturdy sailor performance under fire, the scouting methods employed, and results of deadly skirmishes to include a submarine attack.

Basic Insights for Modern Missile Warfare

Surprise attacks are easier to make in littoral waters and will be more frequent there. Coastal clutter makes concealment easier and scouting less certain. A tactical commander must often coordinate by fighting instructions and battle plans sometimes executed silently without signal.

Two departures from the missile salvo mindset are: when air superiority is at issue, and when early expenditure of all ASCMs leads to a gun duel.

ASW tactics are different from surface tactics and take forms of analysis that emphasize the detection, classification, and localization processes.

Attack modes for salvo warfare at sea can be concentrated, dispersed, or sequential. The preference depends on radiation doctrine, the strength of the defense, the availability of off-board scouting, and the likelihood of successful surprise on either side. A dispersed but simultaneous attack looks best from a theoretical point of view. For a detailed discussion see Hughes, *Fleet Tactics and Coastal Combat*, pp. 266-293. Whether to concentrate in one or more formations is a many-faceted decision, but in general massing a force is only wise when the defense is very strong because of the collective *mutual support* by

[46] Woodward with Patrick Robinson, *One Hundred Days: The Memoirs of the Falklands Battle Group Commander,* Annapolis MD, Naval Institute Press, 1992

semi-independent, automatic actions. During and since World War II the choice of concentrating for defense has been based on all screening ships defending their neighbors by defending themselves.[47]

Maintaining Stocks of Missiles, Torpedoes, and Other Ordnance

The U. S. Navy should estimate the adequacy of our reserve stockpiles of weapons and also the number and types carried in ships or aircraft. In the Falklands War, one of the unexpected results—that tactical analysis would have been anticipated—was the large number of torpedoes, about 250 of them, fired at false contacts against an enemy order of battle of one effective Argentine diesel submarine. Every campaign analysis and training exercise should count weapon "expenditures." In general, the offense has an advantage over the defense by threatening to drain the defender dry of defensive weapons. The aforementioned Chinese Harpies are very low cost autonomous aerial vehicles whose purpose is to do just that.

One offensive missile can require several SAMs and point defense shots in response. Soft kill defense is the opposite: one chaff cloud may distract several incoming missiles. A seldom mentioned advantage of many small attacking combatants is to impose the need for the enemy to fire at many targets, expanding the number of apparent targets, especially if each defender deploys multiple decoys.[48] This is the same principle that made Multiple Independent Reentry Vehicles (MIRVs) such a complicating factor when defending against intercontinental or long range ballistic missiles. A swarm attack by small deadly surface vessels or unmanned aerial combat vehicles imposes similar problems of saturating defenders with targets that can consume all the defender's "bullets."

A good Measure of Effectiveness for ships that may come under attack and defend themselves is "maximum delivered firepower over the combat life of the ship." Thus, a dilemma. A big ship armed with many missiles so that it will not run out while defending itself will, if put out of action by an ASCM leaker, lose the use of all its other missiles not yet fired.

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Detection, Tracking, and Targeting

[47] In the Falklands War the opposite happened. A screening ship, HMS *Ambuscade*, operating automatically and doctrinally, fired chaff that deceived both of two approaching Exocets fired by Argentine Etenard aircraft. Its chaff protected the screening ship as intended, but with the unintended consequence that the Exocets sought another target and destroyed one of the ships being protected, the *Atlantic Conveyer*.

[48] The quantitative effectiveness has been calculated by this study's principal investigator, J. R. Kline, in *Exploring Effects of Countertargeting in Naval Warfare*, Naval Postgraduate School, unpublished essay, 2008.

For twenty years U. S. Navy forces of all descriptions have been able to take for granted air superiority on both sides of a coastline. Now against China we must expect a period of intense competition to achieve command of the air. Meanwhile surface naval forces will be confronted with new targeting challenges to attack effectively first. This is most evident inside the first island chain, and a principal reason why flotilla vessels are the only surface ships that should be risked while air ascendency is being contested.

