CONTRIBUTIONS TO NAVAL HISTORY NO. 10

THE U.S. NAVY AND INNOVATION

Twentieth-Century Case Studies

Edited by Peter C. Luebke

FOREWORD BY

Secretary of the Navy Carlos Del Toro

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FOREWORD

We are entering a new era demanding a new maritime statecraft, one emphasizing coordination across the services and commercial maritime industries. This will demand unprecedented levels of understanding across disciplines, services, and sectors.

You hold in your hands a valuable resource. Each of us has a vital role, one only we can identify and execute to the fullest. Alfred Thayer Mahan, Earl Ellis, Theodore and Franklin Delano Roosevelt, Elmo Zumwalt, Victor Krulak, and Arthur Cebrowski stepped back from the minutiae of their desks to contemplate the bigger-picture uncertainties and challenges of their day; now it's your turn.

These thinkers often used historic case studies to map out the interplay of adversaries and partners, as well as the diverse mandates of U.S. institutions. With that in mind, the Naval History and Heritage Command crafted these chapters to help our generation of thinkers find models to explore today's evolving threat environment.

These chapters present some timeless themes to help diagnose and address uncertainties we face. They also drive us to ask important questions:

- Despite adopting new technology and adapting doctrine to match it, forces can still fall short applying them in the field. *In the wake of battlefield failures, how can leadership best learn and move forward? Upon recovery from a setback, how can we best preserve and share ad hoc problem-solving?*
- Across generations, political, strategic, and technological compromises often force our hand when determining where to lead or to fast follow. *When is it best to invent something new or to adapt what we already have?* This process demands coordination and understanding.
- When innovation means a novel organization or a new expertise, sometimes units blending strengths of different backgrounds are the answer; sometimes unit cohesion demands familiar conventions and a shared identity. *Weighing these extremes, how can we best experiment and adapt in real time?*

- *How can we foster a collaborative mindset using patience, personal rapport, respect, and sincere curiosity about counterparts and their customs? How best to build trust with local civilian and military officials? How can we ensure each individual, ally, or partner contributes their full potential? When lacking advocates, how can personal perseverance and resilience reshape the situation?*
- *Looking ahead, how might victories in one warfare domain prompt counter-innovations in seemingly unrelated domains? And finally: how might today's diplomatic, informational, military, and economic (DIME) evolutions necessitate naval counter-innovations down the line?*

The Navy is again being called upon to interweave operational needs, strategic partnerships, and political imperatives to meet the demands of new forms of competition.

These questions are why great naval thinkers looked to their past. Your Navy is accountable to one of history's largest and most diverse democracies; your global mission is in many regards unparalleled. Thus, often, your past can be your own best case study.

As you proceed, use the resources of the Naval History and Heritage Command (including our network of Navy museums), National Museum of the Marine Corps, and both the Naval War College and the Marine Corps University. The mission of these institutions is to preserve and present an accurate history of their respective services, and these institutions exist so that you can draw upon the wealth of knowledge gained in the past to better execute your responsibilities today.

Carlos Del Toro
Secretary of the Navy

THE U.S. NAVY AND INNOVATION

Twentieth-Century Case Studies

INTRODUCTION

Peter C. Luebke

In his 2022 Navigation Plan, Chief of Naval Operations (CNO) Michael Gilday wrote, "History shows that the navy which adapts, learns, and improves the fastest gains an enduring warfighting advantage."[1] Today, the U.S. Navy has entered an era of renewed great power competition following a generation-long focus on insurgency and counterterrorism operations in Iraq, Afghanistan, and the Middle East. The challenges posed by peer and near-peer competitors differ widely from those the Navy confronted during the global war on terrorism, requiring the Navy to adapt, learn, and improve at a pace not seen since the end of the Cold War.[2] In other words, the Navy must innovate to confront old adversaries who possess new capabilities operating across the full spectrum of domains. As CNO Gilday suggests, history holds lessons for today. Hence, the present volume, which provides a series of case studies on U.S. Navy–led innovation in the twentieth century.

Innovation, at its heart, means finding a new or more efficient way of doing something and then effectively implementing that change.[3] Within

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[1] Michael M. Gilday, *Chief of Naval Operations Navigation Plan 2022* (Washington, DC: Department of the Navy, 2022), 1, https://media.defense.gov/2022/Jul/26/2003042389/-1/-1/1/NAVIGATION%20PLAN%202022_SIGNED.PDF.

[2] Successive CNOs have emphasized the importance of a strategic focus on great power competition, as well as the urgency for the Navy to address this competition through innovation. See John M. Richardson, *A Design for Maintaining Maritime Superiority, Version 1.0* (Washington, DC: Department of the Navy, 2016), https://apps.dtic.mil/sti/pdfs/AD1002755.pdf; Richardson, *A Design for Maintaining Maritime Superiority 2.0* (Washington, DC: Department of the Navy, 2018), https://media.defense.gov/2020/May/18/2002301999/-1/-1/1/DESIGN_2.0.PDF; Gilday, *FRAGO 01/2019: A Design for Maintaining Maritime Superiority* (Washington, DC: Department of the Navy, 2019), https://media.defense.gov/2020/Jul/23/2002463491/-1/-1/1/CNO%20FRAGO%2001_2019.PDF; and Gilday, *CNO NAVPLAN*, *January 2021* (Washington, DC: Department of the Navy, 2021), https://media.defense.gov/2021/Jan/11/2002562551/-1/-1/1/CNO%20NAVPLAN%202021%20-%20FINAL.PDF.

[3] Jon T. Hoffman, ed., *A History of Innovation: U.S. Army Adaptation in War and Peace* (Washington, DC: U.S. Army Center of Military History, 2009), 1.

large organizations, that also means incorporating each innovation into bureaucratic and administrative systems, ensuring not only its adoption, but also its dissemination throughout the system, with corresponding changes to policy, doctrine, and procurement.[4] Although the Navy's experience with developing and fielding new technologies and doctrines spans the entirety of its history, the accelerated pace of technological change in the twentieth century makes it a useful era to seek lessons from the past.

Sir Herbert Richmond, a British admiral and authority on naval policy, once commented, "Our neglect to use History as a means of fostering the imaginative & deductive sides of our minds are at the root . . . of our failure to visualize the progress of the war in advance."[5] Though Richmond wrote these words about World War I, they hold true today. The chapters in this volume aim to facilitate those "imaginative & deductive sides" rather than derive a proscriptive framework for innovation. After all, there are a plethora of books and articles devoted to charting out the "rules" of innovation and how to incorporate those precepts within an organization.[6] Moreover, the sheer volume of existing literature on fostering innovation and the diverse perspectives they offer suggest those sets of rules might defy simple description

[4] For a study on naval learning, see Trent Hone, *Learning War: The Evolution of Fighting Doctrine in the U.S. Navy, 1898–1945* (Annapolis, MD: Naval Institute Press, 2018). For a study of technological naval innovation, see Vincent P. O'Hara and Leonard R. Heinz, *Innovating Victory: Naval Technology in Three Wars* (Annapolis, MD: Naval Institute Press, 2022). Essays on the interplay between technology, institutions, and strategy within the context of innovation can be found in Alessio Patalano and James A. Russell, eds., *Maritime Strategy and Naval Innovation: Technology, Bureaucracy, and the Problem of Change in the Age of Competition* (Annapolis, MD: Naval Institute Press, 2021).

[5] Herbert Richmond to Arthur Joseph Hungerford Pollen, 27 March 1916, quoted in Daniel A. Baugh, "Admiral Sir Herbert Richmond and the Objects of Sea Power," in *Mahan Is Not Enough: The Proceedings of a Conference on the Works of Sir Julian Corbett and Admiral Sir Herbert Richmond*, ed. James Goldrick and John B. Hattendorf (Newport, RI: Naval War College Press, 1993), 15n5.

[6] For examples of these kinds of books, see Steve Brown, *The Innovation Ultimatum: How Six Strategic Technologies Will Reshape Every Business in the 2020s* (New York: Wiley, 2020); Peter J. Denning and Robert Dunham, *The Innovator's Way: Essential Practices for Successful Innovation* (Cambridge, MA: MIT Press, 2010); and David S. Weiss and Claude Legrand, *Innovative Intelligence: The Art and Practice of Leading Sustainable Innovation in Your Organization* (New York: Wiley, 2011).

or easy implementation. Thus, instead of offering a guide on how to innovate in the abstract, this volume will instead illustrate how the U.S. Navy went about innovation in the past. By applying history in this manner—to guide readers along a narrative of how naval professionals thought through and creatively addressed problems—the authors of these case studies aim to stimulate and encourage imaginative thought among naval professionals today.[7]

This volume represents a collective effort by the Naval History and Heritage Command to share the stories of naval innovation and the innovators themselves amid the great power struggles of the twentieth century. The eight case studies that follow cover nearly the full span of the century, ranging from the naval arms race prior to World War I to the Navy's strategy renaissance of the 1980s. Presenting innovations achieved and implemented both during wartime and outside it, each case study includes examples of changes in doctrine and strategy. Several show the complex interplay between the two.

The collection opens with a discussion of significant change in the Navy at the start of the twentieth century. John E. Fahey describes the Navy's innovation of superfiring turrets and highlights the role that collaborative

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[7] Richard E. Neustadt and Ernest R. May pioneered the concept of applied history in the government with their now-classic *Thinking in Time*. In this book, the pair develop a series of history-informed heuristics for policymakers to use today with decision-making. The approach suggested here by me, drawing upon Admiral Sir Herbert Richmond, among others, uses historical case studies as a tool in which to exercise critical thinking. The parallax created between the process of reading the narrative of the past and the lived experience of the current practitioner within the Navy should create cognitive space to facilitate better decision-making. Put differently, the rules and conventions of historical writing create a structured thought process that can yield insight, regardless of any perceived direct applicability to a current problem, much in the way that a war game encourages thought even though no naval officer today will command HMS *Lion* at Jutland. See Neustadt and May, *Thinking in Time: The Uses of History for Decision-Makers* (New York: Free Press, 1986); Jon Tetsuro Sumida, *Inventing Grand Strategy and Teaching Command: The Classic Works of Alfred Thayer Mahan Reconsidered* (Baltimore: Johns Hopkins University Press, 1999); Sumida, "The Relationship between History and Theory in *On War*: The Clausewitzian Ideal and Its Implications," *Journal of Military History* 65, no. 2 (April 2001): 333–54; Sumida, *Decoding Clausewitz: A New Approach to "On War"* (Lawrence: University Press of Kansas, 2008); and Daniel L. Kuester, "Naval War College Reenacts Jutland Wargame," U.S. Naval War College, 11 May 2016, https://usnwc.edu/News-and-Events/News/Naval-War-College-reenacts-Jutland-wargame.

professionalization played in achieving innovation in spite of the Navy's convoluted and contested ship design and construction process.

The next four essays show the Navy innovating during wartime. Martin R. Waldman writes on organizational innovation, as Admirals Jesse Oldendorf and John H. Hoover worked to develop an effective joint and combined command structure that could address Germany's U-boat threat in the Caribbean during the opening days of World War II. Nicholas K. Roland and Guy J. Nasuti both consider how the Navy had to adapt to Japanese tactics during the island-hopping campaigns in the Pacific. Roland covers innovation in naval surface gunfire support during amphibious landings, while Nasuti charts the advent of underwater demolition units. Rounding out the World War II topics, Shawn R. Woodford describes a cycle of innovation to counter Japanese kamikaze suicide attacks during the closing days of the war.

The final three essays consider Navy innovation after World War II. Peter C. Luebke discusses local innovation during a naval air campaign of the Korean War and suggests why that innovation remained limited. Regina T. Akers brings to the fore the role of the individual in innovation with her piece on Raye Jean Jordan Montague and also reminds readers that diverse backgrounds and experiences provide advantages in adaptation. Finally, Ryan A. Peeks describes innovation in Navy strategy, as the Navy in the 1980s changed course to meet the threat of a resurgent Soviet Union.

Taken together, the essays give relevant examples of how the Navy innovated during the twentieth century. As shall be seen, the exigencies and urgencies of war drove many of the innovations discussed in this volume. Unlike peace, war often brought more resources, a greater willingness to take risks, the intensification of active efforts to facilitate innovation both individually and institutionally, and the leveraging of new technology to drive innovation.

The following discussion questions will help professional readers through the essays:

- What institutional factors facilitated or impeded innovation? How did the Navy—as an organization—play a role in innovation?

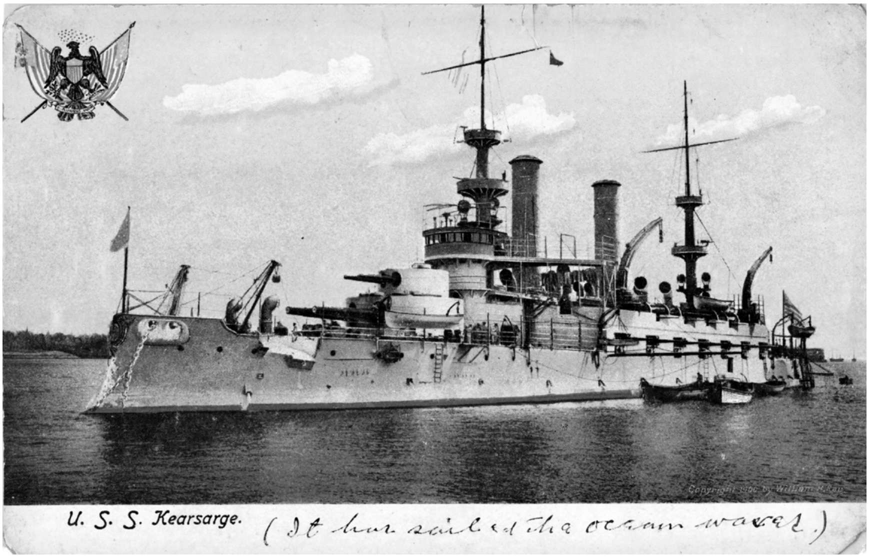
- What role did the individual play in innovation? Did innovation result from a single forceful personality, or did it come as part of a team effort?
- How did technology relate to innovation? Did new technology result from innovation, or did the introduction of a new technology drive innovation in practice?
- How does the concept of risk either facilitate or impede innovation?

CHAPTER ONE

Skeerd-o'-Nothin': Innovating Battleship Design in the Age of the Dreadnought

John E. Fahey

The United States ended the Spanish-American War with new imperial possessions in the Pacific, East Asia, and the Caribbean. Having emerged as a new player on the world stage, the nation now had to act the part of a great power to preserve its new territories. Among other changes to U.S. foreign and military policy, this shift meant a new naval policy and an expanded Navy. As the principal instrument of naval power at the time, battleships were a tangible status symbol overshadowing other ship classes in combat potential and prestige. Consequently, a cadre of reform-minded American officers, politicians, and naval enthusiasts pushed for more, and increasingly powerful, battleships in the first decade of the twentieth century. While the pre–World War I U.S. Navy did not lead the world in groundbreaking technologies or capital ship concepts like HMS *Dreadnought* (launched in 1906), its search for a better, more effective battleship led to fundamental improvements in naval design, such as an all-big-gun battleship, the placement of all main guns on the centerline, and the introduction of superfiring turrets. Such innovations, though implemented by Navy engineers, were derived from the initiative of midlevel officers and technological insurgents, debates in professional forums and service boards, and the influence of civilian authorities like the President and Congress. Though convoluted, contested, and imperfect, the U.S. naval construction process in the early twentieth century illustrates the critical role collaborative professionalization plays in naval innovation.



A postcard of *Kearsarge* (Battleship No. 5) from the early 1900s. Note the stacked arrangement of the forward turrets. (NHHC, NH 52031-KN)

U.S. naval innovation took place in the shadow of other great powers. The United States started its modern fleet in the 1880s, following a long period of naval neglect after the Civil War.[1] The Navy then joined a decades-long period of international naval competition prompted by new industrial technologies, assorted regional competitions, and naval enthusiasm around the world. The fleet's successful performance in the Spanish-American War contributed to a rise in the Navy's popularity nationwide and encouraged further investment in the fleet. In 1900, the U.S. Navy had 13 battleships in service or nearing completion, but that number rose to 26 by the autumn of 1905.[2] The United States was not alone in expanding its fleet. By 1905, the United Kingdom had built, or was building, 64 modern battleships; France, 33;

[1] For an interesting assessment of the U.S. Navy prior to the Spanish-American War, see Timothy S. Wolters, "Recapitalizing the Fleet: A Material Analysis of Late-Nineteenth-Century U.S. Naval Power," *Technology and Culture* 52, no. 1 (January 2011): 103–26.

[2] Norman Friedman, *U.S. Battleships: An Illustrated Design History* (Annapolis, MD: Naval Institute Press, 1985), 418–19.

Germany, 28; Italy, 18; and Japan, 16.[3] The United States followed standard practice at the time and gave its battleships a variety of gun calibers. Large guns, those of 11 inches in diameter and greater, provided long-range penetrating power, while secondary batteries of between 5 and 7 inches in caliber could produce a large volume of rapid suppressive fire. Although the smaller guns could not penetrate contemporary main armor, they could kill gun crews and destroy superstructures and funnels.

U.S. battleships differed from most other nations' capital ships by also carrying a set of intermediate guns, usually 8 inches in caliber.[4] Not main guns, they were designed to fire somewhat rapidly at long range in support of the main battery. These guns were the topic of some debate among naval architects. Although the caliber had proven useful in the Spanish-American War, it complicated U.S. ship design and gunnery. For example, *Kearsarge* (Battleship No. 5), commissioned in 1900, had an eclectic array of weapons—two turrets with two 13-inch guns, each superimposed with an additional turret carrying two 8-inch intermediate guns. This was supplemented by fourteen 5-inch guns in the broadside.[5] The idea was to provide greater forward firepower, but this design proved unwieldy as 8-inch shells for the topmost turret had to be lifted through the 13-inch turret, slowing

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[3] Laurence Sondhaus, *Naval Warfare: 1815–1914* (London: Routledge, 2001), 192. In addition, all of these countries had a number of coastal-defense battleships and monitors. The growth in battleship construction does not mean that battleships were universally seen as the marker of naval power. French admiral Théophile Aube's Jeune École advocated using swarms of torpedo boats to sink enemy capital ships, though by the 1890s, torpedo defenses, including the destroyer, had largely neutralized this school of thought. Torpedo-centered warfare would see a resurgence with effective submarines and destroyer flotillas early in the twentieth century. See Sondhaus, *Naval Warfare*, 139–60.

[4] Norman Friedman, "The *South Carolina* Sisters: America's First Dreadnoughts," *Naval History*, February 2010, 17–23.

[5] "Battleships," *Scientific American*, 7 December 1907, 408–10, 429–31. For more on *Kearsarge*, see Mark L. Evans and Paul J. Marcello, "*Kearsarge* II (Battleship No. 5), 1896–1955," Naval History and Heritage Command, last modified 12 December 2017, https://www.history.navy.mil/research/histories/ship-histories/danfs/k/kearsarge-ii.html.

the loading and firing of both sets of guns. Moreover, as both turrets turned as a unit, they were incapable of independent targeting.[6]

Though the *Illinois* class (commissioned in 1900) dispensed with intermediate guns, the *Maine* (1901), *Virginia* (1906), and *Connecticut* (1906) classes all carried eight 8-inch guns, in addition to four 12-inch main guns and more than a dozen secondary guns. These vessels carried their intermediate guns as chasers toward the bow and stern of the ship or as wing turrets amidships. There were many flaws with a mixed-caliber-gun battleship.[7] Magazine management was a nightmare given the guns' disparate effective ranges. Most significantly, accurate gunfire was extremely difficult with mixed guns. The simplest way for a ship to engage a target was to adjust fire depending on the splash of the preceding round. With multiple splashes from guns of different ranges and capabilities, adjusting fire was essentially impossible, a problem that had resulted in embarrassing gunnery during the Spanish-American War.[8]

Solving the problem of naval gunnery was complicated. It would take new firing techniques and also new ship design. The Navy's structure did not make these reforms easy. In the late nineteenth century, the Navy lacked any central coordinating staff outside of the Secretary of the Navy himself. Instead, the department was administered by a series of bureaus

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[6] Roger Chesneau, Eugène M. Koleśnik, and N. J. M. Campbell, *Conway's All the World's Fighting Ships, 1860–1905* (New York: Mayflower Books, 1979), 141.

[7] That is, beyond design and construction defects. For a lengthy discussion of the defects of America's Navy in the early twentieth century, see Henry Reuterdahl, "The Needs of Our Navy," *McClure's Magazine* 30, no. 3 (January 1908): 251–63. The article by Reuterdahl, a friend of William Sims, was a way for Sims to air his complaints with the Navy board system and ship design. The article precipitated a series of congressional hearings. See Elting E. Morison, *Admiral Sims and the Modern American Navy* (Boston: Houghton Mifflin, 1942), 182–200.