Alternative scouting methods include helicopters and UAVs, submarines and UUVs at "periscope depth," USVs, and covert scouts that are masked to look like fishing boats or coastal traders. Big warships can neither be concealed at sea nor defend themselves without their electronic emissions being detectable at long range. But a distributed squadron of *Cushings* will be hard to detect in fishing fleets that usually ply their trade even in wartime. They can duck in and out from behind islands. They can camouflage under trees in inlets amidst the 10,000 or more islands that rim the China Seas, waiting for the right moment to shoot their missiles at long range, or venture forth to attack. Learning how to conduct time-sharing radiation plans or use decoys that radiate ostentatiously to first draw attention and then go silent—these will be part of the tactical development process in the flotilla, once it is built and deployed.

(b) (5) [redacted] Flotilla operations are particularly well suited for bi-static and multi-static search, in which one ship transmits radar pulses and the returns are picked up by the receivers of other ships that do not themselves transmit. The technology is at least 35 years old and should be easy to adapt.

We don't know what air war strategists believe about a war in the air with China. At its outset, the war *above* the sea probably will be so intense that surface surveillance by aircraft on both sides will be hampered. Flotilla operations will be hazardous, of course, but not to the degree that a CVBG or ESG will draw fire from Chinese missiles and aircraft. In worst case circumstances of near dominance by Chinese air, the flotilla would still be able to conceal itself for a substantial time, moving from inlet to inlet, and firing its long range missiles to harass Chinese shipping without venturing far offshore. The flotilla's first priority would often be to prevent Chinese amphibious ships from easy occupation of key islands and help protect the Marine outposts from attack.

Submarine Threats

We have disregarded submarines as a threat to high speed 500-ton missile craft partly because they are difficult and not very lucrative targets, and partly because we believe Chinese submarines will be intensely preoccupied with our own SSNs operating in their waters. This relative security from attack would not be true of our carriers and amphibious ships. Wherever they operate, until the Chinese submarine threat is reduced, big ships will require old fashioned screening of the kind not seen since Soviet submarines were a serious threat.

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Training and Tactical Competence

We quote from Mark R. Peattie's book, *Sunburst*, on the comprehensive subject of the Japanese navy's preparations for a war with the United States. Regarding the need to change swiftly from a battleship-centric fleet to a carrier-centric fleet in World War II, Peattie observed, "Although important consideration was ultimately given by the staff of the Combined Fleet to the problem of fleet air defense, too many years had been wasted in ignoring the problem to work out an effective air defense in the short time remaining before hostilities began. There were a number of reasons for this neglect. [One was] the importance of fleet air defense was given little serious study in the 1920s and 1930s because the navy's traditional obsession with offensive operations blinded it to all other considerations." One does not have to believe the U. S. Navy of today will shift to a more distributed fleet at the onset of a conflict to see that a flotilla, to be viable, must be trained and ready for both strike and self-defense.

Flotilla warfare requires unique skills, with many variations depending on the geographical location, enemy, and purpose. We have indicated some of these skills: exploitation of land masking and radar ducting, and concealment amidst fishing boats, inlets, small islands, or oil rigs. We believe, however, that it will be easier to train to and perform one or two narrowly focused functions expertly, as the Israeli navy did before the 1973 War.

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- [redacted]

Sea battles, once the missiles fly, are essentially maneuver-free. A 21st Century fleet must fight in the formation it's in. Combat "maneuvering" is embedded in the high speed missiles and the strike aircraft.[49] Tactical maneuvering by warships takes place during the scouting phase of the battle.

Gun duels may occur. In the 1973 War, when the Egyptian *Osa's* and *Komar's* salvoed all their SS-N-2 Styx missiles to no effect they turned and fled. An Israeli friend said that that was probably a bad decision. If they had closed at maximum speed, some might have survived the dash and done some harm with guns before being sunk. As it was, the tail chase with a five knot closing speed gave the Israeli *Sa'ar* boats the time to aim carefully for maximum effect. When retired Admiral Arleigh Burke was given a tour of his namesake, the DDG-51, he was asked if there was anything in the design he would have changed. Reportedly he said, yes, he would have liked to see a brace of cutlasses in the wardroom. More than likely he was reminding his listeners of his experience in the short range battles in the upper Solomons, battles that were full of surprises and fought at close range.

As was the purpose of a *guerre de course*—a guerilla war at sea—in the past, the purpose of the flotilla and Marine outposts in wartime is to impose unsafe regions in China's own home waters. Precisely to the extent that China threatens to deny access we would threaten to deny it access, creating a no man's land that disadvantages China far more than any other state or commercial enterprise.

Summary

Building and deploying a flotilla of 64 or more small missile combatants is the single most promising way to quickly enhance *surface warfare* capabilities against China.

- It is requires a very low cost, very low risk procurement decision.
- Teaming with LCS will give the *Cushings* air reconnaissance in peacetime and for edge-of-war operations.
- A variety of scouting modes are possible, should war ensue.
- The Marine outposts will be a powerful, multifaceted manifestation of expeditionary warfare, leading to new modes of cooperation and coordination between Marine detachments and new Navy ships, representatively LCS, JHSV, and flotilla vessels.

[49] Tactics, operations, and strategy will all be affected greatly by which side is ahead in the battle for control of the air space. Failure to achieve air superiority will have major implications that far exceed concern for the flotilla's survival.

CHAPTER 6 FIFTEEN FINDINGS AND ONE CONCLUSION

1. The U. S. Navy is peerless at designing and operating multi-mission blue water ships. But for green water, we must understudy the best designs and tactics of the best foreign coastal navies. The time it takes to match their capabilities is not the time to build the ships. It is the time needed to train the force for operations in peace and develop effective tactics for war. Our navy ought to move quickly to develop first generation designs, capabilities, and combat tactics that are integrated with scouting methods.

2. A(b) (5) [redacted] A fleet of 64 is, we suggest without proof, about right as a low-cost critical mass. Its steady state cost requires only 2% of the published future annual SCN, even assuming replacement after a short 15 year service life.

3. The U. S. Navy doesn't need to *improve upon* the best foreign designs. The first generation *Cushings* we espouse (of 500 tons, carrying eight offensive missiles, a dozen or more short range missiles, extensive soft kill defenses, and a 57 mm gun) will be similar to the best missile combatants of other navies.

4. There are alternatives to 500-ton vessels *Cushings.* We chose one class of 500-tons initially because this size can be fought with a small crew; it will be offensively potent; it can be sent without hesitation in harm's way; it can be abandoned when put out of action, saving the small crew;(b) (5) [redacted] With experience, our operating forces can recommend better second and third generation designs.

5.(b) (5) [redacted]. The flotilla, once built and deployed, will operate conjointly from the same wartime locations in mutual support between flotilla and Marine detachments. Peacetime engagement activities with friendly states should be conducted now to anticipate combined occupation of these key outposts and to confirm U. S. intentions to stay the course in East Asia. It is far easier to defend an island outpost than to take it after it has been occupied by the enemy who has built up its defenses.

6. One or two flotillas would be a valuable presence in the Persian Gulf. Flotilla vessels are also much more suitable than large blue water ships for operations in other *cul de sacs* around the world, for example in support of South Korea in the Yellow Sea; Georgia, Turkey, Rumania, and Bulgaria in the Black Sea; Israel in the Eastern Mediterranean: or Sweden, Finland, and other states in the Baltic.

7. If past experience is a reliable guide, deployment of flotilla ships to a theater of operations will pose few challenges. The vessels can deploy themselves without refueling at sea. On special occasions a squadron of eight might be carried to the desired location by one leased large commercial carrier ship. Deployment will not be a significant constraint on flotilla freedom of action.