[8] Christopher B. Havern Sr., "A Gunnery Revolution Manqué: William S. Sims and the Adoption of Continuous-Aim in the United States Navy, 1898–1910" (master's thesis, University of Maryland, 1995), 5–19. U.S. gunnery at the Battle of Manila Bay was atrocious. Dewey's fleet managed only 142 hits after firing almost 6,000 shells against stationary Spanish ships at ranges of less than 5,000 yards. At the Battle of Santiago, Rear Admiral William T. Sampson's fleet managed a wretched 1.29 percent hit rate. While this was good enough to defeat the Spanish fleet, this performance boded ill for any war with a more competent naval power.

based on function, such as navigation, ordnance, steam engineering, and construction and repair. The chiefs of these bureaus met regularly as the Board on Construction to determine design and needs for new ships. These proposals were in turn evaluated by the Secretary of the Navy, who might or might not forward the requests to Congress. Congress then debated and usually appropriated funds, which might not even relate to what the Navy requested. After appropriation, the Bureau of Construction and Repair oversaw contracts and construction over the next several years as the ships were built. Frustrated by the Navy's inefficiencies during the Spanish-American War, President William McKinley created the General Board of the Navy in 1900 in order to coordinate force design, advise the Secretary, and create naval policy. The board's mission quickly grew to include ship design. However, the General Board had no formal authority over the bureaus, much less Congress, so its control over ships revolved around personal connections, persuasion, influence, the whims of legislators, and public opinion.[9]

While the General Board and bureaus certainly adapted and changed as technology rapidly advanced around the turn of the century, true innovation often came from younger officers like William S. Sims. An 1880 graduate of the United States Naval Academy, Sims made his name improving naval gunnery and was a prolific writer and experimenter on the topic. He also befriended other naval reformers. For example, Sims roomed with Homer C. Poundstone at the Naval Academy, with whom he later exchanged ideas on battleship design, and much later, impressed President Theodore Roosevelt with suggestions for refining fire control. Sims became inspector

[9] John C. Riley Jr. and Robert L. Scheina, *American Battleships, 1886–1923: Predreadnought Design and Construction* (Annapolis, MD: Naval Institute Press, 1980), 5–7. The General Board's influence came in large part from its well-respected chair, Admiral George Dewey. See also Scott Mobley, *Progressives in Navy Blue: Maritime Strategy, American Empire, and the Transformation of the U.S. Naval Identity, 1873–1898* (Annapolis, MD: Naval Institute Press, 2018).

of target practice in 1903, and he later served as Roosevelt's naval aide in 1907.[10] Roosevelt, Poundstone, and Sims all looked for ways to improve gunnery.[11] Officers like Sims were more than willing to give suggestions on how to develop better training, fire-control systems, and armament.

Faced with a convoluted appropriations process, U.S. naval officers leveraged professional publications like the U.S. Naval Institute's *Proceedings* and the *Army and Navy Journal* to advocate for reforms and improvements to the service. The Navy had only recently become a professional organization in the modern sense, a process paralleling developments in law, medicine, education, engineering, and other skilled fields. The Naval War College, the Office of Naval Intelligence, and journals like *Proceedings* were only a few decades old in 1900, and the General Board was a brand-new product of post–Spanish-American War reforms.[12] *Proceedings* was particularly important for communication and professional development, serving as the main way for naval bureaus to spread information and encourage dialogue between officers until well into the twentieth century.[13] These institutions

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[10] Morison, *Admiral Sims*, 102–5. Sims's relationship with Roosevelt started when Sims wrote the President a letter on the state of U.S. gunnery in 1901. Roosevelt responded by distributing Sims's reports and proposals throughout the fleet. Sims's system of continuous aim would eventually become the standard in the U.S. Navy. Roosevelt was an enthusiastic navalist, having written a naval history of the War of 1812, and saw the expansion of American naval power and reach as one of his administration's primary objectives. Carl Cavanagh Hodge, "A Whiff of Cordite: Theodore Roosevelt and the Transatlantic Naval Arms Race, 1897–1909," *Diplomacy & Statecraft* 19, no. 4 (2008): 712–31.

[11] President Roosevelt constantly weighed in on technical debates within the Navy. See Matthew Oyos, "Facilitator, Mediator, Dabbler: Theodore Roosevelt and Technological Innovation in the U.S. Navy," in *Forging the Trident: Theodore Roosevelt and the United States Navy*, ed. John B. Hattendorf and William P. Leeman (Annapolis, MD: Naval Institute Press, 2020), 127–48.

[12] Mobley discusses the growth of professions in the United States and the military in *Progressives in Navy Blue*, 58–65. See also John T. Kuehn, *America's First General Staff: A Short History of the Rise and Fall of the General Board of the Navy, 1900–1950* (Annapolis, MD: Naval Institute Press, 2017), 1–10; and W. H. Russel, "Seventy-Five Years of Progressive Naval Thinking," *Proceedings* 74, no. 10 (October 1948): 1251–61.

[13] Russel, "Seventy-Five Years of Progressive Naval Thinking," 1251–61. *Proceedings* also let naval officers participate in a cosmopolitan and international forum of ideas as it featured translated articles from around the world.

gave a space connected to, but separate from, the various bureaus for officers, administrators, and naval architects to debate reforms and shape public expectations of the Navy.

Many of these suggestions revolved around changing gunnery, armament, and ship design. For example, in 1902 Lieutenant Matt H. Signor published a proposal for "A New Type of Battleship" in *Proceedings* that advocated for a battleship with cruiser endurance and an armament of two triple 13-inch-gun main turrets, two waist-mounted triple 10-inch-gun intermediate turrets, and secondary batteries of 5-inch and 3-inch guns. Signor's proposed ship displaced 17,475 tons, at a time when the recently launched *Ohio* (Battleship No. 12) was a mere 13,000.[14] Signor considered using stacked or "superposed" turrets, arguing that the arrangement gave "a manifest superiority to guns so mounted," but preferred adding a third gun to the main turrets for simplicity's sake. While his proposal was not adopted, triple-gun turrets would eventually become standards of battleship design.[15] Signor's article prompted some discussion in *Proceedings*, including a comment by Naval Academy professor Phillip R. Alger. He opined that rather than a mixed battery, he "should prefer eight 12-inch guns," which may be the first published proposal for an all-big-gun ship.[16]

Meanwhile, Lieutenant Homer Poundstone experimented with ship armament in a series of battleship plans that would eventually apply Alger's suggestion. Poundstone had worked with ordnance for most of his early career.[17] In 1901, while sailing with Sims to Samar on *New York* (Armored Cruiser No. 2), Poundstone worked out several designs for possible U.S. warships. He called his initial proposal USS *Feasible*—a mixed-battery ship (four 11-inch guns, twelve 7-inch guns, and eight 9-inch guns), sized up

[14] Matt H. Signor, "A New Type of Battleship," *Proceedings* 28, no. 1 (March 1902): 1–8.

[15] Signor, "New Type of Battleship," 8; Friedman, *U.S. Battleships*, 51.

[16] Philip R. Alger, "Discussion: 'A New Type of Battleship,'" *Proceedings* 28, no. 2 (June 1902): 271. Alger was another longtime associate and confidant of Sims.

[17] D. R. Morris, "Homer Clark Poundstone and the All-Big-Gun Ship," *Proceedings* 74, no. 6 (June 1948): 711.

to almost 18,000 tons.[18] He made some improvements to the turrets and conning towers, but the design was fairly similar to earlier U.S. ships. His second design, USS *Probable*, involved upsizing the secondary armament in number and caliber to fourteen 9-inchers.[19] The next year, he sent a paper to President Roosevelt arguing that the Navy should upgrade its 8-inch guns to 9-inch guns. Roosevelt responded that he thought Poundstone's proposal was "excellent."[20]

Encouraged by the President's reaction, Poundstone published his paper on gun sizes in *Proceedings* in 1903. He used great power competition as the framework for battleship armament, asking, "Can our battleships of the Louisiana class meet the latest and best types of fighting ships from abroad and defeat them every time and all the time? Until an affirmative reply can be made to this query, we have not reached that all-around perfection of general design . . . for the first line-of-battle that we should attain, and to which the Congress and the country have a right to expect."[21] Poundstone suggested future battleships should upgrade the 8-inch guns to 9-inch, and that main guns should be 11-inch, starting the process of merging the main battery and the intermediate guns. These larger guns would be supplemented by a broadside of 7-inch guns. Poundstone wrote that this arrangement would be "reasonable, logical, practicable and feasible, and to be infinitely preferred to what is, apparently, now regarded as the highest attainable battery combination for our most powerful battleships."[22]

Although Poundstone's proposal for an upsized mixed-gun ship was published in 1903, by then he had already moved on to prefer a single-caliber

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[18] When Poundstone designed the *Feasible*, the *Virginia*-class battleship, displacing 15,000 tons, had just been approved.

[19] Morris, "Homer Clark Poundstone," 717.

[20] Theodore Roosevelt to Homer C. Poundstone, 27 December 1902, Theodore Roosevelt Papers, Library of Congress, in Theodore Roosevelt Digital Library, Dickinson State University, https://www.theodorerooseveltcenter.org/Research/Digital-Library/Record/ImageViewer?libID=o183827.

[21] Homer Poundstone, "Proposed Armament for Type Battleship of U.S. Navy, with Some Suggestions Relative to Armor Protection," *Proceedings* 29, no. 2 (June 1903): 409. *Louisiana* (Battleship No. 19) was a *Connecticut*-class battleship laid down in February 1903.

[22] Poundstone, "Proposed Armament," 387–97.

ship that he called USS *Possible*, which he wanted to be 19,000 tons and capable of 20 knots. *Possible*'s most notable feature, though, was its guns. Poundstone proposed arming the ship with twelve 11-inch guns distributed in six turrets—two centerline, two per side—as well as a battery of small torpedo boat defense guns. This innovative plan eliminated secondary and intermediate weapons, relying entirely on the long-range power of the main guns. Such an arrangement would simplify gunnery and enable the Navy's improvements in fire-control systems and practices to have full effect.[23] Eventually nicknamed the *Skeerd-o'-Nothin*, *Possible* was a revolutionary proposal.[24] Unfortunately, Poundstone was hospitalized in 1903 with a severe, and career-ending, case of arthritis, which prevented him from directly participating in further developments in naval architecture. He did, however, submit plans for *Possible* at the encouragement of Sims in 1904, when the General Board requested the Bureau of Construction and Repair to consider new battleship designs.[25]

Officers like Poundstone, Sims, and Signor constituted one of the great strengths of the U.S. Navy. Willing to propose and develop solutions to the Navy's problems, they pushed toward better gunnery and larger, more effective battleship design. As Sims later told Poundstone, "The Board of Construction has decided that the next [battleship] to be designed would have nothing but 12-inch and 10-inch in the main battery, and principally 3-inch in the secondary. The credit of this belongs largely to you, and you will get most all of it, if you get your papers in time."[26] Of course, these officers had support from high places, including President Roosevelt, but their initiative greatly helped the Navy. Once they had proposed improvements,

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23 Morris, "Homer Clark Poundstone," 707–21.

24 *Possible* got its nickname after a friend of Sims painted a mockup of the ship. After the launch of HMS *Dreadnought*, Sims named the painting *Skeerd-o'-Nothin*, a folksy Americanization of *Dreadnought*. Morris, "Homer Clark Poundstone," 720. See also H. C. Poundstone to H. A. Baldrige, 25 December 1939, folder FlCm.016.0686, Naval Academy Museum Archives, Annapolis, MD.

25 Morris, "Homer Clark Poundstone," 711, 718.

26 Quoted in Morris, "Homer Clark Poundstone," 718.

the next step was to persuade the boards and professional forums, along with performing endless rounds of testing, modification, and improvement.

The time was right for Poundstone's design as naval experts and enthusiasts were warming to the idea. In 1903, Italian admiral Vittorio Cuniberti wrote an article in *Jane's Fighting Ships* calling for an all-12-inch-gun ship fast enough to hunt down cruisers and strong enough to kill battleships.[27] Once the idea was out, naval institutions began to examine it. The concept of an all-big-gun ship was discussed at the Naval War College's 1903 Newport summer conference, and in October, the General Board asked the Bureau of Construction and Repair to conduct a feasibility study on an all-big-gun ship. The bureau ignored the request, even after the General Board repeated it in January 1904, but eventually designed a ship with a mixed 12-inch and 10-inch battery in September 1904. Unfortunately, its proposed mixed battery would not significantly simplify gunnery.[28] President Roosevelt got involved in October, asking Sims for advice on all-big-gun ships. Sims assured him, "The great majority of our naval officers who interest themselves in such matters have long since been convinced that this is the only logical battery for a fighting vessel." Roosevelt then sent a memorandum to the Bureau of Construction and Repair advocating for an all-big-gun ship, which the bureau avoided by asking for more time to consider such a change.[29]

As the bureau took its time, events in Asia drove home the importance of an up-to-date navy. In 1904, the world watched as Russia and Japan, both of which had modern battleships, went to war. Prompted by fears of Russian encroachment on Japan's sphere of influence in East Asia, Japan launched a surprise attack on the Russian fleet at Port Arthur in February. This initial Japanese attack relied on destroyers, disappointing battleship enthusiasts. *Scientific American*, describing the lessons of the Russo-Japanese War as of May 1904, wrote, "What naval men are hoping for is that there may yet

[27] Vittorio Cuniberti, "An Ideal Battleship for the British Fleet," *All the World's Fighting Ships*, 1903.

[28] Norman Friedman, *U.S. Battleships*, 55. The General Board had a complicated relationship with the other naval bureaus. Although it theoretically directed naval development, it had no direct control over the bureaus. See Kuehn, *America's First General Staff.*

[29] Quoted in Morison, *Admiral Sims*, 160–62.

be a fleet engagement in which the battleship will be given an opportunity to demonstrate its powers of attack and defense."[30] This wish was granted at Tsushima on 27–28 May 1905, where Admiral Heihachirō Tōgō's forces sank or captured 11 Russian battleships, killing over 5,000 Russian sailors and capturing another 6,000, while losing just three torpedo boats.

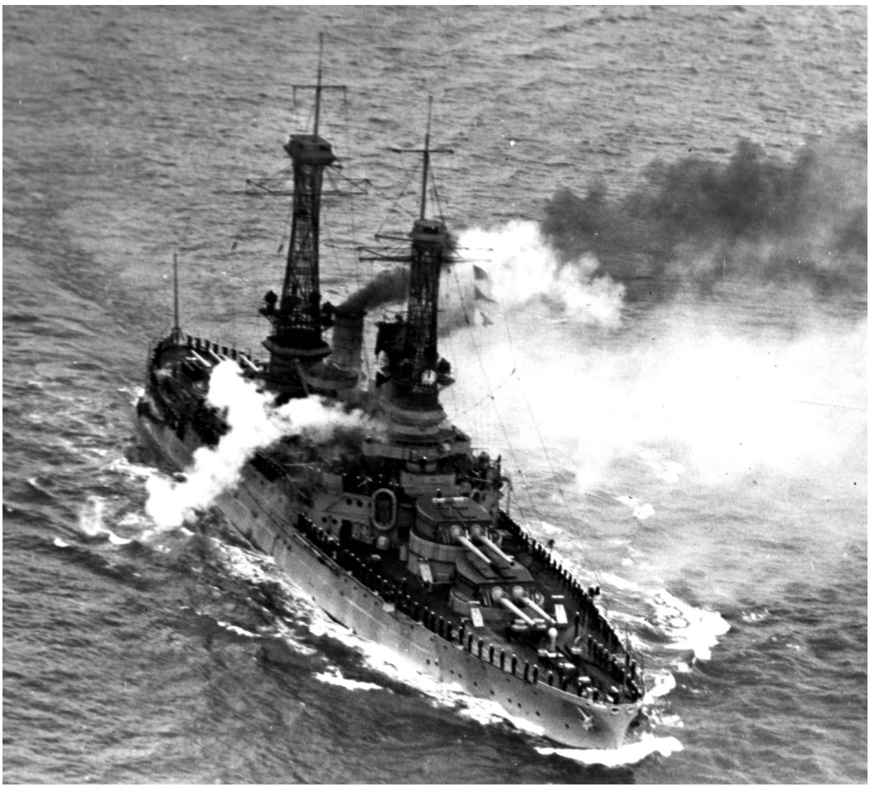
The Russo-Japanese War was a powerful lesson on the importance of effective ship design and gunnery, and it encouraged naval development around the world.[31] On 3 March 1905, Congress passed a naval authorization bill for two battleships that became *South Carolina* (Battleship No. 26) and *Michigan* (Battleship No. 27). Though the General Board and Sims's insurgents wanted these ships to be as large as current European models, a fiscally minded Congress limited vessels to 16,000 tons, the same maximum set for the previous *Connecticut* class. This created a problem for Rear Admiral Washington L. Capps, chief of the Bureau of Construction and Repair. Capps had been convinced that all-big-gun ships were the way forward, but was constrained by the ships' approved tonnage. While previous all-big-gun designs placed a number of one- or two-gun turrets on each side, *South Carolina* would be too small for more than eight total 12-inch guns. Thus limited, Capps decided on a radical new approach—placing all four of the ship's main gun turrets along the centerline. Capps's design elevated the rear turret in each pair, enabling it to fire over the bow and stern, respectively. Though this seems natural, superfiring was an innovative setup, finalized only after tests on *Florida* (Monitor No. 9) on 6 March 1907 proved that the format would not damage the ship.[32] Superfiring turrets had many advantages for space allocation, firing arcs, and efficiencies, but forced some changes in the placement of the turrets' gunsights. This new superfiring, centerline

[30] "Battleship or Torpedo Boat," *Scientific American*, 7 May 1904, 358.

[31] The war accelerated changes in ship design and gunnery already underway. See Rotem Kowner, "The Impact of the War on Naval Warfare," in *The Impact of the Russo-Japanese War*, ed. Rotem Kowner (London: Routledge, 2007), 269–89.

[32] R. M. Watt, "Influence of the United States on the World's Battleship Designs," *Scientific American*, 9 December 1911, 516–17. Ship designers before Capps feared that the upper superfiring gun's blast might damage the lower of the pair or wound the lower gun's crew. See Friedman, "America's First Dreadnoughts," 19–21.

arrangement allowed the ship to fire all eight guns in a broadside. Naval doctrine at the time called for battleships to fight as part of a line of battle. Hence, Capps recognized that any single ship's most important aspect was the throw weight of broadsides. His design ensured the most powerful broadside possible for the ship's tonnage at the acceptable cost of forward and aft fire, and is a good example of how tactical doctrine can affect ship layout.[33] The Bureau of Construction and Repair completed plans for *South Carolina* and *Michigan* by the end of June 1905, well before the Royal Navy started its own radical all-big-gun battleship, HMS *Dreadnought*, in October.[34]



South Carolina (Battleship No. 26) underway in 1921. From this angle, *South Carolina*'s centerline gun arrangement is clearly visible, as are its cage masts used for spotting and fire control. (NHHC, NH 97499)

[33] Friedman, *U.S. Battleships*, 55.

[34] Friedman, "America's First Dreadnoughts," 17–23.

Although the plans were ready, the concept of an all-big-gun ship was still a new idea that would be challenged by conservative officers and politicians fearing the expense, especially as *South Carolina* and *Michigan* would not be laid down until December 1906. Admiral George Dewey, as part of the General Board, had to advocate for and defend the new setup. He wrote to Secretary of the Navy Charles J. Bonaparte in September 1905: "It has been clearly shown by experiments and practice in fire control that the fire of a mixed battery at fighting ranges cannot be accurately placed when two or more calibers, especially if approaching each other in size, are firing at the same time, and that to control such a mixed battery at all in battle it would be necessary to restrict and limit the firing with other calibers while controlling the fire of any one caliber—an intolerable situation. . . . The General Board for some time has believed that battleships should have a battery of large guns of but one caliber."[35]

The United Kingdom took the first concrete step toward an all-big-gun battleship by laying down HMS *Dreadnought* in 1905. Commissioned a mere 15 months later, *Dreadnought* was a revolutionary ship with ten 12-inch guns and an impressive speed of 21 knots made possible by a new turbine steam engine.[36] *Scientific American* was typical in calling it an "extraordinary" ship, "unsinkable by any weapon except a ram."[37] The ship gave its name—"dreadnought"—to large all-big-gun battleships built from that point forward. *Dreadnought* prompted a worldwide rush among the great powers to revamp

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[35] George Dewey to Charles J. Bonaparte, 30 September 1905, General Board Letters, vol. 4, July 1905–March 1907, 49–52, General Board Letter Books, General Records of the Department of the Navy, Record Group 60, National Archives Building, Washington, DC.

[36] Nicholas A. Lambert, *Sir John Fisher's Naval Revolution* (Columbia: University of South Carolina Press, 1999), 127–61. HMS *Dreadnought* was championed by Admiral John "Jackie" Fisher, the first sea lord. Fisher had a complicated relationship with *Dreadnought*. He hoped to make battle cruisers—fast, heavily armed but lightly armored battleships—the chief capital ship of the Royal Navy. *Dreadnought* was laid down along with three battle cruisers, but proved far more popular among the public, parliament, and the Royal Navy itself. Fisher's battle cruisers turned out to be ill-suited for line-of-battle combat. Three exploded at the Battle of Jutland in 1916, killing almost everyone on board.