8. Sustainment is very theater dependent. We suggest that(b) (5) [redacted]. For patrolling off Africa, tender support is indicated. For the

European theater, existing U. S. bases or quickly established host nation support will serve. For Latin America either tender or host nation support is indicated.

9. Sea keeping is not an issue. Throughout history, inshore coastal combatants have exploited foul weather and dark of night for concealment and stealthy approaches. Then the small vessels needed to close to torpedo or gun range; now a modern flotilla often can lurk in sheltered waters, attacking with its long range missiles.

10. An element that begs for development is the best way to conduct theater-specific scouting (or "ISR"). A flotilla opens up new opportunities and scouting methods for reporting enemy movements, from small innocent looking "coastal traders," up to sophisticated unmanned vehicles. The availability of aerial reconnaissance—or satellites—cannot be taken for granted at the onset of hostilities, but small combatants will be more adaptable in these uncertain conditions.

11. Command and control is also wide open for development for missile combat. Combat doctrine and training to fight under highly disciplined, often-silent, minimum-control conditions is indicated. Paradoxically, a dispersed fleet of many small combatants conducting offensive strikes needs less electronic radiation (radar and radio) than does a carrier battle group or expeditionary strike group, neither of which can perform its mission without radiating intensely.

12. Defenses, whether for large blue water warships or flotilla-sized ships, will require continuing attention as ASCMs and TBMs become hotter. A realistic appraisal of leaker probabilities is vital. For potential conflicts with a small number of states, the possibility of running out of missiles is real, whether the danger is for individual ships in battle, for individual task forces, or for the entire fleet. Large numbers of small combatants dilute an enemy attack and force him to increase his missile expenditures. USVs and other decoys may be the most effective future countermeasures to reduce the hazard of being sucked dry of defensive missiles.

13. Small combatants are an excellent hedge against an adversary's tactical or technological surprises, once a cadre of officers and sailors has been trained to exploit new capabilities and counter the enemy's.

14. Because flotilla operations are so dependent on region and threat, the single most important Navy decision will be to establish a flotilla type command under a senior admiral to pursue combat readiness anywhere. The command is necessary to:

- foster sound designs;
- develop an experienced corps of officers and enlisted professionals;
- cooperate with special forces and Marine detachments;
- develop theater-specific training, support, and reconnaissance;
- collaborate with the blue water fleet;
- engage international partners at the most important locations around the world.

15. We believe a flotilla is not necessary for the U. S. government to announce a new national strategy of "offshore control." But the flotilla, once built, will quickly become the force component that competes

most directly with China's surface fleet. In some circumstances it may be our first choice to confront Chinese maritime hegemonic ambitions, in peace and war.

Conclusion

It is hard to imagine another U. S. defense program so well-hedged with fall backs and replete with possible extensions. The small missile combatants are easy to design, entail no new technologies in the first generation, are quickly built, and are eminently affordable. Mistakes made will quickly be uncovered in operations at sea. More contractors can compete and change orders need not lead to cost growth. If the flotilla fails to contribute to influencing and constraining China, it is still useful in the Yellow Sea, Persian Gulf, Black Sea, and other *cul de sacs.* Offshore balancing does not *depend upon* a successful flotilla as it did for our imaginary Admiral Grant in the Battle of the Aegean. Marine outpost development has no dollar costs except for the small one to adapt surface-to-surface missiles for land-to-sea warfare. Unless the *Cushing* designs are utter failures, international sales and foreign aid will hasten cost reductions and other improvements. Ship design changes as radical as 200 ton *Phantoms* or enlarged *Sea Shadow* stealth-ship designs of about 1,000 tons are alternatives, should *Cushings* somehow be the "wrong size."

Risks seem far-fetched but must be mentioned. Junior officers may not wish to stake their careers on becoming experts at littoral warfare. NAVSEA construction standards for big warships, such as for damage control and habitability, must not be mindlessly applied. Flotilla ships might unimaginatively be seen as a threat, rather than as a complement, to` LCS designs. Logistical support might be hampered by a Pentagon proclivity to program one solution to fit all circumstances. Pressure for traditional large multipurpose ships might inappropriately distort the streetfighter concept by burdening *Cushings* with expensive complexity, excessive automation, and an attitude that no ship can be lost in battle.

APPENDIX A: THE SALVO EQUATIONS: THEIR STRUCTURE AND APPLICATIONS

The basic mathematical equations described in words in Chapter 2 are as follows:

$$\Delta B = \frac{\alpha A - b3 \quad B}{b_1} \qquad \alpha = a_2 P_{ha}$$

$$\Delta A = \frac{\beta B - a_3 A}{a_1} \qquad \beta = b_2 P_{hb}$$

A, B = the number of combat units

a_1 , b_1 = the number of hits to put a unit out of action

a_2 , b_2 = the number of shots/ship-salvo

a_3 , b_3 = the number of enemy shots eliminated/ship

P_{ha} , P_{hb} = the probability a shot is well-aimed and can hit

Many embellishments have been added by different users. The most important ones are probably:

- A coefficient, σ, attached to the first, attacker-effectiveness, term is a number between 0 and 1 indicating the scouting effectiveness of A in locating and targeting all of B's forces. In practical application, a zero indicates an undetected enemy who will conduct a first attack before A can launch a salvo. Otherwise most analyses assume full effectiveness with all enemy taken under fire.
- A coefficient, τ, attached to the second, defender-effectiveness, term is also a number between 0 and 1. A value of one indicates a fully ready defensive force, illustrated by the Israeli *Sa'ar* boats in the 1973 Arab-Israeli War. A value of zero indicates complete surprise, illustrated by HMS *Sheffield* and USS *Stark* that failed to defend themselves.

Another powerful insight is how to reflect the state of training of a warship. We believe that one simply adds a coefficient to the first and the second terms in the numerator, both numbers taking values between zero and one. It tells the fleet that insofar as *combat readiness* is concerned, training effectiveness involves only two things: full readiness to attack the enemy, and full readiness to defend the ship by all means available. This seems a straight-forward and valuable insight. One might argue that a damage control training coefficient belongs next to a_1 in the denominator. As a former Damage Control Assistant, author (b) (5) doesn't think so. Staying power is a measure of how much ordnance it takes to put the ship out of action, not to sink it, and damage control is principally concerned with keeping a crippled ship afloat, or after a period often measured in hours restoring it to combat ready status.

The reader should not infer that the equations have much power to predict the outcome of a future engagement. The power comes from the general conclusions, such as those in Chapter 2, that can be determined by parametric analysis. On the other hand, quite important and valuable have been many efforts to determine how well the equations "predict" actual results of past battles when the two forces are

known ex post facto, as well as who fired first and with how many missiles—what is called the model validation process in the jargon of operations research. It would take a lengthy discourse to describe the tests and their results in detail, but it is fair to say when departures occurred between "predicted" and actual outcomes the differences could be explained. None of the tests challenged the major conclusions of parametric analysis, e.g., that force numbers are the most important single property of a fleet in combat, and that running out of defensive firepower is a significant concern for a fighting force.

SELECT SALVO EQUATION TESTS, APPLICATIONS, AND EMBELLISHMENTS

LT Thomas R. Beall, *The Development of a Naval Battle Model and Its Validation Using Historical Data,* NPS thesis, March 1990. Data from fourteen historical naval battles were gathered to compute model input parameters for the opposing forces and their interactions. Salvo model results were compared with historical outcomes. The conclusion is that a salvo model is a fair representation of reality. But the after-the-fact "predictive power" of this or other combat models he tests depends on knowing the actual input parameters for the battle after the battle is over, so that its actual facts, e.g., open and cease fire times, can be used as inputs.