[37] "The British Battleship '*Dreadnought*,'" *Scientific American*, 25 August 1906, 138.

their navies' battleship fleets.[38] Thanks to Poundstone's work and the plan for *South Carolina*, the United States already had designed its own answer to the new ship. The General Board was able to write to Secretary of the Navy Victor H. Metcalf in 1907 that *Dreadnought* was "substantially the same as that proposed by the General Board, when three years ago in January 1904 it, for the first time, suggested to the Department, that the Bureau of Construction & Repair should be directed to prepare a tentative design for a battleship fitted with a main battery of twelve heavy turret guns of over 10-inch caliber, and with a secondary battery of 3-inch guns for torpedo protection," an arrangement accepted by "nearly all naval experts."[39]

Despite the General Board's enthusiasm, the construction of *South Carolina* and *Michigan*, and the launching of *Dreadnought*, all-big-gun ships were still considered controversial among some naval circles, who attempted to use Navy professional forums to influence public opinion against the ships.[40] Alfred Thayer Mahan weighed in on the topic of battleships, writing in *Proceedings* in 1906 that the Battle of Tsushima discredited the idea of large all-big-gun ships like *Dreadnought* or *South Carolina*. He argued that large numbers of smaller, slower battleships with a powerful secondary armament would prevail over larger, faster battleships with all long-range guns.[41] This was a shot across the bow of Poundstone, Sims, Capps, and the General Board. Captain Richard Wainwright responded in the next issue of *Proceedings*, pointing out the value of speed, better gunnery control, and effi-

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[38] Only eight mixed-caliber predreadnoughts were started after the launch of *Dreadnought*. Instead, the major navies invested in dreadnoughts and, to a lesser extent, battle cruisers. The United Kingdom had 45 capital ships (dreadnoughts or battle cruisers) completed or under construction in 1914. Germany had 26, followed by the United States with 14, Japan and France with 12 each, Russia with 11, Italy with 6, and Austria-Hungary with 4. Sondhaus, *Naval Warfare*, 201, 222.

[39] George Dewey to Victor H. Metcalf, 9 January 1907, 467–71, General Board Letters, National Archives Building.

[40] *South Carolina* and *Michigan* were laid down in December 1906, launched in the summer of 1908, and commissioned in early 1910. See Friedman, "America's First Dreadnoughts," 24–25.

[41] Alfred Thayer Mahan, "Reflections, Historic and Other, Suggested by the Battle of the Japan Sea," *Proceedings* 32, no. 2 (June 1906): 447–70.

ciency offered by larger ships, before asking, "Are the best ships too good for the American Navy?"[42] A few months later, Sims thoroughly refuted Mahan's analysis, showing that his conclusions about Tsushima were "in error." "They are, in my opinion, founded largely upon mistaken facts . . . , mistaken principles of gunfire, and upon an apparent failure to consider the inherent and very important tactical qualities of large vessels," Sims wrote. Sims showed that Japanese long-range gunnery had been key to the nation's victory, and that Tōgō had used higher speed to remain out of the optimal Russian range. He also demonstrated the tactical uses of speed and that Mahan's proposal of smaller ships would result in unwieldy battle lines. He reminded his readers that the United States had to keep pace with other countries if it was "to remain a world power," which meant dreadnoughts.[43]

Sims's article answered the fundamental question on battleship armament, and from that point on naval officers and civilian naval enthusiasts generally advocated for all-big-gun battleships. Even Mahan admitted the weaknesses of his initial paper.[44] Riding a wave of popular enthusiasm for dreadnoughts and naval expansion, Congress authorized the construction of the 20,000-ton, ten 12-inch gun *Delaware* (Battleship No. 28) and *North Dakota* (Battleship No. 29) in March 1907. Much larger and faster than *South Carolina*, these ships confirmed the move toward the all-big-gun future, even as America's predreadnought Great White Fleet set sail for its voyage around the world.[45]

Dreadnought-style battleships served as the yardstick for naval power in the years before World War I, despite advances in submarines, aircraft, and torpedoes. Constantly refined and improved, they illustrated the effectiveness

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42 Richard Wainwright, "A Further Argument for the Big Ship," *Proceedings* 32, no. 3 (September 1906): 1057–63. Quoted text on 1063.

43 William S. Sims, "The Inherent Tactical Qualities of All-Big-Gun, One-Caliber Battleships of High Speed, Large Displacement and Gun-Power," *Proceedings* 32, no. 4 (December 1906): 1337–66.

44 Morison, *Admiral Sims*, 164–74.

45 Friedman, *U.S. Battleships*, 69. The Great White Fleet was made up of 16 predreadnoughts, some of which had to be replaced midvoyage due to mechanical difficulties. It sailed from December 1907 to February 1909. See James R. Reckner, *Teddy Roosevelt's Great White Fleet* (Annapolis, MD: Naval Institute Press, 1988).

of America's naval designers and innovators, at least for dreadnought enthusiasts. *Jane's Fighting Ships* of 1907 called *South Carolina* the "best all-big-gun ship yet put in hand."[46] Launched in 1908 and commissioned in 1910, *South Carolina* proved a valuable addition to the fleet, though, like most U.S. battleships of this era, it never saw combat.[47]

Rear Admiral Richard M. Watt, chief of the Bureau of Construction and Repair, used the global influence of *South Carolina* to celebrate U.S. naval innovations. He wrote in 1911 that "the designers of the war vessels of the United States *in their first all-big-gun battleship* adopted as the emphasized feature of the fighting machine, a battery arrangement which, after experiment with various other battery arrangements, is now generally accepted by the designers of all nations as the standard battery arrangement (of guns) for the all-big-gun battleship. In thus setting the standard battery arrangement of fighting vessels, the influence of the United States on the world's battleship design *cannot be overestimated*."[48] Although *Dreadnought* and its immediate successors used wing turrets, the United Kingdom followed *South Carolina*'s superfiring, centerline gun model from the *Orion* class on.[49] Likewise, Italy's *Dante Alighieri*, Austria-Hungary's *Prinz Eugen*, France's *Bretagne*, Germany's *König*, Russia's *Gangut*, and Japan's *Kong*ō classes all used centerline, superfiring gun turrets, as did all U.S. battleships after *South Carolina*.[50]

By proving able to not just build its own warships, but to innovate and contribute to battleship design, the United States Navy demonstrated that

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[46] Watt, "Battleship Designs," 516–17.

[47] Robert J. Cressman, "*South Carolina* IV (Battleship No. 26), 1910–1923," Naval History and Heritage Command, last modified 13 January 2022, https://www.history.navy.mil/research/histories/ship-histories/danfs/s/south-carolina-iv.html.

[48] Watt, "Battleship Designs," 516. Italics in the original.

[49] The *Bellerophon*, *Collingwood*, and *Neptune* classes used wing turrets. *Orion* was designed in 1909, after *South Carolina* was launched.

[50] Frederick A. Edwards, "United States Line-of-Battle Ships" (unpublished manuscript, 1991), box 1, Frederick A. Edwards Papers, 1989–1991, Nimitz Library Special Collections and Archives, United States Naval Academy, Annapolis, Maryland.

it had a place among the great naval powers.[51] More importantly, the development of an effective dreadnought showed the United States had a process that, though convoluted, could result in rapid innovation and real improvement. Officers like Poundstone, Signor, Sims, and Capps; institutions like *Proceedings*, the General Board, and the Bureau of Construction and Repair; and participatory civilian oversight from the presidency and Congress all contributed to improved U.S. battleships. These institutions and forums would be the battlegrounds for further innovation and ship design for decades and eventually give birth to true U.S. naval supremacy.

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[51] Several naval powers, such as Argentina, Chile, and the Ottoman Empire, relied on foreign-built vessels for their major capital ships in the early twentieth century. By building and designing its own capital ships domestically, the United States joined a more exclusive group of naval powers, including the United Kingdom, Germany, Japan, Italy, Russia, France, and Austria-Hungary.

CHAPTER TWO

Command and Cooperation: Innovating Unity of Command in the Caribbean Sea Frontier, 1942–1943

Martin R. Waldman

In the first year of U.S. involvement in World War II, the Allies suffered severe shipping losses due to German submarine operations off the Eastern Seaboard of the United States and within the Caribbean. At the height of their offensive in the Caribbean in 1942, German submarines sank on average 1.5 ships per day and over one million tons of shipping total.[1] Gradually, however, the United States and its allies turned the tide against the Germans, significantly degrading the U-boat threat by the end of 1943. Technical and tactical innovations such as convoying and high-frequency direction finding played a critical role in this outcome, but organizational innovations were also quite important. With most of its ships and personnel allocated to other theaters, the U.S. Navy had to rely heavily on the support and cooperation of both the U.S. Army and foreign allies such as the British and the Dutch. This interdependence would require a new framework for cooperation, one rooted in the concept of "unity of command." Equally important, it required commanders who possessed the collaborative mindset, organizational skills, and operational adaptability to innovate and refine different modes of cooperation in order to transform this new framework from a doctrinal proscription into a working practice.

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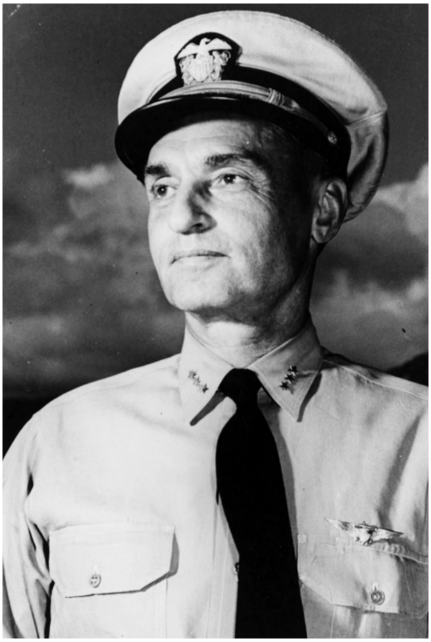
[1] Samuel Eliot Morison, *History of United States Naval Operations in World War II*, vol. 1, *The Battle of the Atlantic, September 1939–1943* (1947; repr., Annapolis, MD: Naval Institute Press, 2010), 257–58.

Vice Admiral John H. Hoover (*left*) and Rear Admiral Jesse B. Oldendorf (*right*) worked hard to secure the full cooperation of the Army, the Dutch, and the British in the Caribbean in order to secure the region from the U-boat threat. (*Left*: NHHC, NH 82804; *Right*: NHHC, 80-G-451546)

Unity of command entails joint or combined forces operating "under a single commander with the requisite authority to direct all forces employed in pursuit of a common purpose."[2] Today, it is a cornerstone of U.S. military doctrine,[3] but in 1941, it was still very much an open question as to whether this framework could actually work across an entire theater of operations in which joint and combined forces were involved.[4]

[2] Joint Publication (JP) 3-0, *Joint Operations,* rev. ed. (2017; repr., Washington, DC: Joint Chiefs of Staff, 2018), A-2. Hereafter cited as JP 3-0.

[3] JP 3-0, ix; JP 3-16, *Multinational Operations* (Washington, DC: Joint Chiefs of Staff, 2019), II-5. Hereafter cited as JP 3-16.

[4] The closest precedent was General Ferdinand Foch's elevation to Supreme Allied Commander in 1918, but this arrangement was still heavily reliant on mutual cooperation among all forces rather than a truly integrated command structure. Forrest C. Pogue, *The Supreme Command*, United States Army in World War II: The European Theater of Operations (1954; repr., Washington, DC: U.S. Army Center of Military History, 1989), 59.

The Caribbean Sea Frontier (CSF) demonstrated not only that it could, but that unity of command itself offered considerable operational benefits, including greater unity of effort and enhanced interoperability among joint or combined forces. Its successful implementation here foreshadowed the development of integrated joint/combined commands across other theaters, most notably, the Supreme Headquarters Allied Expeditionary Force in Europe.[5]

Within the Caribbean theater, unity of command succeeded not simply because it was a useful innovation nor because of the carefully crafted agreements made among the various governments and branches of the U.S. armed forces that allowed for its implementation. It succeeded because the CSF had officers who were capable of putting this concept into practice. Despite the considerable obstacles they faced, Vice Admiral John H. Hoover (Commander, CSF) and his subordinate, Rear Admiral Jesse B. Oldendorf (Commander, All Forces, Aruba-Curaçao; subsequently, Commander, Trinidad Sector), were able to secure the full cooperation of the Dutch, the British, and the U.S. Army largely by observing the very tenets of joint and multinational operations that military planners still emphasize today: exercising patience, developing personal rapport, demonstrating respect, acquiring knowledge, maintaining mission focus, and building trust.[6] Their efforts would not only help to secure the Caribbean from the U-boat menace and demonstrate the viability of unity of command as a framework for cooperation, but also provide a model for how officers can successfully navigate the tensions and territorialism that are often inherent in joint and combined operations.

Before delving into how these officers implemented unity of command, we first need to understand both the theater they were operating in and the challenges they faced in exercising command. The Caribbean's

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[5] Pogue, *The Supreme Command*, 42–55; Commander, Caribbean Sea Frontier, "Aruba-Curaçao Command Headquarters, Commander All Forces (Caribbean Sea Frontier)" (unpublished manuscript, 1945), 11. U.S. Naval Administrative Histories of World War II, Navy Department Library, Naval History and Heritage Command (NHHC), Washington Navy Yard, DC. Hereafter cited as "Aruba-Curaçao Admin."

[6] JP 3-16, I-2-5.

importance to U.S. and Allied military operations during World War II should not be understated. The islands and the surrounding waters were an important defensive buffer for the continental United States; a source of key resources such as bauxite, oil, coffee, and sugar; a thoroughfare through which Navy ships could transport people and supplies to and from the Pacific; and a shared diplomatic concern among the United States and the countries of Central and South America. Roosevelt wrote that he feared "we would find ourselves surrounded by hostile states"[7] if the Axis successfully infiltrated and occupied any of the islands in the Caribbean or the coastal South and Central American countries, so he conducted extensive negotiations with the British and Dutch to secure basing rights and land across their colonial holdings, as well as their mutual cooperation in the event of war.[8]

While all parties agreed in principle that the United States had a prevailing interest in leading the defense of the Caribbean, the issue of how it would do so was still largely unsettled when the United States entered the war in December 1941. From Vice Admiral Hoover's standpoint, there was never any question as to what was needed. As he later emphasized, "In order to make a situation like that work, where on each one of these bases we had some Army and some Air Corps people and Navy people, and foreigners, one had to have a unity of command."[9]

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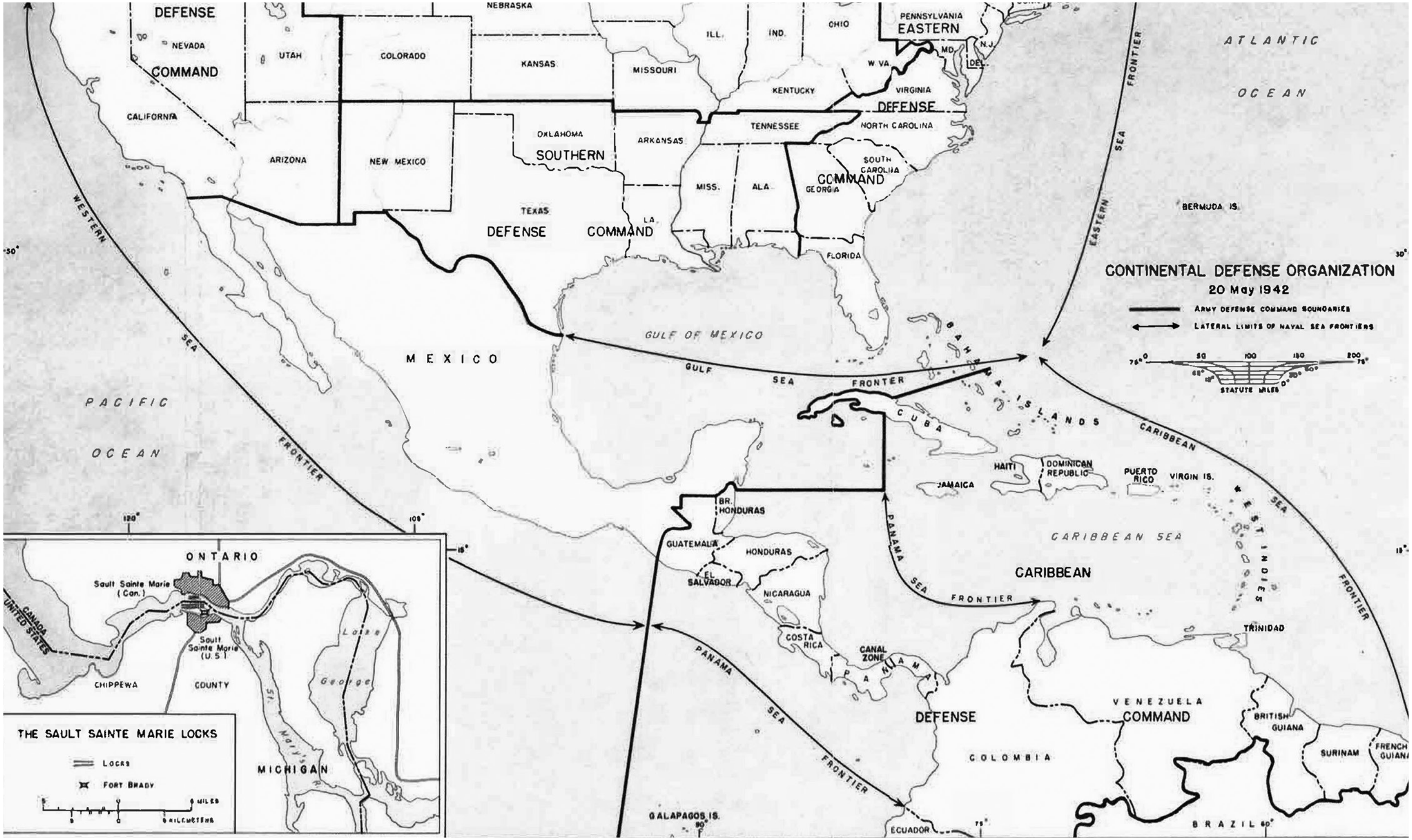
[7] Quoted in Stetson Conn and Byron Fairchild, *The Framework of Hemisphere Defense*, United States Army in World War II: The Western Hemisphere (1960; repr., Washington, DC: U.S. Army Center of Military History, 1989), 7.

[8] Fitzroy André Baptiste, *War, Cooperation, and Conflict: The European Possessions in the Caribbean, 1939–1945* (New York: Greenwood Press, 1988), 51–61; Stetson Conn, Rose C. Engelman, and Byron Fairchild, *Guarding the United States and Its Outposts*, United States Army in World War II: The Western Hemisphere (1962; repr., Washington, DC: U.S. Army Center of Military History, 2000), 354–83; Morison, *Battle of the Atlantic*, 33–36.

The most notable of these agreements, the destroyers-for-bases agreement, saw the United States swap 50 of its World War I–era destroyers for basing rights and long-term leases on the British-held islands of Bermuda, Jamaica, the Bahamas, Antigua, British Guiana, St. Lucia, and Trinidad.

[9] John H. Hoover, *The Reminiscences of Admiral John H. Hoover*, Naval History Project (New York: Columbia University, Oral History Research Office, 1964), 265.



Areas of responsibility in the Western Hemisphere, including the Caribbean Sea Frontier. (Stetson Conn, Rose C. Engelman, and Byron Fairchild, *Guarding the United States and Its Outposts*, United States Army in World War II: The Western Hemisphere [1962; repr., Washington, DC: U.S. Army Center of Military History, 2000], map insert.)

Among the United States' major partners, however, only the British had agreed to place their forces under the U.S. military's overall command,[10] but questions lingered about how command would be exercised within each territory. The Dutch proved far more reluctant partners, not even agreeing to allow U.S. forces onto the islands of Aruba and Curaçao until 11 February 1942, just five days before the Germans launched their first major submarine campaign.[11] Even among the U.S. armed forces, it was still an open question well into December as to which branch would hold overall command within the Caribbean. Ultimately, President Roosevelt chose to split the difference, placing the Army in command of the Panama Canal and its surrounding waters while granting the Navy command of the Caribbean.[12]

Setting aside, for the moment, the question of how the Navy would exercise command over the combined forces of the Army, the British, and the Dutch, it bears emphasizing that there were considerable logistical challenges to administering the Caribbean. The CSF encompassed an estimated 2.5 million square miles, making it among the largest antisubmarine commands.[13] It was also among the most resource poor, being forced to compete with adjacent sea frontiers that were deemed more essential to operations such as the Panama Sea Frontier (Panama Canal and Central America), the Gulf Sea Frontier (Florida and the Gulf of Mexico), and the Eastern Sea Frontier (the Atlantic and the Eastern Seaboard of the United States). At the commencement of the Germans' first major submarine campaign in the Caribbean in

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10 Commander, Caribbean Sea Frontier, "An Administrative History of the US Naval Operating Base Trinidad, BWI and the Trinidad Sector of the Caribbean Sea Frontier, 7 December 1941 to August 1945," (unpublished manuscript, 1945), 27, U.S. Naval Administrative Histories of World War II, Navy Department Library, NHHC, Washington Navy Yard, DC. Hereafter cited as "Trinidad Admin."

11 Baptiste, *War, Cooperation, and Conflict*, 120–23, 131–40; Conn, Engelman, and Fairchild, *Guarding the United States*, 414–15. This difficulty was, in no small part, due to the United States' insistence on including the Brazilian and Venezuelan militaries as part of any defense arrangements.

12 Conn, Engelman, and Fairchild, *Guarding the United States*, 410–11.

13 Gaylord T. M. Kelshall, *The U-Boat War in the Caribbean* (Annapolis, MD: Naval Institute Press, 1994), 8.

February 1942 (Operation Neuland), the CSF possessed only an estimated two destroyers, one squadron of PBY Catalinas belonging to Patrol Squadron 12, three *S*-class submarines, and a handful of smaller vessels such as yachts and subchasers.[14] At the beginning of the campaign, as Hoover grimly noted, "About all you could do was to get the report that the ship was sinking, and then maybe a couple of days later, get something out there and pick up the survivors. The matter of hunting down, locating and sinking submarines was just out of the question."[15]

Given this dearth of resources, cooperation among the Navy, the Army, the British, and the Dutch was an absolute necessity for success. In theory, the arrangements for unity of command made among various Allied governments and branches of the U.S. armed forces guaranteed this, but, in practice, it would still fall to commanders on the ground to implement it, with success depending just as much on their professionalism and interpersonal skills as it did on their place within the CSF's organizational chart. Fortunately, the Navy's chosen commander for the CSF, Vice Admiral Hoover, was well suited to this task. Oldendorf described him as a "forceful personality and a fighting admiral" with "interests so broad that he usually" was "able to hold his own regardless of what subject" was "up for discussion."[16] Hoover not only had prior experience with conducting antisubmarine patrols during World War I, but also was one of the rare flag officers who was both a qualified aviator and a former submarine commander.[17] All of this made him uniquely suited to implement unity of command and develop a workable antisubmarine strategy among all forces.[18]

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[14] Morison, *Battle of the Atlantic*, 145n43; Hoover, *Reminiscences*, 276; Conn, Engelman, and Fairchild, *Guarding the United States*, 413.

[15] Hoover, *Reminiscences*, 276–77.

[16] Jesse B. Oldendorf and Hawthorne Daniel, "As Seen from the Bridge: Glimpses Along the Sea Road to Tokyo, as Seen by an Admiral Enroute," (unpublished memoir, 1945), 11–12, Jesse B. Oldendorf Memoirs, 1944–1945, Special Collections & Archives, Nimitz Library, U.S. Naval Academy, Annapolis, MD.

[17] Hoover, *Reminiscences*, 121–28. Hoover had been in command of *Cushing* (Destroyer No. 55).

[18] Hoover, *Reminiscences*, 202.

Hoover would not be operating alone, however. Given the sheer size of the CSF, it was necessary to divide it into multiple sectors (Puerto Rico, Guantanamo, Trinidad, and, later on, Aruba-Curaçao), each of which encompassed major sea-lanes, critical junctions in the Allies' supply chain, and/or significant transfer points for convoys. To administer these sectors, officers from both the Army and the Navy were assigned to command, the most stalwart and successful of whom proved to be Rear Admiral Jesse "Oley" Oldendorf. At first glance, Oldendorf would not appear to have been a natural fit for the task at hand. Although he had some experience with convoying and antisubmarine warfare,[19] he had only recently been appointed to flag rank and possessed very limited knowledge of the territory he was to command. It turned out, however, that Oldendorf was both a capable organizer and a natural-born diplomat, working very well with his Army, British, and Dutch counterparts. He was so successful in Aruba-Curaçao that Hoover swiftly placed him in charge of the much more extensive operations in the Trinidad Sector.

Despite their considerable abilities, both Hoover's and Oldendorf's skills would be sorely tested by the task in front of them. Leaving aside the fact that they had been provided with very few resources with which to conduct antisubmarine warfare (ASW) operations, they also had to overcome resistance from local civilian and military officials (some of whom were loath to cede any authority whatsoever to U.S. commanders), differences in strategic doctrine among all forces, and the Navy's own lack of recent experience with conducting antisubmarine operations. Time and patience would help to overcome these challenges, but they also required Oldendorf and Hoover to build trust and personal rapport with their counterparts.

Failure to undertake this critical task could forestall or even permanently prevent unity of command from being implemented. In Surinam, for example, the unilateral decision by Brigadier General Ralph Talbot Jr. (Commander, Trinidad Sector) that the United States would be assuming

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[19] Oldendorf had served as a gunnery officer on board the troop transport *President Lincoln* and even survived its torpedoing on 31 May 1918. For more on his career, see "Jesse Barrett Oldendorf, 16 February 1887–27 April 1974," NHHC, last modified 20 March 2019, https://www.history.navy.mil/content/history/nhhc/research/library/research-guides/modern-biographical-files-ndl/modern-bios-o/oldendorf-jesse-barrett.html.

command of all forces in the colony provoked a furious backlash from the Dutch government-in-exile, leading it to agree only to "mutual cooperation" among all forces rather than unity of command.[20] A similar situation might have developed in Aruba-Curaçao, where Rear Admiral Oldendorf quickly discovered upon his arrival on 1 March 1942 that no word had been sent informing the Dutch governor, Gielliam Johannes Josephus Wouters, that he was assuming command. While the governor received Oldendorf cordially enough, he also pointedly reminded the admiral that "it was traditional among the Dutch that the governor of any province was, by virtue of his position, commander of all forces in his jurisdiction."[21]

Oldendorf wisely did not contest this point, at least not openly. Instead, he quietly assumed command of all U.S. forces in the area without issuing any public statement to that effect and assiduously avoided issuing any orders to the local Dutch forces. It was only when it became clear that the situation was not going to resolve itself anytime soon and that the U-boat threat was growing exponentially that he decided to announce publicly that he was assuming command of all American forces (both Army and Navy) in the area and sought to come to some sort of understanding with the Dutch. Even so, he proceeded cautiously, first informing the ranking British and Army officers of his plans and then calling a meeting with the commander of the Dutch forces, Captain Baron Carel Johan van Asbeck, and his senior officer afloat, Captain Cornelis Hellingman (commanding officer [CO], HMNS *Van Kinsbergen*). Taking a firm, but respectful, approach, Oldendorf pointedly asked Hellingman "if he considered himself to be operating under Admiral Hoover." Hellingman answered in the affirmative, to which Oldendorf responded, "I am Admiral Hoover's representative in Curaçao. So you are operating under me. Is that

[20] Baptiste, *War, Cooperation, and Conflict*, 115–31; Conn, Engelman, and Fairchild, *Guarding the United States*, 422. Both the War Department and Lieutenant General Frank Andrews (Commander, Caribbean Defense Command) swiftly countermanded Talbot's orders, but this proved insufficient. Governor Johannes C. Kielstra and the Dutch government were already concerned about the possibility that the United States was seeking to annex Surinam, owing to earlier statements from U.S. military officials to the effect that they would take whatever military action was necessary in the event of an emergency (including moving U.S. forces into Surinam).

[21] Oldendorf, "As Seen from the Bridge," 20.

correct?" Hellingman again answered in the affirmative. Although this exchange did not entirely resolve the dispute, Oldendorf could note with evident satisfaction that "even before the Governor received word from his Government [concerning Oldendorf's appointment], things were beginning to line up."[22] It was a testament to Oldendorf's ability to balance the need for diplomacy with the need to maintain mission focus.

Oldendorf's position as Commander, All Forces, Aruba-Curaçao (CAFAC) would eventually receive official acknowledgement from the Dutch government and Governor Wouters on 31 March 1943.[23] It must be emphasized, however, that even after the dispute over his command had been resolved, Oldendorf always remained respectful toward his hosts and sensitive to their concerns. He not only made Captain van Asbeck his chief of staff and Captain Hellingman his senior officer afloat,[24] but even went so far as to attend meetings of the local Rotary Club in Willemstad, Curaçao, in a bid to build stronger relations with the local community and deepen his knowledge of the Dutch and their customs. He also came to appreciate that although his Dutch officers spoke English quite fluently, they did not always understand it perfectly, and he would need to exercise considerable patience with them, repeating his orders when necessary and expressing them in simpler terms that the Dutch could more easily understand. These efforts to demonstrate respect, develop local knowledge, and exercise patience were not only textbook examples of how to oversee a combined operation but served to build trust and facilitate cooperation between the Dutch and the Americans.[25]

Oldendorf's deft handling of the Dutch would garner him a potentially tougher assignment in Trinidad. Trinidad had long been a source of tension between the United States and United Kingdom with both sides largely operating independently of each other. Even after the United States entered the war, it

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[22] Oldendorf, "As Seen from the Bridge," 23–24.

[23] "Aruba-Curaçao Admin," Annex 3.

[24] "Aruba-Curaçao Admin," 43. In this arrangement, the chief of staff served as head of the Dutch naval and military forces rather than as an executive officer to CAFAC.

[25] Oldendorf, "As Seen from the Bridge," 27–29.

took the two sides nearly three weeks to begin drawing up a joint defense plan, one which would not be completed until June of 1942, well after the U-boat offensive had commenced.[26] Some of the blame for this can be attributed to the island's governor, Sir Hubert Young, who was not only highly resistant to any attempts to implement unity of command, but also constantly at loggerheads with the Trinidad Sector commander, Brigadier General Ralph Talbot Jr.[27] Both men proved to be intractable in their dealings with each other, with the Army's own official history disapprovingly noting that both were "cut from the same cloth, blunt and outspoken in their personal opinions; each was insistent that the prestige of his own government could be upheld by not yielding to the other; neither believed in appeasement."[28]

Compounding this situation further was the matter of rank. As Hoover astutely recognized, both Talbot and the Navy officers assigned to Trinidad were significantly outranked by their British counterparts. Young was not only a former officer in the British Army, but as governor, was considered to hold superior rank over everyone. The commander of the local naval defense force, Admiral Sir Michael Hodges, likewise outranked all of his American counterparts.[29] Believing that "if you don't have rank, you don't get much consideration anywhere," and that his officers "couldn't quite hold their own with this high ranking governor,"[30] Hoover pushed for a command shakeup, working with Lieutenant General Frank Andrews to replace Brigadier General Talbot with the higher-ranking (and considerably more diplomatic) Major General Henry Conger Pratt in January 1942 and then subsequently securing an agreement with the British to transfer control of the local naval

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[26] Kelshall, *U-Boat War*, 5.

[27] Conn, Engelman, and Fairchild, *Guarding the United States*, 416–19. Examples of Young's recalcitrance can be found in the minutes of the Local Combined Defense Committee, in which he raised numerous objections on any matters related to unity of command. "Trinidad Admin," 28–31, 33–37.

[28] Conn, Engelman, and Fairchild, *Guarding the United States*, 406.

[29] Kelshall, *U-Boat War*, 44. Prior to Oldendorf's arrival in July 1942, the ranking Navy officers included Captain Silas Ginder and Commander Arthur W. Radford. Radford would serve as chairman of the Joint Chiefs of Staff between 1953 and 1957.

[30] Hoover, *Reminiscences*, 267, 307.

defense force from Hodges to Oldendorf in September 1942.[31] Equally important, Hoover and Admiral Ernest J. King, Commander in Chief, U.S. Fleet, and Chief of Naval Operations, persuaded the British government to recall Young on 8 June 1942. The governor's replacement, Sir Bede Clifford, would prove far more amenable to cooperation, possibly on account of the fact that his own wife was an American.[32]

Fortunately for Hoover and his subordinates, issues of rank and rapport would be far less of an issue with the U.S. Army than they were with the Dutch and the British. Although questions over who would command in the Caribbean had provoked vigorous debate in Washington and would burn even hotter when it came to the ongoing discussions as to whether to organize a joint ASW command,[33] at least in the Caribbean, there was significant cooperation from an early date. The command arrangements made at the war's outset certainly had something to do with this, but it also seems clear that at least some of the Caribbean commanders had a more cooperative mindset, not to mention a greater degree of personal rapport with each other. In contrast to his dealings with the Army in the Pacific, Hoover emphasized, "Down in the Caribbean they [the Army] were 100 percent cooperative and did all they could possibly do to help," particularly when it came to supplying planes.[34] Oldendorf echoed Hoover's sentiments, noting, "It was remarkable how little friction there was, and how well we all got along together." Concerning his Army counterpart in Trinidad, Major

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[31] Conn, Engelman, and Fairchild, *Guarding the United States*, 419.

[32] Baptiste, *War, Cooperation, and Conflict*, 162–63; Kelshall, *U-Boat War*, 101; Oldendorf, "As Seen from the Bridge," 33. It is perhaps no coincidence that after Clifford arrived, the Americans and the British finally settled on a joint defense plan for Trinidad, granting the Americans command over routing and shipping to and from the island. The principle of determining command based on rank and force strength could and did work both ways. In Jamaica, for example, the British sought to have the local police and volunteer militia counted as part of their force strength (nearly doubling it) and also made plans to promote the local commander to the rank of major general in order to forestall the possibility of the United States assuming command. Conn, Engelman, and Fairchild, *Guarding the United States*, 419–20.

[33] Morison, *Battle of the Atlantic*, 244–47.

[34] Hoover, *Reminiscences*, 306, 398. As Hoover acknowledged, much of this was due to the efforts of Lieutenant General Frank Andrews, his counterpart who led the Caribbean Defense Command.

General Henry Conger Pratt, Oldendorf's praise was even more fulsome: "The General and I hit it off perfectly from the first. We almost invariably saw eye to eye, and we literally never found ourselves at cross purposes. In fact, we came to be known as 'the Service twins'—a nickname that pleased me immensely, and I hope did not displease the General."[35]

Personal rapport between commanders was just one of the ingredients necessary for achieving unity of command. As more modern Joint Chiefs of Staff joint doctrine publications note, rapport and mutual confidence cannot exist without respect, and to obtain this, "all partners must be included in the planning process, and their opinions must be sought in mission assignment, organizational structure, and the operation assessment process. Understanding, discussing, and considering partner ideas are essential to building effective relationships."[36] Building this understanding is where joint and combined staffs played an important role. While Hoover certainly leaned on his fellow Navy officers for advice and support, he also had a joint staff that included members of both the Army and Army Air Forces (AAF), including General James Lawton Collins and Colonel Edwin House.[37] Oldendorf, likewise, had combined staffs at both Aruba-Curaçao and Trinidad, though in his case, this was almost as much by necessity as it was by design, as he had been provided no Navy staff upon his assignment to Aruba-Curaçao.[38] Even after his staff increased in size and he was able to incorporate more Navy officers into it, Oldendorf still relied heavily upon officers from other services such as Colonel Charles F. Born (AAF). Historian Samuel Eliot Morison described Oldendorf and Born's working relationship in positively glowing terms, noting, "Between them they ironed out every incipient Army-Navy conflict, and ran military activities as one team, with flexibility and intelligence. 'Oley' and 'Charley'

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[35] Oldendorf, "As Seen from the Bridge," 33.

[36] JP 3-16, I-3.

[37] Hoover, *Reminiscences*, 306.

[38] Hoover, *Reminiscences*, 309; Oldendorf, "As Seen from the Bridge," 12. According to CAFAC's administrative history, there were only seven Navy officers and one enlisted sailor when Oldendorf was formally named commander. "Aruba-Curaçao Admin," 32.

were an inspiration to their subordinates; and the naval personnel worked themselves ragged to 'keep the ships sailing.'"[39]

Morison's reference to "incipient conflicts" and running "military activities as one team" raises an interesting point. To make unity of command truly effective, it was imperative that Hoover and his commanders not only build trust and foster respect among all partners, but also enhance their interoperability. Although the Dutch, the British, and the Army had all agreed to place their forces under the overall command of the Navy in the Caribbean, there were still critical differences in terms of strategic doctrine, training, and relative experience among all partners that needed to be resolved if they were to work effectively together. This cooperation is another area where joint and combined staffs played a critical role, as they not only created a forum through which disagreements could more easily be mediated and operating procedures standardized, but also offered a pool of knowledge and experience that commanders could draw upon to develop more effective ASW strategies and maximize partner contributions.

Take the Dutch officers under Oldendorf's command, for example. Although their nation's material contributions to the war effort in the Caribbean were more limited than those of other partners,[40] the Dutch officers' understanding of how both the British and the Germans operated was absolutely invaluable. As Oldendorf gratefully acknowledged in his memoir, much of his ASW strategy had been shaped by the advice of his senior officer afloat, Captain Hellingman, who he said was not only "highly efficient, intensely loyal, and invariably helpful on all the work on which we were called upon to cooperate," but also quite experienced in dealing with the German submarines. Recognizing the value of this, Oldendorf actually went so far as to ask Hellingman to outline what he would do if he were in command of the U-boats and then formulated a strategy based upon those discussions. Similarly, Oldendorf came to rely heavily on Lieutenant Commander Baron Thomas Karel van Asbeck, CO of HMNS *Jan van Brakel*, whose prior

[39] Morison, *Battle of the Atlantic*, 148.

[40] Hoover, *Reminiscences*, 279, 308.

experience working with the British made him the ideal person to assist in coordinating the first Caribbean convoys when they launched in May 1942.[41]

The Dutch were, of course, not the only ones who could bring their expertise and experience to bear on the U-boat problem. Having endured U-boat attacks within their territorial waters since the war commenced, the British had already developed an effective system of convoys and air patrols to combat the submarine threat.[42] Consequently, they could provide not only staff with the necessary expertise to help establish a similar system in the Caribbean, but also experienced air and naval units to assist in carrying out operations and training American personnel. Escort Group B5, for example, was shifted from the North Atlantic to Trinidad in April 1942 and conducted some of the earliest convoy operations with additional contributions from the Royal Canadian Navy.[43] No. 53 Squadron (Royal Air Force Coastal Command), which already had significant experience hunting U-boats off the coast of England, was equally valuable. Although the unit was only stationed in Trinidad from August to November 1942, it flew around 700 missions and carried out 15 attacks on U-boats.[44] Its personnel also worked with Army and Navy pilots to improve their communication and ASW techniques, and even helped to supervise a system of coast-watching stations.[45] Such efforts were critical, as they not only kept the U-boats in check, but also afforded the Navy additional time to train up its own antisubmarine squadrons.[46]

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[41] Oldendorf, "As Seen from the Bridge," 24–27. Commander Baron van Asbeck was Captain Baron van Asbeck's cousin.

[42] U.S. Navy leadership (particularly Admiral King) had initially been quite reluctant to adopt similar tactics, but the severe shipping losses inflicted by Operation Paukenschlag (Drumbeat) off the East Coast and by Operation Neuland in the Caribbean ultimately forced the Navy to establish a convoy system. For perspectives on this, see Michael Gannon, *Operation Drumbeat* (New York: Harper & Row, 1990), 384–91; and Kelshall, *U-Boat War*, 12–18.

[43] Kelshall, *U-Boat War*, 97.

[44] Kelshall, *U-Boat War*, 237.

[45] Morison, *Battle of the Atlantic*, 259.

[46] Kelshall, *U-Boat War*, 128, 237.

Working with the Army provided a different sort of challenge for Hoover and his subordinates.[47] Although the Army had already agreed that the Navy would exercise unity of command in the Caribbean, the Army still offered some resistance to deploying its aircraft in what the service saw as long-range reconnaissance missions. From the Army Air Forces' standpoint, the defensive system set up in the Caribbean "robbed the air arm of what the AAF considered its primary advantage, namely, its mobility as an offensive striking force."[48] While Navy commanders themselves would have preferred a more offensive-oriented role, they did not have enough planes to execute such a strategy, let alone cover the convoys. Thus, it fell to the Army to provide much of the air coverage from 1942 to 1943.

Unity of command mooted some of the above disagreements, but it did not change the fact that Army pilots lacked both the training and the experience to conduct effective antisubmarine operations. Aside from the complexities of navigating and attacking targets over water,[49] one of the most significant challenges faced by Army pilots was that they, in Hoover's colorful description, could not "tell a submarine from a whale or a fish or a rock."[50] False submarine sightings, in particular, proved to be a significant impediment to operations, as every report required Hoover and his commanders to deploy the limited ships and aircraft at their disposal to investigate. The Army was, of course, cognizant of this issue and sought to train its pilots to

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[47] Traditionally, the roles of the Army and the Navy in coastal defense had been delineated between defense of the shore and defense of the sea-lanes. The advent of air power complicated this considerably, leading to the creation of a command framework that allowed for limited unity of command depending on which branch had "paramount interest" in the operation. *Joint Action of the Army and the Navy*, rev. ed. (1927; repr., Washington, DC: U.S. Government Printing Office, 1936), 17–18, 43–46; *Joint Army and Navy Action in Coast Defense* (Washington, DC: U.S. Government Printing Office, 1920), 12–15.

[48] Wesley F. Craven and James L. Cate, eds., *The Army Air Forces in WWII* (1948; repr., Washington, DC: Office of Air Force History, 1983), 542. See also David J. Bercuson and Holger H. Herwig, *Long Night of the Tankers: Hitler's War against Caribbean Oil* (Calgary: University of Calgary Press, 2014), 35; and Conn, Engelman, and Fairchild, *Guarding the United States*, 429.

[49] Morison, *Battle of the Atlantic*, 237–47.

[50] Hoover, *Reminiscences*, 277.

conduct ASW operations, but Hoover could not afford to exercise patience in this instance.

As the Joint Chiefs of Staff guidance notes, “If operational necessity requires tasks being assigned to personnel who are not proficient in accomplishing those tasks, then the MNFC [multinational force commander] must recognize the risks and apply appropriate mitigating measures.”[51] In Hoover’s case, these “mitigating measures” amounted to using his authority to send the Army pilots within his command to Saint Thomas, U.S. Virgin Islands. There, they conducted joint training exercises with two Navy submarines, spending days observing the submarines maneuver about until they could identify them under a variety of conditions. In Hoover’s estimation, the exercises led to a significant decrease in the number of false reports received and increased the overall effectiveness of the air patrols.[52]

The above examples are just a few that highlight both the primary challenges and the benefits of unity of command. It was not simply enough for all sides to agree in principle to unity of command; there needed to be a constant effort on the part of commanders to build trust and command the respect of partners, to integrate partners into their command structure and decision-making processes, and to facilitate the exchange of expertise in order to enhance interoperability. The agreements made between the Navy and its partners certainly offered the opportunity for all of this, but it was up to commanders such as Hoover and Oldendorf to put unity into practice. Their success in doing so not only allowed for closer cooperation among all partners, but also enhanced individual and collective effectiveness as a fighting force and achieved unity of effort more rapidly than might have been possible under a different framework of cooperation.