LT Jeffrey R. Cares, *The Fundamental of Salvo Warfare,* NPS thesis, March 1990. Cares used the then-popular NAVTAG war game as "the real world" and compared simulation results with salvo equation results. He arrived at conclusions similar to T. R. Beall's. To help understand the differences between salvo model predictions and simulation outcomes for identical inputs, Cares usefully defines and applies concepts like "combat entropy" and "the sump effect."

LT Epaminondas Hatzploulos, Greek Navy, *A Modern Naval Combat Model,* NPS thesis, September 1990. In addition to amplifying the salvo equations as validated by Beall and Cares, the thesis shows how to introduce human factors that affect combat outcomes, namely alertness, leadership, morale, and training.

LT Ray L. Snell, *Countertargeting in Modern Naval Combat,* NPS thesis, March 1991.The first adaptation of the salvo model for exploring air attacks on warships. Explores the effect of jamming and decoys on aircraft attack effectiveness quantitatively, aided by the RESA wargaming system.

LT Timothy T. Smith, *Combat Modeling Low Intensity Conflict Anti-surface Warfare for Engagement Analysis,* SECRET NPS thesis, March 1991. Examines the threat of missile-carrying FPBs to shipping in coastal waters escorted by FFG-type surface combatants. The results are classified, but the unclassified conclusion emphasizes the importance of outscouting the FPB enemy in order to attack him effectively first.

Wayne P. Hughes, Jr., *The Value of Warship Attributes in Missile Combat,* NPS Technical Report NPS-OR-93-001, Oct 1992. Traces the evolution of force-on-force combat at sea since 1900 and the parallel need to evolve different models. With parametric analysis alone, reaches important conclusions, some of which are described in Chapter 2.

LCDR Dimitrios Sakellariou, Greek Navy, *The Effect of Staying Power on Offensive and Defensive Power of a Modern Warship,* March 1993. Determines the non-linear quantitative relationships between offensive power, defensive power, and staying power.

LT Adrianos M. Poulos, Greek Navy, *An Anti-air Warfare Study for a Small Size Navy,* NPS thesis, March 1994. Uses the salvo equations to reach practical conclusion about formation design for a small navy that must fight in littoral waters.

LT John C. Schulte, *An Analysis of the Historical Effectiveness of Antiship Cruise Missiles in Littoral Warfare,* NPS thesis, March 1994. A compendium of all known missile attacks, Schulte's results are summarized in Chapter 2.

Wayne P. Hughes, Jr., *The Military Worth of Staying Power,* CONFIDENTIAL NPS Technical Report, May 1994. Using a hypothetical 10% ASCM leaker rate in littoral waters, shows the great advantage and desirability of increasing the staying power of modern missile ships, using the MOE, "Maximum delivered combat power over the combat life of the ship." Because of the constant need for instant reaction, the study then hypothesizes an attack when the defender is not fully alert and the first two incoming missiles have higher leaker probabilities. The unstated implication of the results is that many more small combatants are as effective or more so in attenuating attacks than a few big combatants unless the latter's staying power against missiles can be greatly increased.

LT John McGunnigle, *Information on Information: Comparing the Military Values of Force Advantage and Information Advantage,* NPS thesis, December 1999. Uses several techniques including a stochastic version of the salvo equations. An interesting conclusion is that student officers tended to overestimate the value of information's effect on outcomes, when compared with the value of more firepower.

LT Michael D. Johns, *Heterogeneous Salvo Model for the Navy After Next,* NPS thesis, December 2000. Johns develops the equations in matrix format so that different force combinations can be explored explicitly. The expanded model has not often been applied because of the difficulty in obtaining inputs.

Michael J. Armstrong, "Effects of Lethality in Naval Combat Models," in *Naval Research Logistics,* February 2004. An exploration of the full range of offensive versus defensive powers. Shows that swings from no losses to total losses of forces can be abrupt when offense power dominates defensive power per ship. Armstrong has followed with several other insightful papers applying the salvo equations, and has established a Wikipedia websight called Salvo Combat Models.

LT Chase D. Patrick, *Shared Self-defense Policies for Surface Combatants Against ASCMs,* NPS thesis, December 2000. A thoughtful look at a neglected tactical factor in the missile age.