All of these measures would have been critical in any theater of war, but they were especially imperative in the Caribbean where the Navy could not rely primarily on its own capabilities to achieve victory. Particularly in the first half of 1942, when the Navy could spare few vessels and personnel, Hoover and his subordinates were largely reliant on ships, aircraft, and

51 JP 3-16, I-4.

52 Hoover, *Reminiscences*, 277.

expertise provided by the British, the Dutch, and the Army to mitigate the severe shipping losses inflicted by the Germans. Even after the Navy was able to increase its presence in the Caribbean during the summer of 1942 and the tides began to turn against the U-boats, the service would still rely heavily on partner contributions to organize and implement a robust convoy system and provide significant air coverage across the Caribbean. While these actions alone were not sufficient to achieve victory, they helped keep the war effort afloat until other factors (technological advancements, a robust intelligence-collecting apparatus, success in other theaters of war, increasing U.S. industrial capacity, etc.) could come into play. As Hoover acknowledged, "We were getting help from everywhere in the world before we got through."[53] It would be only in September 1943, when the campaign against the U-boats had largely been won and an all-new antisubmarine command, Tenth Fleet, had been set up, that the Navy would be capable of assuming sole responsibility for antisubmarine operations in the Caribbean.[54]

Incidentally, it was around this time that there was changing of the guard in the Caribbean, with Oldendorf departing for an assignment in Argentia, Newfoundland, in April 1943 and Hoover transferring to the Pacific in August. Although their legacies would ultimately be defined by their subsequent successes in the Pacific theater,[55] their contributions in the Caribbean should not be overlooked. Hoover and Oldendorf had not only protected critical sea-lanes from the U-boat onslaught, but also were among the first commanders to successfully implement unity of command across a major joint/combined theater of operations during World War II. Oldendorf was quick to emphasize just how critical this development was to operations, noting to reporters, "We make no distinctions between uniforms. The United

[53] Hoover, *Reminiscences*, 283.

[54] On this shift, see Samuel Eliot Morison, *History of United States Naval Operations in World War II*, vol. 10, *The Atlantic Battle Won, May 1943–May 1945* (1953; repr., Annapolis, MD: Naval Institute Press, 2011), 12–31. Tenth Fleet was established in May 1943.

[55] Oldendorf famously commanded the force that crossed the T with the Japanese at Surigao Strait, while Hoover ably served as Commander, Central Pacific Forward Area, under Admiral Chester Nimitz.

States Army, Navy, air and merchant marine are all working together alongside the British and Dutch in this area. We are a single fighting unit."[56]

This "single fighting unit" was not forged overnight nor solely by agreements made between the United States and its partners. It was a product of Oldendorf's and Hoover's ability to innovate and refine different modes of cooperation in order to transform unity of command from a collection of abstract political and interservice agreements into a concrete set of working practices. Although neither one of them had been particularly keen to take on this assignment (Hoover described it as "being relegated to the boondocks"),[57] they were, in many respects, the perfect officers for this task, possessing the sort of collaborative mindset, organizational skills, and operational adaptability necessary to implement and exercise unity of command. In a war noted for its clashing personalities and internecine conflicts among branches of the U.S. armed services and its international allies, their performance in the CSF was both a model for how to oversee a joint/combined operation and an unmistakable reminder that military innovation requires not only strategically sound ideas but also officers capable of putting them into action.

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[56] Reynolds Packard, "Dirty Tricks Used by Subs to Lure Ships," *Knoxville News-Sentinel*, 26 October 1942, 2.

[57] Hoover, *Reminiscences*, 258. Oldendorf similarly characterized his time in the Caribbean as the "hard work and the drudgery of war, not the brilliant battle action that makes headlines." Oldendorf, "As Seen from the Bridge," 39.

CHAPTER THREE

Innovating Fire Support: The Development of Naval Surface Gunfire Support in the Pacific during World War II

Nicholas K. Roland

Victory in the Pacific war required the United States to project military power across the world's largest ocean, seize control of dozens of Japanese-occupied islands, and bring the war to the Japanese homeland to force their capitulation. The scale and duration of this amphibious warfare campaign were unprecedented in history and presented many new tactical problems for the U.S. Navy and other services. Among the most crucial issues confronting U.S. forces in the Pacific was the necessity for effective and synchronized naval gunfire support during amphibious assaults against prepared enemy positions.

Historians have identified several factors crucial to determining a military service's innovative potential, including strategic calculations, the state of technology, organizational politics, and a service's culture.[1] Both the strategic calculation and organizational politics underlying the development of naval gunfire support were established in the years that followed the First World War, when visionaries such as Lieutenant Colonel Earl "Pete" Ellis foresaw that a future war in the Pacific would

[1] See Allan R. Millett, "Patterns of Military Innovation in the Interwar Period," in *Military Innovation in the Interwar Period*, ed. Williamson Murray and Allan R. Millett (New York: Cambridge University Press, 1996), 329–68; and Williamson Murray, "Innovation: Past and Future," in Murray and Millett, *Military Innovation*, 312–17.

require the Marine Corps to master the art of amphibious warfare.[2] The interwar period also saw many technological innovations, such as improvements to wireless radios and the increased use and effectiveness of aircraft, which provided the raw tools required for effective naval gunfire support during landing operations. Given these developments, the U.S. Navy and Marine Corps seemingly had in place most of the preconditions required to catalyze the creation of an effective system for naval gunfire.

Yet military innovation does not occur simply because the necessity of a new system or process and the technology to support it are present. Despite the strides Navy and Marine Corps planners had made toward an effective landing doctrine in the pre- and early-war periods, naval gunfire support remained underdeveloped on the eve of Pearl Harbor. Early combat experiences in the Aleutians, the Solomons, and North Africa revealed weaknesses in American naval gunfire support, but prewar assumptions remained unchallenged until U.S. forces conducted an amphibious assault against a fortified Japanese position on 20 November 1943 at Tarawa Atoll. Naval gunfire in support of the landing proved largely ineffective, and the 2nd Marine Division's attack nearly foundered at the water's edge while taking 30 percent casualties.[3] Confronted with this failure, the Navy had to undertake a process of rapid evolutionary change in its training, planning, and implementation of naval gunfire support.

Fortunately for the United States, the stern teacher of combat found a receptive audience due to the Navy's culture of innovation.[4] Naval gunfire support swiftly matured after late 1943 owing to updated targeting processes, intensive training, improved technology, and new techniques,

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[2] Fleet Marine Force Reference Publication (FMFRP) 12-46, *Advanced Base Operations in Micronesia* (1921; repr., Washington, DC: United States Marine Corps, 1992), v–vi. Hereafter cited as FMFRP 12-46.

[3] S. Matthew Cheser and Nicholas Roland, *Galvanic: Beyond the Reef—Tarawa and the Gilberts, November 1943* (Washington, DC: Naval History and Heritage Command, 2020), 53.

[4] Trent Hone, *Learning War: The Evolution of Fighting Doctrine in the U.S. Navy, 1898–1945* (Annapolis, MD: Naval Institute Press, 2018), 4.

A Japanese blockhouse on Betio Island, November 1943. Admiral Chester W. Nimitz, CINCPAC, and a party of Navy and Marine Corps officers inspected this and other installations on Betio after the island's seizure. Recognition of the ineffectiveness of American naval gunfire against many enemy fortifications during the Tarawa invasion initiated a cycle of rapid improvement in the planning, training, and application of naval gunfire support in the Pacific. (NHHC, NH 62567) all subject to iterative refinement via a system of feedback loops with origins in prewar Navy culture. This organizational capacity for learning and innovation would manifest itself in the development of a system of effective naval gunfire support that played an important role in winning the Pacific war.

After World War I, American naval planners began to consider the problem of naval gunfire once they identified amphibious assaults as key operations in the anticipated future war in the Pacific. The Marine Corps published the work of intelligence officer and war planner Lieutenant Colonel Ellis in 1921 as Operation Plan 712: *Advanced Base Operations in Micronesia*.[5] Five years later, the Navy formally assigned an amphibious mission to the Marine Corps. Several fleet problems in the early to mid-1920s involved amphibious exercises that helped identify shortcomings in landing craft and other issues, but planning and experimentation with amphibious doctrine accelerated with the 1933 reorganization of the Marine Corps as a Fleet Marine Force. In the same year, Assistant Commandant John H. Russell Jr. assigned the Marine Corps schools at Quantico, Virginia, the task of creating a doctrine for landing operations. The result was the 1934 *Tentative Manual for Landing Operations*. With the aid of the Marine Corps schools' naval advisors, the manual's authors addressed one chapter to naval gunfire in support of landing operations.[6] The Navy published Fleet Training Publication (FTP) 167 in 1938, a work that expanded on the core doctrine developed by the Marine Corps. FTP

[5] FMFRP 12-46, v–vi.

[6] Chris K. Hemler, "'Getting the Shells to Fall Where You Want Them': Coordinating U.S. Naval Gunfire and Air Support in the Interwar Period," *Marine Corps History* 6, no. 1 (Summer 2020): 9–10; Donald M. Weller, "Salvo – Splash! The Development of Naval Gunfire Support in World War II: Part I," *Proceedings* 80, no. 8 (August 1954): 841. Although the failure of naval gunfire in the disastrous Gallipoli campaign of 1915 seemed at first blush to support Lord Horatio Nelson's supposed maxim, "A ship's a fool to fight a fort," Marine Corps and Navy planners studied the campaign closely and believed that naval gunfire, properly applied, would serve an effective and vital role in the Marine Corps' new amphibious mission. See Angus Murray, "The U.S. Marine Corps and Gallipoli," in *On Contested Shores: The Evolving Role of Amphibious Operations in the History of Warfare*, ed. Timothy Heck and B. A. Friedman (Quantico, VA: Marine Corps University Press, 2020), 147–66.

167 provided the doctrinal foundation upon which the Navy and Marine Corps would rely in waging amphibious war after Pearl Harbor.[7]

Interwar planners acknowledged both the advantages and the limitations of naval gunnery in engaging targets on land. Naval gunfire support would take place during prelanding bombardment and in support of landing forces once ashore. Two distinct effects could be achieved with naval gunfire: destruction or neutralization. Fires for destruction would permanently demolish enemy fortifications and destroy enemy formations, while neutralization effects were only temporary and rendered enemy personnel ineffective through casualties, shock, and partial destruction of fortifications.[8] Although destruction could be desirable in some cases, such as reduction of enemy coastal artillery positions prior to an assault landing, the experience of field artillery on the Western Front in the First World War indicated that the effect was difficult and required tremendous amounts of ammunition. Consequently, Western Front field artillery tactics established the precedent of neutralization as the goal prior to an assault on a prepared position.[9] Unlike field artillery, ships could maneuver to advantageous firing positions to mitigate some of the limitations inherent in their weapon systems. Limitations included the high velocity and correspondingly flat trajectory of naval ordnance, which gave impressive range and destructive power to naval gunfire, but limited the ability of troops to follow supporting fires closely. Flat trajectories also prevented the engagement of reverse slopes or small, silhouetted point targets like pillboxes.

Furthermore, the anticipation of a Mahanian decisive fleet action remained foremost in the minds of Navy planners, even though they had identified the importance of amphibious assault operations. Ships' magazines

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7 FTP-167, Change 3, *Landing Operations Doctrine: United States Navy, 1938* (Washington, DC: U.S. Government Printing Office, 1938), https://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/l/landing-operations-doctrine-usn-ftp-167.html.

8 FTP-167, 113–15.

9 Michel Goya, *Flesh and Steel during the Great War: The Transformation of the French Army and the Invention of Modern Warfare*, trans. Andrew Uffindell (Barnsley, UK: Pen & Sword Books, 2018), 242, 251; Paddy Griffith, *Battle Tactics of the Western Front: The British Army's Art of Attack, 1916–1918* (New Haven, CT: Yale University Press, 1994), 142–51.

consequently had to maintain enough standard armor-piercing shells to support any anticipated naval combat, limiting the number of high-explosive shells available for use against land targets.[10] Enemy air and naval forces also posed a danger to ships in support of a landing, so bombardments needed to be short to preserve surprise, buying time to prepare for enemy counterattacks and allowing naval forces to maneuver against enemy threats that materialized. Related to the prioritization of readiness for naval combat was the assumption that ships must engage fortified enemy positions while maneuvering rapidly to prevent losses from coastal artillery, inherently reducing the accuracy of their gunfire.[11] The limitations imposed by magazine capacities, the anticipated danger from coastal artillery, and a reliance on artillery tactics developed in the First World War culminated in an explicit assumption by FTP 167 that "most targets engaged by naval gunfire" would "be of the type for which neutralization is appropriate."[12]

The publication of FTP 167 was one of many examples of the Navy's institutional capacity for innovation and learning during the interwar years, a period in which the Navy created an effective framework upon which it could build and innovate with new methods and technologies. During the interwar period, forward-thinking officers such as William S. Sims helped institutionalize "a broad learning cycle that integrated war planning in OPNAV [Office of the Chief of Naval Operations], experimentation and learning at the Naval War College, and fleet exercises."[13] This process supported the development of doctrine through "a deliberately created system of learning" and encouraged doctrinal experimentation at the fleet level.[14] Landing exercises of the 1920s and 1930s and the publication of manuals for landing operations were part of this system of learning and bottom-up

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[10] Walter C. Ansel, "Naval Gun Fire in Support of a Landing," *Marine Corps Gazette* 17, no. 1 (May 1932): 23–26.

[11] Donald M. Weller, *Naval Gunfire Support of Amphibious Operations: Past, Present, and Future* (Dahlgren, VA: Naval Surface Weapons Center, 1977), 47.

[12] FTP-167, 114.

[13] Hone, *Learning War*, 127.

[14] Hone, *Learning War*, 135.

innovation. Yet absent the experience of actual combat, the lessons learned in training exercises, historical studies, and war games were necessarily limited.

Fleet landing exercises between 1935 and 1939 helped to refine American amphibious doctrine, but they failed to predict the actual wartime conditions of amphibious landings. Insufficient prewar service budgets meant that these exercises were small in scale and could not replicate the complexity of the operations that would characterize the Pacific war. Additionally, risk aversion meant that training conditions were unrealistic, with live naval gunfire often engaging targets on beaches far away from where troops were landed. The targets themselves were typically flags or wooden structures rather than the hardened positions that landing forces would eventually encounter in the Second World War.[15] Finally, the ability to coordinate called fires between ship and shore was in a rudimentary stage of development in the pre- and early-war periods, with Navy officers and crew members tasked on an as-needed basis to go ashore with marines and provide gunfire liaison and spotting. Systematic planning and coordination of naval gunfire support was not developed in the interwar period, nor was naval gunfire considered anything more than an additional duty.[16]

Following the United States' entry into the Second World War in December 1941, U.S. forces soon found themselves conducting amphibious operations around the world. The Navy published Change 3 to FTP 167 in September 1943, a revision based on experiences gained in operations in the Solomons, North Africa, the Aleutians, and the Mediterranean in 1942 and 1943.[17] For example, Change 3 provided more explicit guidance than previous versions for the phasing and expected timeline of landing operations,

[15] Hemler, "Getting the Shells to Fall Where You Want Them," 15–17.

[16] Steven M. Selig, *ANGLICO: Not Many–But Much* (n.p.: Agreka History Preserved, 2011), 13; Weller, "Salvo–Splash!," 842–43.

[17] Donald K. Mitchener, "The American Doctrine for the Use of Naval Gunfire in Support of Amphibious Landings: Myth vs. Reality in the Central Pacific of World War II" (master's thesis, University of North Texas, 2006), 26–63.

and it outlined a detailed system for classification of fires.[18] In addition to doctrinal refinement, in the early-war period the Navy sought to improve naval gunfire support training and techniques such as called fire. In recognition of the importance of competent gunnery against land targets, the Navy purchased Bloodsworth Island, Maryland, in 1942 and Kahoolawe, Territory of Hawaii, in October 1943 to serve as naval gunfire training ranges.[19] The Navy and Marine Corps also continued to develop their own shore fire-control parties, but the Army's creation of the signal company (special) in September 1942 provided the model that would be adopted as the joint assault signal company (JASCO, later shortened to ASCO) in October 1943.[20] Instead of relying as before upon ad hoc assemblages of naval officers, signalmen, and marines for shore fire-control parties, JASCOs provided a dedicated, specialized, interchangeable organization for all phases of naval gunfire support.

By the fall of 1943, the U.S. Central Pacific Force prepared to seize Tarawa Atoll in the Gilbert Islands as the first step in a new Central Pacific offensive. Although a process of incremental improvements to naval gunfire doctrine and techniques was underway, prior combat experiences had not provided American staffs in the Pacific with an adequate understanding of the level of coordination and techniques required to achieve synchronized, effective fires during contested landing operations. As one participant in the Solomons campaign recalled, "Gunfire operations throughout the entire Solomons campaign were characterized by a high degree of informality."[21] The Japanese defenses at Tarawa proved to be a different problem entirely for naval gunfire support.

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[18] FTP-167, 113–15. Fires were classified by five criteria: the effects sought, the forms taken, whether they were prearranged, the tactical purposes sought, and the method of fire control needed to complete them.

[19] Robert D. Heinl Jr., "Naval Gunfire Training in the Pacific," *Marine Corps Gazette* 32, no. 6 (June 1948): 11–12.

[20] Rebecca Robbins Rains, *Getting the Message Through: A Branch History of the U.S. Army Signal Corps*, 292, 312n22; Selig, *ANGLICO*, 15, 23.

[21] F. P. Henderson, "NGF Support in the Solomons," *Marine Corps Gazette* 40, no. 3 (March 1956): 46.

Unlike the Solomons and Aleutians, Tarawa's main island, Betio, had been heavily fortified by the Japanese, who planned to defeat American landing forces at the waterline. Mutually supporting hardened positions studded the island and obstacles denied most approaches to the shoreline, channeling landing craft into areas covered by Japanese fire. Betio bristled with heavy weaponry: the approximately 1.5-square-mile island hosted 58 guns firing 37-millimeter or larger ammunition, including four 8-inch naval rifles, and approximately 3,000 Japanese combat troops.[22]

The fire-support plan for the Betio landings mostly adhered to naval gunfire support doctrine at the time of the operation, but incorporated some new techniques. Recognizing the strength of the Japanese defenses and having learned from the American experience with French coastal forts in North Africa, staffers planned for the fire-support ships to close on Betio and maneuver slowly in order to achieve a greater likelihood of target destruction.[23] However, concerns about a counterattack by the nearby Japanese Combined Fleet meant that preparatory fires would be limited to less than three hours of total air and naval bombardment on D-Day. This was the model timeline presented in FTP 167, and American planners believed that the short duration of bombardment would preserve an element of surprise and prevent the exposure of naval forces to Japanese naval attack.[24] The firing plan also instructed ships to shift to new target areas periodically to achieve "surprise" in the pattern of bombardment.[25] With three old-model battleships, four cruisers, and nine destroyers dedicated to shelling Betio, the fire-support group commander, Rear Admiral Howard F. Kingman, was confident that the weight of American firepower targeting the island would be at least sufficient to neutralize the Japanese positions ashore.[26]

The prelanding bombardment lobbed approximately 3,000 tons of projectiles at Japanese defenses, but air and naval gunnery fires quickly became

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[22] Cheser and Roland, *Galvanic*, 5–7, 10–12, 13.

[23] Weller, "Salvo–Splash!," 846.

[24] FTP-167, 115; Cheser and Roland, *Galvanic*, 22.

[25] Weller, "Salvo–Splash!," 847.

[26] Cheser and Roland, *Galvanic*, 42.

desynchronized. All supporting fires lifted early, while the U.S. Marine landing force was still approaching the beach, and the Japanese defenders had about 15 minutes to recover from the bombardment. The fires did achieve some neutralization effects, as the first three waves of marines got ashore without undue difficulty. Once on the beaches, however, Japanese defenses proved to be intact and quickly halted the marines' advance with heavy casualties. Accurate Japanese fire took a deadly toll on subsequent landing waves in the lagoon kill zone. By the end of the first day of combat, the 2nd Marine Division had suffered approximately 1,500 casualties out of 5,000 troops sent onto Betio, and it clung to small beachheads against determined Japanese resistance. Major General Holland Smith finally declared the island to be under control of the marines after three days of combat. More than 1,000 Americans had died in the fighting.[27]

Operations at Tarawa suffered from many problems, with ineffective preparatory fires being high on the list of failures identified by Navy and Marine Corps after-action reports. Instead of what had amounted at Betio to neutralization fire, fire-support groups in the future had to pinpoint hardened enemy positions and fire slowly until they achieved destruction.[28] Moreover, the techniques of mapping and designating naval gunfire targets had proven "cumbersome and inaccurate."[29] The use of high-explosive shells designed to engage troops and light installations was insufficient to achieve destruction. After-action reports recommended the future employment of armor-piercing shells against hardened structures and positions dug into coral and rock.[30] Fire-support plans also had to be conditions based, rather than set to a timetable, in order to avoid the disastrous early lifting of fires as had occurred at Betio.[31] Adequate command and control demanded the introduction of specialized amphibious command

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27 Cheser and Roland, *Galvanic*, 42–60.

28 Cheser and Roland, *Galvanic*, 74.

29 Quoted in Henry I. Shaw Jr., Bernard C. Nalty, and Edwin T. Turnbladh, *History of U.S. Marine Corps Operations in World War II*, vol. 3, *Central Pacific Drive* (Washington, DC: Historical Branch, U.S. Marine Corps, 1966), 110n22.

30 Cheser and Roland, *Galvanic*, 74.

31 Weller, "Salvo–Splash!," 849.

ships, waterproofed radios to support called fire, and aerial spotting for both accurate gunfire and synchronizing fires with the progress of troops approaching shore. After-action reviews also determined that air support could occur simultaneously with naval gunfire, so long as the aircraft stayed above the maximum ordinate of gun projectiles.[32]

Navy and Marine Corps leadership quickly gathered, distributed, and incorporated the lessons learned at Tarawa into training and planning for future operations. At Pearl Harbor, a team of Army, Navy, and Marine Corps intelligence and mapping officers developed the new tactical area designation system to improve the process of joint targeting. All service agencies adopted the new fire-control system in future Central Pacific operations.[33] Thousands of miles away, the Bureau of Ordnance asked the Navy's testing ground at Dahlgren, Virginia, to replicate the Japanese fortifications encountered at Betio. Once completed, these reconstructions became targets for naval gunfire experiments to evaluate the best shell-fuse combinations for future operations.[34] The JASCO organization replaced the shore fire-control parties that were still in use at Tarawa, and the new range at Kahoolawe provided an invaluable resource for the training of JASCOs and ASCOs, ships' crews, and gunfire spotter pilots.

While Tarawa's aftermath set in motion a process of continuous updates to training, techniques, and technological aspects of naval gunfire support in the Pacific, the Navy also rapidly implemented its lessons in the near term. The seizure of Kwajalein Atoll beginning on 31 January 1944 saw a radical departure from the concept of neutralization fire employed only two months prior at Tarawa. At Roi-Namur Island, the primary northern objective at Kwajalein, fire support ships and aircraft subjected the Japanese position to

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32 Roland and Cheser, *Galvanic*, 75–76. For a more extensive discussion of after-action reports and recommendations from the Tarawa operation, see James P. McGrath III, "Missing the Mark: Lessons in Naval Gunfire Support in Tarawa," in Heck and Friedman, *On Contested Shores*, 232–34.

33 Shaw, Nalty, and Turnbladh, *Central Pacific Drive*, 110n22.

34 James P. Rife and Rodney Carlisle, *The Sound of Freedom: Naval Weapons Technology at Dahlgren, Virginia, 1918–2006* (Dahlgren, VA: Naval Surface Warfare Center, Dahlgren Division, 2006), 70–71.

Destroyed blockhouse on Roi-Namur Island, February 1944. The contrast with naval gunfire effects achieved at Betio only two months before is obvious. (NHHC, S-065)

a day and night of slow, close-range preparatory bombardment prior to firing in direct support of the U.S. Marine landings. In a tactic that had been proposed and rejected at Tarawa, marine artillery landed on secondary objectives the day prior and added to the weight of the bombardment. Fires were coordinated from the joint operations center on the new amphibious command ship *Appalachian* (AGC-1), covering troops in landing craft up to the last few hundred yards of the approach.[35] Less fortified than Betio, Roi-Namur received about 88 percent of the amount of American ordnance, but with starkly differing results.[36] All but one Japanese blockhouse was destroyed by naval gunfire, and Major General Harry Schmidt, commander of the 4th Marine Division at Roi-Namur, credited aerial and naval bombardment with killing a majority

[35] I. E. McMillian, "Naval Gunfire at Roi-Namur," *Marine Corps Gazette* 32, no. 7 (July 1948): 53–54.

[36] Mitchener, "The American Doctrine," 175.

of the Japanese garrison.[37] A similar pattern played out at the southern objective, Kwajalein Island. American forces seized Kwajalein Atoll within a week at a price of 372 combat deaths versus 7,870 for the Japanese.[38]

From late 1943 until the Japanese capitulation in September 1945, the Navy engaged in an iterative learning process, resulting in constant innovation in the training, doctrine, and implementation of naval gunfire support. To support this cycle of rapid learning, Pacific Fleet habitually gathered after-action reports and disseminated a variety of classified publications. These products ranged from short operational histories to lessons-learned circulars encompassing everything from techniques for the use of white phosphorus and illumination shells to the problems of living on board a ship during extended bombardment operations.[39]

This growing body of knowledge was in turn incorporated into training, updates to formalized doctrine, and operational planning. For example, naval gunfire support training became increasingly demanding and sophisticated, and drew on combat experiences for constant updates to techniques and procedures. Operated by the Naval Gunfire Section, Fleet Marine Force, Pacific, the Kahoolawe gunnery range trained replacement ASCO personnel and initiated a cycle of rapid learning by recalling ASCOs to Hawaii after major operations. Training with these veterans helped to integrate the latest techniques in naval gunfire into the training program, thereby constantly improving and updating standard practices in the Pacific. The range also established ties with the Pacific Fleet's Gunnery and Torpedo School and

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[37] McMillian, "Naval Gunfire at Roi-Namur," 55; Shaw, Nalty, and Turnbladh, *Central Pacific Drive*, 224. On the effectiveness of naval gunfire at Roi-Namur, see also Samuel Eliot Morison, *History of United States Naval Operations in World War II*, vol. 7, *Aleutians, Gilberts and Marshalls, June 1942–April 1944* (Boston: Little, Brown, 1951), 243, 246.

[38] Morison, *Aleutians, Gilberts and Marshalls*, 278.

[39] "Extracts from Pacific Fleet Confidential Notice 36CN-44," in *Shore Bombardment* (n.p.: Training Command, Amphibious Forces, U.S. Pacific Fleet, 1944–45), Special Collections, Navy Department Library, Naval History and Heritage Command, Washington Navy Yard, DC. See also a number of histories published by the Office of Naval Intelligence, such as *Battle Experience: Bombardments of Iwo Jima, November 1944–January 1945;* and *Third Fleet Operations in Support of Central Luzon Landings–including the South China Sea Sweep, 30 December 1944–23 January 1945* (Washington, DC: United States Fleet, Headquarters of the Commander in Chief, Navy Department, 1945).

combat information center school, ensuring dissemination of the latest naval gunfire doctrine through the fleet. Gunnery qualification exercises at the range became a standard expectation for ships rotating in and out of Hawaii, further establishing common doctrine throughout the theater. Air-spotting training also took place at the "most shot-at island in the Pacific." By September 1945, 532 major combatant ships and hundreds of ASCO personnel and air-spotting pilots had undergone training at Kahoolawe.[40]

Pacific Fleet, as well as other proponents, also published periodic updates to formalized naval gunfire doctrine, with its first fleet-specific revision to FTP 167 guidance coming on 1 May 1944.[41] In a longstanding pattern of doctrinal development, surface warfare type and other subordinate commands established and disseminated their own updates to doctrine, facilitating a high degree of specificity in naval gunfire support practices.[42] At the operational and tactical levels, the planning and execution of naval gunfire support in the campaigns of 1944 and 1945 took on a degree of sophistication unheard of prior to Tarawa, with an emphasis on prelanding bombardment. Naval gunfire targeting became a detailed planning process involving coordination between the marine intelligence and operations staffs, as well as the naval gunfire officer at echelon and the naval fire support unit staffs. In recognition of the inherent variables in intelligence and operational conditions, authority for execution of the bombardment shifted over time down the chain of command from the commander of naval attack forces to the commander of fire support. Prelanding bombardments achieved synchronization through the use of air spotters and gunfire spotters in radio-equipped boats on the flanks of landing beaches. ASCOs now provided expertise in called fire for troops ashore, and instead of the prewar model of naval liaisons from fire-support

[40] Quoted in Robert D. Heinl Jr., "The Most Shot-At Island in the Pacific," *Proceedings* 73, no. 4 (April 1947): 397–98; Heinl, "Naval Gunfire Training in the Pacific," 12–15.

[41] "Pacific Fleet Confidential Letter 13CL-44," 1 May 1944, in *Shore Bombardment*.

[42] See "Cruiser Gunfire Support in Landing Operations, Cruiser Tactical Bulletin No. 2-45," 10 March 1945; "Destroyer Gunfire Support in Landing Operations, Destroyer Tactical Bulletin No. 3-45," 4 February 1945; and "General Order No. 35-44, Fleet Marine Force Pacific," 17 December 1944, all in *Shore Bombardment*.

ships attaching to their supported land units, marine fire-support liaisons now operated on board fire-support ships.[43]

Despite the Japanese ability to continue inflicting high casualties, the maturation of American naval gunfire support meant that the Japanese could not stymie the most critical phase of an amphibious assault: the movement from ships to shore and initial objectives. Once ashore, newly developed ASCOs and called fire techniques allowed Marine Corps and Army units to call on accurate and timely naval gunfire support to destroy Japanese defenses and break up counterattacks. At Iwo Jima, a single U.S. Marine division executed more than 1,000 naval gunfire missions in support of inland operations.[44] The testimony of Japanese commanders throughout the theater after Tarawa speaks to their respect for the effectiveness of American naval gunfire support. Japanese reports from Guam stated that "the interruptive operation of the severe bombardments" prevented resistance to an American landing.[45] Lieutenant General Tadamichi Kuribayashi, commander of Iwo Jima, likewise reported to Tokyo, "However firm and stout pillboxes you may build at the beach, they will be destroyed by bombardment of main armament of the battleships." In his estimation, this meant the Americans were capable of carrying out "every landing operation possible to whatever beachhead they like[d]."[46] While at a strategic level the industrial might of the United States meant that the Japanese could not win a war of attrition, at the operational and tactical levels, the sophisticated application of naval gunfire support was crucial to successful landing operations and support for troops in combat ashore.[47]

The interwar Navy's culture of innovation and institutionalized system of feedback loops promoted rapid learning in wartime. At the conclusion of

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[43] William B. Oldfield, "Our Naval Gunfire Preparation," *Marine Corps Gazette* 29, no. 7 (July 1945): 43–44.

[44] William B. Oldfield, "Shore Fire Control Parties," *Marine Corps Gazette* 29, no. 11 (November 1945): 54.

[45] Quoted in Shaw, Nalty, and Turnbladh, *Central Pacific Drive*, 462.

[46] Quoted in Weller, *Naval Gunfire Support*, 98.

[47] Douglas Ford, "Brute Force or Combat Finesse? The Evolving Role of Firepower in US Amphibious Operations against the Imperial Japanese Forces, 1941–1945," *War in History* 23, no. 3 (July 2016): 351–61.

each operation, lessons were gathered, disseminated, and incorporated into a system that supported continuous improvement in training, planning, tactics, and techniques. This cycle meant that the application of naval gunfire shifted radically from 1943 to 1945 in the Pacific, with clear results initially realized only two months after the Tarawa operation. In the amphibious assault phase, naval gunfire support doctrine transitioned from one of brief, long-range neutralization fire without effective synchronization with other elements of the operation to one that emphasized multiday, close-range firing for destruction and synchronization with aerial bombardment and the progress of ground troops, all aided by air spotters and ASCO personnel. Once ashore, new called fire techniques allowed support for American troops that was virtually unimaginable just a few years prior. Innovation in naval gunfire support techniques did not win the Pacific war, but it minimized American casualties and proved to be a key factor in dozens of successful amphibious assaults on the long road to victory.

CHAPTER FOUR

The Genesis of Underwater Demolition Teams in the Pacific in World War II: Innovating Special Warfare

Guy J. Nasuti

The landings of 20 November 1943 on Betio Island, Tarawa Atoll, proved extremely costly for the U.S. Marine Corps. Vice Admiral Richmond Kelly Turner, overall commander of the invasion force, had planned a massive naval and air bombardment of Japanese defenses to soften them up for the follow-up amphibious assault by the 2nd Marine Division. Despite using charts from the previous century, the planners believed the destruction of the Japanese garrison on Betio would require only a single day. Confidence in achieving a quick seizure of the island ran high, especially among Navy officers. "We will not neutralize, we will not destroy; we will obliterate the defenses on Betio," promised Admiral Howard F. Kingman, the naval bombardment force commander for Tarawa.[1]

Unfortunately for the U.S. Marines, this is not what happened. Because the naval bombardment had proven ineffectual, Japanese defenses remained intact and follow-up waves of landing craft ran aground on coral reefs covered by much less water than was anticipated, preventing succeeding waves of marines from reaching the beachhead. Running into a murderous fusillade of machine-gun, artillery, and mortar fire, the marines took heavy casualties. In three days at Tarawa, 997 marines and 30 sailors were killed in action, and another 2,292 Marine Corps and Navy personnel wounded. The

[1] John Costello, *The Pacific War, 1941–1945* (New York: HarperCollins, 1981), 432.

Rear Admiral James L. Kauffman presents his son, Lieutenant Commander Draper L. Kauffman, a gold star in lieu of a second Navy Cross for heroism. Ceremonies took place prior to 1 September 1944 in Pearl Harbor. (NHHC, 80-G-244700) landing of additional reserves, artillery, and tanks helped turn the tide, but a horrified American public (as well as leadership in the Navy and Marine Corps) demanded answers for the tremendous loss of life. Admiral Turner swore the Navy would never again make the same mistakes that led to "Terrible Tarawa."[2]

Despite the success of the Gilbert Islands campaign, Admiral Turner felt that his worst performance occurred not at Tarawa but at the simultaneous assault on Makin Island. The narrowness of Makin's beaches made it a poor choice as a landing site for the amphibious assault and resulted in a nightmare for getting supplies ashore. Had aerial photographs of the western beaches taken in July–October 1943 been forwarded to the proper joint intelligence center for close examination, a proper plan for the amphibious assault might have been drawn up. Without this vital intelligence, Turner's staff fatally reasoned that the LCVP (landing craft, vehicle, personnel) could easily reach the beach at any time. The mistakes made during the assaults at Tarawa and Makin led Admiral Turner to admit, "That's why I pushed [for] the development of the Underwater Demolition Teams so hard."[3]

While the experience of Tarawa and Makin prompted Turner to call for the development of underwater combat demolitions units, the seeds for creating such a specialized combat force had already begun to take shape in Washington. Six months prior to the battle of Tarawa, on 6 May 1943, Admiral Ernest J. King, Commander in Chief, U.S. Fleet, and Chief of Naval Operations, directed the "Naval Demolition Project" to make provisions "to meet a present and urgent requirement" for Amphibious Forces, Atlantic Fleet.[4] The "present and urgent requirement" was an unrealized plan for a highly trained group of individuals who could swim into enemy-held waters to find and dismantle or destroy any obstacles that could do harm to American seaborne invasion forces or that might prevent amphibious landings. At the outset of the war, such a unit in the U.S. Navy did not exist.

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[2] Costello, *Pacific War*, 432.

[3] James Douglas O'Dell, *The Water Is Never Cold: The Origins of the U.S. Navy's Combat Demolition Units, UDTs, and SEALs* (Dulles, VA: Brassey's, 2000), 97.

[4] Francis D. Fane and Don Moore, *The Naked Warriors: The Story of the U.S. Navy's Frogmen* (Annapolis, MD: Naval Institute Press, 1956), 13–14.

The shocking loss of American lives during the Battle of Tarawa caused tremendous concern within the Department of the Navy. Realizing that future amphibious landings on enemy-held islands could not proceed without comprehensive reconnaissance, Navy leadership began experimenting with highly trained units created for such a purpose. Tarawa proved that naval bombardment alone would not eliminate enemy obstacles impeding amphibious operations. Therefore, an elite U.S. Navy force to deal exclusively with beach reconnaissance and the elimination of underwater obstacles began taking shape. The resulting underwater demolition teams (UDTs) trained extensively for clearing enemy obstacles and creating channels for invasion forces to come ashore. Drawing upon the training and experiences of other maritime units predating them, the UDTs proved to be a highly motivated, creative, and successful group of naval warriors. Before the conclusion of the war in the Pacific, the innovation UDTs brought against enemy defenses became an "integral part of amphibious warfare."[5]

Prior to Tarawa, Navy leaders had only marginally considered the potential of sea commandos to wreak havoc on enemy defenses before a seaborne invasion. Taking a cue from the British, at war since 1939, the U.S. Navy thought that the potential for crack seaborne commando units seemed remarkable. At a press conference in Secretary of the Navy William "Frank" Knox's office on 11 March 1942, Admiral Thomas Hart shared his thoughts on both enemy-held defenses and the dangers posed to the U.S. Navy's amphibious force, noting, "The Pacific campaign has been and will continue to be one of amphibious war, the most difficult and least known variety of warfare."[6] Prior to the war, "no one had experimented with the demolition of massed obstacles in amphibious assault."[7] The U.S. Army Corps

[5] "Demolition Lectures: Chapter 1, Section 1, History of Underwater Demolition Teams," n.d., 1, World War II Command File, 1939–1945, Operational Archives Branch, Naval History and Heritage Command, Washington Navy Yard, DC.

[6] "Pre-war Training," in Commander in Chief, U.S. Pacific Fleet, *History of the Amphibious Forces, US Pacific Fleet*, vol. 1 (Washington, DC: U.S. Government Printing Office, 1945), 9.

[7] James Douglas O'Dell, "Joint-Service Beach Obstacle Demolition in World War II," *Engineer* 35, no. 2 (April–June 2005): 36.

of Engineers, tasked with developing ways to destroy beach obstacles in the interwar period, began taking the lead by the end of 1942. The Army already had a few months' lead on experimenting with underwater demolition prior to Admiral King's directive, but King swiftly ordered work and training toward permanent naval demolition units for assignment to other amphibious forces in both the Atlantic and Pacific theaters of war. The first phase of this plan included a letter to the chief of the Bureau of Yards and Docks directing the dispatch of 8 officers and 30 enlisted men for duty with Operational Demolition Unit and Naval Demolition Unit No. 1, established at Amphibious Training Base (ATB), Solomons, Maryland. These 38 men all reported from the construction battalion (or CB, better known as "Seabee") training camp at Camp Peary, Williamsburg, Virginia, transferring to ATB Solomons only eight days after King's directive.

A determined and scholarly-looking naval officer, Lieutenant Commander Draper L. Kauffman played a large role in shaping highly trained, innovative units of naval commandos with the naval combat demolition units (NCDUs) and UDTs. A graduate of the Naval Academy class of 1933, Kauffman had been prevented by poor eyesight from receiving his commission. Determined to join the war effort already underway in Europe by 1939, he left for France to become a driver with the American Volunteer Ambulance Corps. After Germany invaded and occupied France in May 1940, the Wehrmacht captured Kauffman, and he spent time in a prison camp before a release of American prisoners brought him to England. Undaunted, he quickly volunteered for mine disposal with the British Royal Naval Volunteer Reserve, receiving two commendations from the British Admiralty, and a third from King George VI for his efforts and bravery in dismantling unexploded German ordnance. After resigning from the Royal Navy, Kauffman accepted an appointment as a lieutenant in the U.S. Naval Reserve on 7 November 1941. His previous bomb disposal experience with the Royal Navy put him in high demand after the Japanese attack on Pearl Harbor a month later. Rushed to Honolulu, Kauffman recovered an unexploded 500-pound bomb discovered on the grounds of Schofield Barracks. In recognition for his skill and bravery in disassembling this bomb, Kauffman received the Navy Cross.[8]

A phenomenal organizer, Kauffman received orders from Admiral King to begin the Navy's Bomb Disposal School at the Washington Navy Yard in January 1942. He also assisted in establishing a comparable school for the U.S. Army at Aberdeen, Maryland. In June 1943, after Kauffman earned a promotion to lieutenant commander, Admiral King issued further orders to the experienced bomb disposal expert, directing him to organize the first Navy demolition teams. Scouting a place to train, Kauffman decided to move his experimental group to the site at the amphibious base at Fort Pierce, Florida, where Army demolition units were already training. With steely determination and an innate ability to get things done quickly and effectively, Kauffman and his small staff established the naval combat demolition unit school at Fort Pierce on 6 June 1943.[9]

Realizing he needed students to begin training in combat demolition, Lieutenant Commander Kauffman began recruiting officers from the Seabees and the Bomb Disposal School at the Washington Navy Yard. The enlisted men were drawn from Seabee trainees at Camp Peary, informed only that they would be volunteering for hazardous duty. To build the

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[8] Elizabeth Kauffman Bush, *America's First Frogman: The Draper Kauffman Story* (Annapolis, MD: Naval Institute Press, 2004), 1–9, 62–63. According to Kauffman's daughter, Congress passed a law during the Great Depression that permitted only half the graduates of the U.S. Naval Academy classes of 1932 and 1933 to receive commissions. Kauffman joined the unfortunate half of midshipmen from the class of '33 without a commission when the Naval Academy raised vision acuity from 18/20 to 20/20. The young academy graduate, now a civilian, went on to become technical director on Hollywood film *Midshipman Jack*, before luckily (in the midst of the Depression) managing to secure a job as an assistant operations manager with United States Lines, a shipping company. Working in a series of offices located in New York, Great Britain, and France, the young Kauffman arrived for two unforgettable months in Germany. Witnessing the turbulent Germany of the mid-to-late 1930s sent Kauffman on the free lecture circuit around New York and New Jersey in a vain attempt to warn fervent isolationist Americans about the growing threat of Hitler's Third Reich. The prevailing sentiment in the country prevented the determined academy graduate from reaching any like-minded followers, and so the undeterred Kauffman managed to secure a six-month leave of absence from United States Lines in order to join the American Volunteer Ambulance Corps in France.