Professor Jeffrey R Kline: "Exploring Effects of Countertargeting in Naval Warfare," Naval Postgraduate School, unpublished essay, 2008. Shows the explicit quantitative value of each decoy protecting a warship. Number of warships are more valuable but the low cost of decoys make them very attractive.

LT Dylan B. Ross and LT Jimmy A. Harmon, "A New Navy Fighting Machine in the South China Sea," June 2012. Approached thru the lens of the salvo equations in order to demonstrate how American surface combatants can confront and attenuate PRC anti-access and area denial measures. Explores new ways to maintain situational awareness, tactical communications with submarines, and better emissions control measures for a flotilla or any other U. S. surface combatants.

Two open source translations and appraisals of the Salvo Equations that appear in Chinese literature:

Xu Xiaoming, Ren Yaofeng, and Fend Wei: “Analysis of Warfare Loss of the Surface Missile Combatant Based on Salvo Model,” Naval University of Engineering, Wuhan 430033, China, 2010

Wu Jun, Yang Feng, Cheng Yong-mei, Pan Quan: “Land-Sea Combat Model for Littoral Engagement in High-Tech Warfare,” College of Automation, Northwestern Polytechical University, Xi’an 710072, China, 2011

APPENDIX B: REAL AND IMAGINED *USS CUSHINGS* IN HISTORY

Designator	Years Service	Displacement	Speed	Crew	Principal Weapons
TB-1	1890-1920	120 tonsFL	23 kts	22	3 torpedoes, two guns

Served in the Cuba blockade in 1898, operating out of Key West

DD-55	1915-1936	1,200 tonsFL	28 kts	98	8 torpedoes, four 4-in guns

Served on East Coast, Irish Coast, and French Coast before returning to New York after WWI

DD-376	1936-1942	1,500 tonsSTD	36 kts	158	12 torpedoes, four 5" guns

Served across the Pacific, including the search for Amelia Earhart in 1937. Sunk in the First Night Battle of Guadalcanal, 13 November 1942. Lost: 70 officers and men

DD-797	1944-47	2,300 tonsSTD	38 kts	273	10 torpedoes, five 5-inch guns

Commissioned in 1944, served in Western Pacific, mothballed, and recommissioned for Korean War

DD-797	1951-1960	2,900 tonsFL	35 kts	same	5 torpedoes, five 5-inch guns

Sailed from San Diego to Norfolk, Norfolk to Korea and returned around the world. Then operated in Med, in an Atlantic HUK group, etc. Sold to Brazil 1961, renamed *Parana* D-29, scrapped 1982.

DD-985	1979-2005	9,200 tonsFL	32 kts	334	6 Harpoons, two-5" guns[50]

USS *Spruance*, nameship of the class, was designed to displace 8,100 tons but with room for growth. USS *Cushing* carried Tomahawk land attack missiles and Kevlar armor was added to protect vital places. She was the last *Spruance* to be decommissioned.

Imaginary Missile Combatants

"Streetfighter"	2000[51]	1,200 tons	??	??	Harpoons, RAM, soft kill, decoys
***"Cushing* 1"**	1985-2000	800 tons	32 kts	60	8 Harpoon 2's

Cushing is the name ship of the class that destroyed the Soviet Mediterranean Fleet in the imaginary Second Battle of the Nile, 1 August 1998. It also "fought" in the "Battle of the Aegean.

***"Cushing* 2"**	not yet built	500 tons	30 kts	12 or 24	8 ASCMs, 57mm gun, soft kill

[50] Plus 2 CWIS, 8 ASROC, 6 torpedo tubes with reloads, 8 Sea Sparrow, 1 RAM launcher, 2 SH-60
[51] Characteristics of the Design in "22 Questions for Streetfighter" *Naval Institute Proceedings*, Feb 2000

Word Count: 17,300 (Chapter 1's extract not counted)