[9] Bush, *America's First Frogman*, 78–81.

successful amphibious force he envisioned, Commander Kauffman recognized he needed to select recruits who were intelligent, had the ability to think quickly on their feet, were in extremely good physical shape, and had no fear of handling demolitions. All of these individual and team-building abilities remain highly sought after and valued in sea, air, land (SEAL) teams today. In reality, Kauffman "did not have a clue how many men he would eventually need."[10] Casting a wide net for those types of individuals early in the war forced him to also temporarily search outside of the Navy. According to Lieutenant (j.g.) Francis Kaine, one of the first volunteers trained in naval combat demolition, "Kauffman gathered 500 men from the Seabee units, a couple of British commandos, and several U.S. Army Rangers."[11]

Commander Kauffman also contributed the rigorous training program first instituted at Fort Pierce. Contracting with the joint Army-Navy Scouts and Raiders (S&R) group, also training at Fort Pierce, he asked the instructors to condense their eight-week physical training course into one week for his trainees. The completely volunteer program, designed to weed out anybody "who was not tough enough for the tremendous endurance," resulted in a 40 percent dropout rate after the first "Hell Week." [12] Kauffman himself successfully passed the grueling training phase alongside men nearly 15 years younger. The infamous Hell Week of NCDU and UDT training continues through the present day, as every basic underwater demolition/SEAL (BUD/S) candidate must complete the extraordinarily rigorous weeklong training evolution before becoming a Navy SEAL. The purpose of Hell Week has the additional benefit of building an "enormous esprit de corps among the survivors."[13] Despite accomplishing a great deal with originating naval combat demolition, Kauffman was not directly responsible for the formation of UDTs. According to former Navy SEAL officer and author Tom Hawkins, "The UDTs were formed in December 1943, while Kauffman was

[10] Bush, *America's First Frogman*, 81.

[11] Francis R. Kaine, "Draper Kauffman and the UDTs," *Naval History*, Winter 1990, 46.

[12] Bush, *America's First Frogman*, 82–83.

[13] Bush, *America's First Frogman*, 82–83.

still at Fort Pierce. He did, however, leave his training position in April 1944 to become commanding officer (CO) of UDT-5."[14]

A graduate with the first group of naval demolition volunteers, Lieutenant Kaine has argued that the term "UDT" did not come into use until "about halfway through World War II." Before that, he remembered, "Kauffman called us naval combat demolition units." Kaine stated that the UDTs were not intended for deployment in the Pacific theater, remarking, "Many people seem to have the idea that the original area of operation for UDT was the South Pacific—not so. In the beginning, everything was geared toward France."[15] However, according to the U.S. Atlantic Fleet's "A History of the Amphibious Training Command," "the name UDT teams was chosen to avoid confusion with NCDUs."[16]

Prior joint service units preceding UDTs also played a significant role in their development, training, and subsequent operations. As Lieutenant Kaine recalled, there were in fact several groups existing prior to the UDT program that both informed and inspired naval underwater demolitions. Many had a maritime connection but were not strictly Navy groups. These included the Special Service Unit No. 1 of the S&R, Office of Strategic Services Maritime Unit, and NCDUs. Composed of sailors from the boat pool at ATB Solomons and soldiers from the U.S. Army's 3rd and 9th Infantry Divisions, the S&R unit was the direct result of the Army's prewar concepts of beach reconnaissance and demolitions. S&R teams received training at ATB, Little Creek, Virginia, in identifying prospective landing beaches and leading assault forces to landing zones in complete darkness. Training for the S&R moved to Fort Pierce in January 1943, and the joint service Amphibious Scout and

[14] Tom Hawkins, "U.S. Navy SEAL Teams: Origins and Evolution 1942–1962," Defense Media Network, 14 April 2021, https://www.defensemedianetwork.com/stories/origins-and-evolution-of-u-s-navy-seal-teams-1942-1962/.

[15] Kaine, "Draper Kauffman and the UDTs," 46.

[16] Commander in Chief, U.S. Atlantic Fleet, "A History of the Amphibious Training Command, United States Atlantic Fleet and Its Antecedent the Amphibious Force, United States Atlantic Fleet," vol. 2 (unpublished manuscript, n.d.), 77, U.S. Naval Administrative Histories of World War II, Navy Department Library, NHHC, Washington Navy Yard, DC.

Raider School taught raiders to gather intelligence behind enemy lines without revealing their presence.[17]

Ordered to take part in Operation Torch prior to the landings in French Morocco, North Africa (8–10 November 1942), the S&R team conducted the first submarine-launched operation of the war. Under the command of Army lieutenant Willard G. Duckworth, the team launched kayaks from the submarine *Barb* (SS-220) to infiltrate the Jette Principal at Safi, Morocco, and guided destroyers *Cole* (DD-155) and *Bernadou* (DD-153) to gun-support positions just offshore. Admiral Henry Kent Hewitt examined the results of the S&R unit after the landings and decided the raiders should include onshore reconnaissance within their mission purview. In February 1943, Admiral Hewitt sent a memorandum to the commanding general of the Army Ground Forces requesting a specially organized company of engineers. Requesting the unit be available by 1 March 1943, he also directed "the training of Scouts and Raiders in the technique of investigating and destroying beach and underwater obstacles."[18] That Admiral Hewitt directed his request to the Army, and not the Navy, is significant. While his colleagues Admiral Kelly and Admiral King discovered rather early on in the war the need for an underwater demolition combat force, Admiral Hewitt eventually recognized the Navy must develop its own such force, fully independent of the other branches, especially the Army.

After the successful operations at Normandy and Southern France in mid-1944, the Navy finally emerged from out of the Army's shadow, leading the way in underwater demolition. The Navy did this by demonstrating a great ability to adapt to ever-changing wartime conditions and incorporating training and personnel from the varied maritime groups into the UDTs. With Allied armies firmly secure in Europe, and no further amphibious operations envisioned, Navy personnel attached to the NCDUs transferred to the Pacific to join the expanding UDT program. The result of NCDU members incorporating into the UDTs provided for a seasoned corps of veterans with

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[17] O'Dell, "Joint-Service Beach Obstacle Demolition," 38.

[18] O'Dell, "Joint-Service Beach Obstacle Demolition," 38–39.

the knowledge and can-do attitude to perform harrowing demolition work under enemy fire.

In contrast to the way UDTs conducted their amphibious missions, the NCDU teams at Normandy normally followed (instead of preceded) the first assault waves at Omaha Beach and Utah Beach, and began clearing beach obstacles, mines, and other hazards to follow-up waves. Tactically, this differed tremendously from UDT missions in the Pacific, where destroying underwater and beach obstacles prior to island assaults remained paramount. The results at Normandy were extremely telling. At Omaha, the gap assault teams took a greater amount of time to clear their objectives due to stronger enemy defenses. NCDU personnel at Omaha suffered 31 killed and 60 wounded, an astonishing casualty rate of 41 percent. The NCDU team at Omaha would not complete its entire beach-clearing mission until D-Day plus two. Casualties for the NCDU at Utah were far fewer, with 6 dead and 11 wounded.[19] However, the differences between the various maritime units were more than a matter of military branch and geography. Tactics, training, and the gear used in operations were just some of the minor differences, and should not suggest a specific linear evolution of naval commandos. In the opinion of historian James O'Dell, "Naval Combat Demolition Units did not evolve from the Scouts and Raiders, nor did the Underwater Demolition Teams evolve from the Naval Combat Demolition Units. Each had a separate origin, at different locations."[20]

Incorporating the combat experiences of the S&R, Office of Strategic Services Maritime Unit, and NCDU teams, a set curriculum for underwater demolition training at Fort Pierce began taking shape. Volunteers for UDTs often had no idea what they were volunteering for, and recruiters generally shared only that the training would be dangerous. This appealed to young men hoping to do their part in the war, with several graduates considering the UDT an elite outfit. However, UDT training continued incorporating lessons learned with each amphibious invasion. By late 1944, the fairly standardized training consisted of an eight-week course, the first

[19] Kaine, "Draper Kauffman and the UDTs," 8–9.

[20] James Douglas O'Dell, *Water Is Never Cold*, 106.

three days beginning with an orientation period including physical examinations, a strength test, and a 400-yard swim test (later UDT trainees at the base in Maui, Hawaii, had to complete a two-mile swim test). The men were also required to attend an introductory lecture on the "over-all picture of amphibious operations."[21] The trainees next entered the tremendously difficult week of training known as Indoctrination Week, which retained the spirit of Kauffman's notorious Hell Week. This phase of training worked exceedingly well at weeding out recruits who could not complete the hazardous and strenuous performance duties required of all UDT members. The men were required to carry and use 300-pound rubber boats in the water, complete a 20-mile forced march, shallow dive in a pool of 8.5 feet while using various breathing apparatuses, train on the use of an SCR-610 radio, and complete day and night exercises after mastering stealth and concealment in enemy territory. The last goal of their long week was to complete an extended exercise (all while being harassed by heavy explosives fire).[22]

Physical fitness remained of utmost importance throughout the entirety of the eight-week course. Trainees began each day with 30 minutes of calisthenics. Divided into three squadrons, one began combat swimming, the second carried out physical training weighted with heavy logs, while the third squad ran the obstacle course. The obstacles, often built from scratch by Seabees, provided trainees with practical experience in identifying and destroying German and Japanese obstacles. The next phase of training focused on demolitions, becoming one of the most important, and potentially fatal, training phases of the entire eight weeks. Trainees received full lectures and demonstrations before performing hands-on exercises with any munitions. The instructors closely monitored and retested the men regularly to ensure they understood all fundamentals of the explosives used. The students learned all they could ever know about Primacord, shaped charges, Mark 20 demolition charges, TNT, tetrytol, Bangalore torpedoes, explosive hoses, booby-trap devices, and Compositions C, C2, and C3. Shortly before

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[21] U.S. Bureau of Naval Personnel, Training, Standards, and Curriculum Division, *Handbook of Naval Combat Underwater Demolition Training* (Washington, DC: Bureau of Naval Personnel, 1944), 52–53.

[22] *Handbook of Naval Combat Underwater Demolition Training*, 53.

this cycle of training ended, the trainees applied all they learned to practical work at various beach locations.[23]

Halfway through the course, the students began working in basic reconnaissance, including seamanship, compass and navigation skills, chart reading and photographic interpretation, channel marking, night vision and coastal silhouette identification, and tide and current reading. The men next applied everything learned from the basic course to the practical reconnaissance course. The practical reconnaissance course included training on an actual coral reef, providing the trainees further hands-on experience in reconnaissance and reef charting. Because the team leaders were in command of their respective teams during this section of training, they had opportunities to identify and correct any mistakes made by their respective teams. The following, and final, sections of training included the "Pay-off Assault Problem" and the "Jen-Stu-Fu Problem." The object of payoff week included assaulting a designated beach in order to clear a 60-foot-wide path through any obstacles that could potentially impede landing craft. In the later Jen-Stu-Fu problem, trainees experimented with channel blasting and channel marking in various depths of water. The teams functioned as a unit to build further cohesion, with all personnel expected to have thorough knowledge in all of their assigned duties. Several of the personnel trained at Fort Pierce would go on to become instructors in Maui after receiving assignments to the UDT training center established in early 1944.[24]

From that first training class at Fort Pierce, 11 units graduated and went overseas. Two went to North Africa and saw action in the invasion of Southern France months later. One unit arrived in England, and two received orders to the South Pacific. Another three units deployed to Amphibious Forces, Pacific, joining Admiral Turner in Hawaii, where they were temporarily organized into UDTs for the assault on Kwajalein. Admiral Turner further recommended the reorganization of these six-man naval combat demolition

[23] *Handbook of Naval Combat Underwater Demolition Training*, 55.

[24] *Handbook of Naval Combat Underwater Demolition Training*, 56–59.

units into UDTs. The new teams would thus have a strength of 100 officers and men, with a headquarters unit and four platoons.[25]

Signing off on Turner's recommendation, Admiral Chester Nimitz obtained Navy Department approval and further ordered the establishment of a training and underwater experimentation school in Hawaii. Only a month of training and organizing volunteers for the invasion of Kwajalein and Roi-Namur (Operation Flintlock) on 31 January 1944 had occurred prior to the formation of the first two Pacific UDT units, UDT-1 and UDT-2. Volunteers from all the service branches qualifying for demolition training arrived at Waimanalo Amphibious Base, across the island from Honolulu. The men conducted drills in reconnaissance, landing craft seamanship, and explosives detonation. Obstacles and mines modeled on enemy defenses of Tarawa became training targets. The two demolition teams, UDT-1 and UDT-2, began training with a new secret weapon known as the "Stingray," an ordinary low-ramped wooden landing craft filled with several tons of explosive. Directed to a coral reef or underwater obstacle, the radio-controlled craft would, in theory, explode and create a sizable gap through which landing craft could pass.[26]

On the morning of 31 January 1944, UDT-1 launched three Stingray drone boats against Enubuj, west of Kwajalein Island. Each Stingray was loaded with 6,000 pounds of tetrytol, and despite the sinking of one of the drones and the engine failures of two others, U.S. forces successfully took Enubuj. Four LCVP craft from UDT-1 became stuck on a large number of coral heads just 500 yards from shore during a reconnaissance mission on the western beaches of Kwajalein at high tide. The innovative Stingray ultimately failed in its first action with both UDT units at Kwajalein, and no real tactical gains were achieved. The drones were doomed to failure by the decision to use salvaged landing craft barely able to stay afloat. Thereafter, the UDTs resorted instead to hand placing charges on obstacles. Adapting and overcoming these frustrating setbacks, two swimmers quickly stripped off their fatigues and dove into the water, taking note of the

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25 Fane, *Naked Warriors*, 24–25.

26 Fane, *Naked Warriors*, 26.

Underwater demolition personnel watch as U.S. Army Air Forces North American B-25 Mitchell bombers strafe the invasion beaches of Balikpapan, Borneo, circa 3 July 1945. They are awaiting orders to leave their boat to clear underwater obstacles. (NHHC, 80-G-274676)

depth and enemy positions along the beach. These were exactly the type of warriors Commander Kauffman wanted in the new naval commando force, quick-thinking men who could achieve positive results despite the odds. The men in the underwater demolition units also marked coral heads with buoys, dynamited passages through the reef, and demolished a few Japanese pillboxes for good measure.[27]

Impressed by reports of the success of the Kwajalein operations, Admiral King pressed for future UDTs to become an all-Navy endeavor, believing unit cohesion would become stronger if all volunteers came from the same branch of service. His viewpoint was also due in part to an after-action report

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[27] Eugene Liptak, *World War II US Navy Special Warfare Units* (New York: Osprey, 2014), 39–40.

titled *Experience in the Marshalls*, which hinted at the difficulty in "maintaining discipline among soldiers, sailors, *and* Marines who served together in the same unit."[28] Inevitably, this historic amphibious assault involving UDTs drew important lessons learned. Ultimately, King's desire to make the UDT an all-Navy organization, providing unit cohesion and esprit de corps, came to fruition. After the operations in the Marshalls, UDT-1 and UDT-2 disbanded, with their Army and Marine Corps members returned to parent units. Another major fix adopted by the UDT units at Kwajalein concerned the way they performed future missions. At Kwajalein, the UDTs conducted their offshore surveys while tethered by safety lines to a rubber boat or landing craft, which proved a major impediment to the swimmers. Navy leaders decided that during succeeding invasions, UDTs would swim to the beach to survey approaches for landing craft instead of wading in tethered to a boat.[29]

After the successful operations at Kwajalein and Roi-Namur, the administrative commander of Fifth Amphibious Force, Pacific Fleet, established a demolitions training base at Maui in late February 1944, further supporting the UDT program. A few weeks later, on 14 March, Admiral Turner ordered the training and organization of 10 UDTs, and two days later Captain K. W. Palmer became CO of the Maui base, with Lieutenant Commander John Koehler becoming his executive officer. On 29 March, all UDT personnel and equipment moved from Waimanalo to Maui. After operations in the Mariana Islands from June to July 1944, UDTs 3, 4, 5, 6, and 7 became available for training duties by September. The training phase in Maui lasted a total of 29 days, with the first phase lasting two weeks before expanding to six weeks. A single team consisted of 13 officers and 87 enlisted men (with an allotment of two photographer's mates) upon graduation. Each team consisted of the previously mentioned headquarters platoon and four operations platoons. By the end of 1944, 13 UDTs were in training at the same time.[30]

The veteran UDT members of these first Pacific operations often went on to become instructors at the Maui training base, and new trainees from the

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[28] Quoted in O'Dell, *Water Is Never Cold,* 138. Italics in the original.

[29] Liptak, *US Navy Special Warfare Units*, 38.

[30] O'Dell, *Water Is Never Cold,* 139–40.

naval combat demolition training transferred from Fort Pierce quickly learned the experienced men emphasized swimming far more than their colleagues in Florida did. According to the official history of UDT-7, prior to transfer to the Pacific, "there was very little swimming practice; the problem of approaching the beach and returning was never solved, at least to the extent of a maximum survival of personnel."[31] The Fort Pierce–trained personnel also noticed the Pacific theater did not afford itself to the same type of equipment used in the Atlantic. Helmets, combat fatigues, firearms, and "Mae West" life jackets were all impediments in Pacific underwater demolition. The men often performed operations wearing little more than Navy-issued swim trunks, dive masks, and later Churchill swim fins and canvas coral shoes. The swimmers also learned that smearing themselves in aluminum greasepaint cut down on the chill experienced working for hours in frigid waters.[32]

Despite these challenges, the UDTs ultimately proved their worth in the island-hopping assaults on Japanese-held islands throughout the rest of 1944. On the morning of 14 June 1944, UDT-5 and UDT-7 successfully surveyed the landing beaches at Saipan. A month later, swimmers from UDT-3 and UDT-4 conducted a reconnaissance off Guam, later clearing obstacles off the reefs in front of Asan and Agat landing beaches with explosives. UDT-6 searched for mines (none were found) one day prior to the invasion of Asan. On the night of 10 July, UDT-7 worked alongside recon marines to reconnoiter two beaches on the island of Tinian (code-named White 1 and White 2). The next night, the group found both beaches suitable for the use of LVT (landing vehicle, tracked) craft, and after UDT swimmers performed a feint in the waters off Tinian Town, the attacking marines suffered light casualties while surprising the enemy with landings there. UDT operations (while tactically remaining similar as far as conducting surveys of the water and checking for dangerous enemy obstacles off the beaches) often depended on the geography of the island assaulted and could change from mission to mission, highlighting

[31] O'Dell, *Water Is Never Cold*, 146.

[32] O'Dell, *Water Is Never Cold*; Liptak, *US Navy Special Warfare Units*, 47.

the groups' high-level training and growing reputation for accomplishing mission requirements no matter the unforeseen risks involved.[33]

Often, the teams added or refined tactics and procedures after gaining experience from preassault landings, making notes of lessons learned. After UDT-8's operations on Angaur Island, Palau (14–19 September 1944), for example, a list titled "Recommendations for Training for Future Operations" stressed the "maintenance of physical condition of Underwater Demolition Teams embarked for long periods."[34] Officers discovered the team in "very poor condition" for the assault, owing to a 40-day underway period on board ship prior to the Angaur mission. Additionally, team members contended with crowded conditions due to living and working in confined spaces while at sea. Suggestions included improving overall conditions by converting destroyer escorts into high-speed transports (APDs) specifically for the teams, establishing permanent UDT bases on land in forward areas (although studied, the project never came to full fruition), and requiring daily swims by UDT personnel while underway. Further recommendations included developing additional reconnaissance training, allowing the CO or another officer from the team to accompany photoreconnaissance aircraft on missions over target islands, adding further target practice for machine gunners, and keeping APDs with team explosives on board from performing screening duties.[35]

The UDTs quickly adopted several of the recommendations made in the lessons learned from the Palau Islands and applied them toward future missions. For instance, the Navy converted several destroyer escorts into APDs and began keeping team explosives on board ship during upcoming operations. All of this preparation paid off at amphibious landings at Leyte, Lingayen, Iwo Jima, Okinawa, and Borneo, where the UDTs demonstrated their value repeatedly. When UDTs conducted operations off Iwo Jima in February 1945,

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[33] Liptak, *US Navy Special Warfare Units*, 41–43.

[34] Enclosure (A), "Underwater Demolition Team Eight Operations on Angaur Island, D-1 to D Plus 4 (September 14 to September 19)," 7–9, World War II War Diaries, Other Operational Records and Histories, Records of the Office of the Chief of Naval Operations, 1875–2006, Record Group 38, Fold3.com, accessed 11 January 2021.

[35] Enclosure (A), "Underwater Demolition Team Eight Operations on Angaur Island, D-1 to D Plus 4," 9.

several of their members were already combat veterans and capably conducted reconnaissance and clearing of Japanese obstacles, often while under heavy enemy fire. During the invasion of Okinawa, a "thousand men in swim trunks spearheaded the invasion."[36] The UDTs' greatest accomplishment during the three-month battle (1 April–22 June 1945) was the elimination of a kamikaze outfit of suicide boat crews that arrived at Okinawa from Kerama Retto for its deadly training just prior to the U.S. invasion. The sudden appearance of UDTs off Okinawa prevented the Japanese crews from returning to their plywood suicide boats, rendering them weaponless and negligible, and undoubtedly saving the lives of countless American sailors and marines offshore.[37]

In August 1945, the dropping of the atomic bombs and subsequent surrender of Japan forced the stand-down of some 28 UDTs (3,000 personnel total) scheduled to participate in the invasion of Japan. Several of the teams were conducting cold-water training in California, preparing for the invasion of the Japanese home islands, when news reached them of the surrender.[38] Eighteen UDT groups left hurriedly by plane or ship to rendezvous with other Allied forces set to land in Japan, China, and Korea. The first naval personnel to go ashore on Japan (29 August) were members of UDT-21. These UDTs left a welcome sign for the marines before leaving to conduct a search for mines at the entrance of Tokyo Bay, where Allied ships would stage the formal imperial Japanese surrender ceremony on 2 September. In the following weeks, the UDTs located and destroyed suicide boats, midget submarines, and naval ordnance all along the coast of Japan, further demonstrating their high value to Allied forces by disarming deadly weaponry that could have caused further casualties.[39]

It is not surprising that the hugely innovative and successful UDTs "were the only naval commando units to survive doctrinally after WWII."[40]

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[36] Fane, *Naked Warriors*, 189.

[37] Fane, *Naked Warriors*, 190.

[38] Fane, *Naked Warriors*, 228.

[39] Liptak, *US Navy Special Warfare Units*, 50.

[40] Tom Hawkins, *America's Hidden Heroes: The History and Evolution of U.S. Navy Frogmen and SEALs* (New York: Phoca Press, 2015), 52.

However, the drawdown from the massive war effort left the teams with little personnel, funding, or support within the Pentagon until the outbreak of the Korean War. The completed drawdown left only four UDTs (two under Commander, Amphibious Force, Pacific Fleet, and two with Commander, Amphibious Force, Atlantic Fleet), with a skeleton complement of 7 officers and 45 men each. After an expansion of the teams fighting against Communist China and North Korea during the Korean War, the UDTs once again thrived. Continuing technological and tactical innovations throughout the 1950s and 1960s led directly to the formation of unconventional warfare teams, especially the eventual evolution of UDTs into SEAL units. The SEALs began conducting special operations missions prior to and then during the Vietnam War. Today, their mission parameters have expanded exponentially from those of the UDTs, proving the training for naval commandos begun by their predecessors remains among the toughest for special operations forces in the world. The result is a continuation of the intelligent, highly trained amphibious commando force that frogmen of this generation can proudly trace back to the UDTs of World War II.[41]

A reporter for *Seabee* magazine best described the Navy's success with the underwater demolition teams formed in World War II: "Demolition teams weren't fostered in any one place, weren't formed because of any one action, weren't dreamed up by any one man."[42] While not solely responsible for the formation of the UDTs, forward-thinking Navy leaders such as Admiral Turner, Admiral King, and Commander Kauffman nonetheless played pivotal roles in their creation. Implementation of the rigorous training requirements of UDT personnel, drawn directly from previous maritime units with reconnaissance and combat experience, set precedents that still influence the training and work of current SEALs. By incorporating the battle experiences and innovations of these predecessor groups, the UDTs undoubtedly perfected them in the process of the island-hopping campaign of the Pacific theater. The demonstrated adaptability of the teams throughout the war was therefore critical to most of the Navy's important operations against the Japanese. In the finest

[41] Fane, *Naked Warriors*, 234.

[42] O'Dell, *Water Is Never Cold*, 215.

traditions of the U.S. Navy, UDTs created a lasting legacy of amphibious innovation during the war, exemplifying the ability of the Navy to adapt and inspire future amphibious and special warfare doctrine.

CHAPTER FIVE

Innovating Fleet Air Defense: The U.S. Fleet and Kamikaze Attacks, 1944–1945

Shawn R. Woodford

Military innovation during wartime is often characterized by an iterative cycle of incremental battlefield improvements by one combatant that lead to counterdevelopments by the adversary. Such innovation is commonly tactical or technological, but the cycle can generate effects on a broader scale. During the Second World War, the U.S. Navy developed a multilayer fleet defense against enemy air attack that integrated centrally directed fighter interception enabled by long-range radar detection capabilities with high-volume antiaircraft fire from shipboard guns for close-in defense. Enabled by this advantage, the Navy decisively destroyed Imperial Japanese Navy (IJN) airpower in the Battle of the Philippine Sea in June 1944. In order to compensate for the precipitous decline of its remaining airpower relative to increasing American advantages in skill, technology, and numbers, the land-based Imperial Japanese Army Air Force (IJAAF) and Imperial Japanese Navy Air Force (IJNAF) resorted to kamikaze ("divine wind") aerial suicide tactics in October 1944.

This counterinnovation proved highly effective. As the headquarters of the Commander in Chief of the U.S. Fleet stated in April 1945:

> The suicide attack represents by far the most difficult antiaircraft problem yet faced by the fleet. The psychological value of [antiaircraft], which in the past has driven away a large percentage of potential attackers, is inoperative against the suicide plane. If the

A view of the antiaircraft suite on the starboard side of the *Essex*-class aircraft carrier *Lexington* (CV-16). On the lower right is a Bofors 40-millimeter quadruple gun mount, in the center are a pair of turrets mounting twin 5-inch/38-caliber dual-purpose guns, and just visible along the deck to the left is a gallery lined with Oerlikon 20-millimeter guns. (NHHC, 80-G-236955)

> plane is not shot down or so severely damaged that its control is impaired, it almost inevitably will hit its target.[1]

The Navy rose to the kamikaze challenge with further formal and informal innovative responses spanning operations and tactics, doctrine, organization, and technology. As explained by naval historian Trent Hone, the Navy had developed a culture of learning, which facilitated efforts to analyze the problem and formulate potential solutions.[2] As successful as these Navy innovations were, they were met with effective Japanese responses through long, costly contests in the Philippines, Iwo Jima, and Okinawa. While the Navy emerged victorious in each of these campaigns, it did not fully master the threat posed by the kamikazes.

The Navy's fleet air defense system evolved from the British Royal Navy's early-war experiences and steady, incremental improvements in radar and weapon technology. Fighter interception formed one pillar of the system. As historian Norman Friedman noted, "Radar made fighter control, hence fleet air defence by fighters, practical." The integration of radar with visual air plots for fighter direction in American aircraft carriers in 1941 helped spur the subsequent development of the combat information center (CIC), an information management innovation that gave the Navy a crucial situational awareness advantage over the Japanese.[3] By 1944, most Navy combat ships possessed CICs and air search radar that could detect incoming aircraft, though not their altitude, to a range of 75–100 nautical miles. The use of destroyers along early warning picket lines extended this capability out to 150 miles. All carriers and many battleships, cruisers, and destroyers had shorter-range radar sets capable

[1] Headquarters of the Commander in Chief, U.S. Fleet (COMINCH), "Antiaircraft Action Summary: Suicide Attacks, April 1945," COMINCH P-009, 30 April 1945, https://www.history.navy.mil/research/library/online-reading-room/title-list-alphabetically/a/suicide-attacks-apr-1945.html.

[2] Trent Hone, *Learning War: The Evolution of Fighting Doctrine in the U.S. Navy, 1898–1945* (Annapolis, MD: Naval Institute Press, 2018).

[3] Norman Friedman, *Fighters over the Fleet: Naval Air Defence from Biplanes to the Cold War* (Barnsley, UK: Seaforth, 2016), 312–25, 765–66, Kindle. The need to integrate radar information with tactical awareness in both air defense and surface night combat led to the development of the CIC. See Hone, *Learning War*, 208–49; and Timothy S. Wolters, *Information at Sea: Shipboard Command and Control in the U.S. Navy, from Mobile Bay to Okinawa* (Baltimore: Johns Hopkins University Press, 2013).

of identifying target direction and altitude. Carriers, battleships, destroyers, and some auxiliary ships had CIC fighter directors to vector combat air patrol (CAP) interceptors onto incoming targets.[4] The fast carrier task forces provided CAP for fleet operations, and all major amphibious landings enjoyed extended air coverage from escort carriers or land-based air units. The fighter groups of the fleet (36–40 planes) and light carriers (21–24 planes) were equipped with aircraft technologically superior to their Japanese counterparts.[5] By mid-1944, Navy pilots averaged two years of training and 300 hours of flight time before joining a carrier squadron, far exceeding the standards of their opponents.[6]

In response to the Royal Navy's struggle with German airpower in Norway in 1940, Secretary of the Navy Charles Edison assigned then rear admiral Ernest J. King of the Navy's General Board to study the issue. King and a new Antiaircraft Defense Board reported later that year that existing Navy defenses were unprepared to cope with modern high-speed aircraft and recommended improvements in doctrine, targeting capability, and procurement of more and better medium-caliber and machine guns.[7] The Navy thereafter began continually upgrading the firepower and accuracy of its antiaircraft weaponry. By 1944, on most warships, 5-inch/38-caliber dual-purpose guns superseded 5-inch/25-caliber and 3-inch guns for long-range defense, while 40-millimeter (40mm) and 20mm automatic cannon batteries replaced 1.1-inch guns and

[4] Friedman, *Fighters over the Fleet*, 293–300, 325–32.

[5] Samuel Eliot Morison, *History of United States Naval Operations in World War II*, vol. 12, *Leyte, June 1944–January 1945* (Boston: Little, Brown, 1958), Appendices; Samuel Eliot Morison, *History of United States Naval Operations in World War II*, vol. 14, *Victory in the Pacific, 1945* (Boston: Little, Brown, 1960), Appendices. Navy Grumman F6F Hellcats and Vought F4U Corsairs far outclassed the IJNAF's Mitsubishi A6M Type 0 and the IJAAF's Nakajima Ki-43 Hayabusa ("Oscar") Type 1 fighter. Most of the escort-carrier fighter squadrons fielded 16–18 General Motors FM-2 Wildcats, an improved version of the older Grumman F4F Wildcat built under license.

[6] Nicolai Timenes Jr., *Defense against Kamikaze Attacks in World War II and Its Relevance to Anti-ship Missile Defense*, vol. 1, *An Analytical History of Kamikaze Attacks against Ships of the United States Navy during World War II* (Monterey, CA: Operations Evaluation Group, Center for Naval Analyses, 1970), 27.

[7] Buford Rowland and William B. Boyd, *U.S. Navy Bureau of Ordnance in World War II* (Washington, DC: U.S. Government Printing Office, 1953), 229; Norman Friedman, *Naval Anti-aircraft Guns and Gunnery* (Barnsley, UK: Seaforth, 2013), 481, 485, 757, Kindle.

.30- and .50-caliber machine guns for short-range coverage. The older weapons were used to arm auxiliary and merchant vessels. Radar- and computer-equipped fire directors were installed that calculated range and bearing to guide the 5-inch guns onto target automatically. Manual and radar-guided gun directors were added for the 40mm batteries that allowed them to be centrally controlled. The 20mm batteries received gyroscopically stabilized gunsights that anticipated elevation and traverse angles to help lead incoming targets. Perhaps more importantly, by early 1943, 5-inch guns were armed, in increasing quantities, with variable time (VT) shells incorporating tiny radar proximity fuses, which could damage or destroy a plane without hitting it.[8]

The Navy drastically increased the number of antiaircraft guns per ship by 1945, averaging the following totals, as shown in table 1.

Table 1. Antiaircraft Guns by Ship Type, 1945

Ship type	Number of barrels	Antiaircraft armament
Battleship	165	10 5-inch/38 twins; 20 40mm quads; 49 20mm singles; 8 20mm twins
Large carrier	158	18 5-inch/54 singles; 21 40mm quads; 28 20mm twins
Fleet carrier	136	4 5-inch/38 twins; 4 5-inch/38 singles; 17 40mm quads; 56 20mm singles
Large cruiser	102	6 5-inch/38 twins; 14 40mm quads; 34 20mm singles
Heavy cruiser	83	6 5-inch/38 twins; 12 40mm quads; 23 20mm singles
Light cruiser	50	6 5-inch/38 twins; 4 40mm quads; 6 40mm twins; 10 20mm singles
Destroyer	42	3 5-inch/38 twins; 3 40mm quads; 2 40mm twins; 10 20mm twins
Light carrier	40	2 40mm quads; 9 40mm twins; 8 20mm twins
Escort carrier	37	1 5-inch/38 single; 8 40mm twins; 20 20mm singles

Source: Headquarters of the Commander in Chief, U.S. Fleet, "Antiaircraft Action Summary: World War II, October 1945," Information Bulletin No. 29, 8 October 1945, 15.

[8] COMINCH, "Antiaircraft Action Summary: World War II, October 1945," Information Bulletin No. 29, 8 October 1945, chap. 4, https://www.history.navy.mil/content/history/nhhc/research/library/online-reading-room/title-list-alphabetically/a/antiaircraft-action-summary.html; *The World War II Proximity Fuze: A Compilation of Naval Ordnance Reports by the Johns Hopkins University Applied Physics Laboratory* (Silver Spring, MD: Johns Hopkins University Applied Physics Laboratory, 1950): 1–12.

The Navy's circular cruising dispositions maximized this firepower, with the highest-value ships in the center and the screen and escorts deployed in concentric layers for an all-around defense in depth. Per doctrine, 5-inch batteries engaged attacking planes first at ranges of 12,000 yards or more using a high percentage of VT shells. These guns were expected to be the primary aircraft killers due to their hitting power, special ammunition, and radar direction. The 40mm and 20mm guns provided close-in defense with massed automatic and aimed fire beginning at 3,000–3,500 yards.[9]

By mid-1944, the Navy's fleet air defense rendered Japanese naval air attack all but impotent. The IJN had laboriously rebuilt its carrier air squadrons decimated during fleet battles in 1942 and the grinding Solomon Islands campaign in 1943. In June 1944, the IJN Mobile Fleet under Vice Admiral Jisaburō Ozawa attacked (Operation A-Go) the Fifth Fleet, commanded by Vice Admiral Raymond Spruance, as it conducted the invasion of the Mariana Islands (Operation Forager). On 19 June, Ozawa's scouts located the Americans, and his five fleet and four light carriers launched four successive mass air strikes against the seven fleet and eight light carriers of Fifth Fleet's Task Force (TF) 58. A total of 295 Navy F6F-3 fighters (out of 446 available)—vectored by radar and directed by picket destroyers—intercepted each strike 50–60 nautical miles from the task force. They shot down 224 of 373 attacking aircraft, against 14 combat losses. Navy antiaircraft gunners splashed 19 more Japanese planes, while the volume of fire and adroit ship-handling limited the remainder to a single bomb hit, three damaging near misses, and one deliberate plane crash. Ozawa withdrew the next day after losing two carriers to U.S. submarines and a third to TF-58 air attacks. His remaining ships could muster only three dive bombers, 29 torpedo bombers, and 68 fighters.[10]

The decimation of Japanese naval airpower in the Battle of the Philippine Sea by the dominant U.S. fleet air defense led midlevel IJN air officers to recommend using suicide attacks against enemy ships. Frustration mounted from

[9] COMINCH, "Antiaircraft Action Summary: World War II, October 1945," chap. 3; Friedman, *Naval Anti-aircraft Guns and Gunnery*, 760.

[10] Timenes, *Defense against Kamikaze Attacks in World War II*, 1:35–37; Friedman, *Fighters over the Fleet*, 331–35; Friedman, *Naval Anti-aircraft Guns and Gunnery*, 770.

pilots flying strike missions that were already virtually suicidal but inflicted no damage on the enemy. More than 50 of Ozawa's attack planes had escaped the CAP and evaded antiaircraft fire to launch their weapons against American ships with only a solitary hit to show for it. The U.S. submarine campaign against Japanese shipping further undermined remaining Japanese airpower. Declining fuel imports reduced flying hours for pilot training. Inexperienced pilots and insufficient maintenance resulted in mounting operational losses as the Japanese shifted planes around the Pacific to counter Allied attacks.[11]

Local IJNAF and IJAAF commanders and individual pilots took the initiative to begin suicide attacks following heavy aircraft losses to air strikes by the fast carriers of TF-38 (as they were designated while assigned to Admiral William F. Halsey's Third Fleet) when the United States invaded the Philippines in October 1944. An IJNAF admiral staged an intentional suicide attack on TF-38 on 13 October, and an IJAAF pilot likely deliberately crashed into an Australian heavy cruiser serving with Vice Admiral Thomas C. Kinkaid's Seventh Fleet on 21 October. At the request of Vice Admiral Takijiro Onishi, commander of the IJNAF First Air Fleet, two dozen pilots volunteered to form the initial *tokubetsu kōgekitai* (*tokko*), or Special Attack Unit, soon known as kamikaze, on 19 October. A dozen IJNAF pilots flying Mitsubishi A6M Type 0 fighters modified to carry 250-kilogram (550-pound) bombs targeted escort carriers of Kinkaid's TF-77 on 25 October with the first successful group attacks. The Japanese heavily reinforced their air units in the Philippines, and the IJAAF Fourth Air Army formed tokkos of its own in early November. The IJNAF and IJAAF mounted continuous suicide and conventional attacks on Third and Seventh Fleet forces through January 1945 during landing operations against Leyte, Mindoro, and Luzon.[12]

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[11] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 1084–88; Peter C. Smith, *Kamikaze: To Die for the Emperor* (Barnsley, UK: Pen & Sword Aviation, 2014), 3–7; Phillips P. O'Brien, *How the War Was Won: Air-Sea Power and Allied Victory in World War II* (Cambridge: Cambridge University Press, 2015), 402–12, 421–23.

[12] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 1084–89; Smith, *Kamikaze*, 7–67; John Prados, *Combined Fleet Decoded: The Secret History of American Intelligence and the Japanese Navy in World War II* (Annapolis, MD: Naval Institute Press, 1995), 618–25, 688–89.

New tactics enabled the tokkos to challenge U.S. fleet air defenses optimized to defend against mass attacks. Through sophisticated signals and electronic intelligence collection and analysis, the Japanese developed techniques for exploiting weaknesses in American fighter direction and radar coverage. Although all types of aircraft were eventually used for kamikaze missions, most of the early attacks employed fast single-engine fighters and attack planes. They sortied alone or in small groups of two to three kamikazes, although occasional escorts increased this to five or six. Approaches were made with frequent changes in altitude, overland, or at low altitude to exploit known gaps in radar coverage. Attackers trailed returning American air strikes and spoofed electronic identification friend or foe signals. As a result, kamikaze pilots often evaded CAP interception.[13]

Intentionally or not, the Japanese learned to exploit CIC capacity limits. Due to technological and information management constraints, CIC fighter directors could not effectively track more than two targets at a time. Multiple contacts and evasive maneuvers hampered continuous radar tracking, saturating individual ship CICs with targets. Typically forming up just outside 5-inch-gun range for 10–15 minutes to select individual targets—sometimes allowing pursuing CAP to catch them—surviving kamikaze groups split up for final approach. Some engaged in aerobatics. High-altitude attacks used the sun or clouds as cover, beginning a shallow-angle descent at 20–30 degrees about 6,000–8,000 yards out. After closing to 1,500–2,000 yards, kamikazes engaged in terminal power dives up to 50 degrees, with little or no evasive maneuver, counting on speed to evade antiaircraft fire before impact. Low-altitude approaches skimmed in 50–100 yards above the water; some closed to 1,000 yards

[13] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 120; Friedman, *Fighters over the Fleet*, 410; COMINCH, "Antiaircraft Action Summary: Suicide Attacks, April 1945," chap. 1, 3; chap. 3, 3; chap. 4, 5–6. Wartime analysis estimated that CAP intercepted and splashed or drove off 60 percent of all attacking aircraft. A Navy study done in 1970 suggested this figure likely averaged closer to 45 percent during the Philippines campaign. While chances of CAP successfully intercepting attacks detected over open water were about 60 percent, sorties over or near land reduced the probability to 30 percent. Timenes, *Defense against Kamikaze Attacks in World War II*, 1:73–74.

before climbing sharply to 500 yards in altitude before diving into their targets; others simply flew directly into the sides of ships.[14]

Kamikazes that penetrated their target areas were often able to achieve tactical surprise due to insufficient coordination between CICs and gun directors. CICs had no mechanical means for designating targets for individual antiaircraft gun directors and batteries. This had to be done by voice communication via telephone switchboard, which inevitably caused delays. Incoming kamikazes were sighted equally often by lookouts and radar, but frequently too close to give effective warning. During the Philippines campaign, Navy antiaircraft gunners engaged suicide attacks at an average range of 5,700 yards, while targeted ships did not open fire until 4,000 yards, well within the range of the 5-inch batteries and nearly at the effective range of the 20mm and 40mm guns. The shortened range and reaction time diminished the effectiveness of the 5-inch guns and their lethal VT ammunition. Even with radar guidance, the 5-inch gun directors could not keep up with rapidly closing targets, and the limited time for engagement reduced the number of shells fired. This often left the burden of point defense to the 40mm and 20mm batteries, which made most of the total kamikaze antiaircraft kills.[15]

While born of desperation, kamikaze tactics proved far more effective than conventional attacks. An estimated 650 IJNAF and IJAAF aircraft were expended in tokko sorties between 25 October 1944 and late January 1945, when the remaining Japanese air units were evacuated from the Philippines. Of 364 kamikazes that reached U.S. and Allied ships, antiaircraft guns claimed 231 kills and deflections (including the near misses), a success rate of 64 percent. However, 115 kamikazes hit ships (32 percent), and 56 more crashed close enough to cause damage (hits plus near misses totaled 47 percent). In comparison, 1,092 conventional attackers were also fired upon, of

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[14] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 152–53; COMINCH, "Antiaircraft Action Summary: Suicide Attacks, April 1945," chap. 3.

[15] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 121, 1094. The 40mm and 20mm batteries were credited with, respectively, 46.8 percent and 31.8 percent of the kamikazes downed by antiaircraft fire in the Philippines campaign, while the 5-inch guns claimed 15.8 percent (VT fuses accounted for 44 percent of that total). Timenes, *Defense against Kamikaze Attacks in World War II*, 1:76.

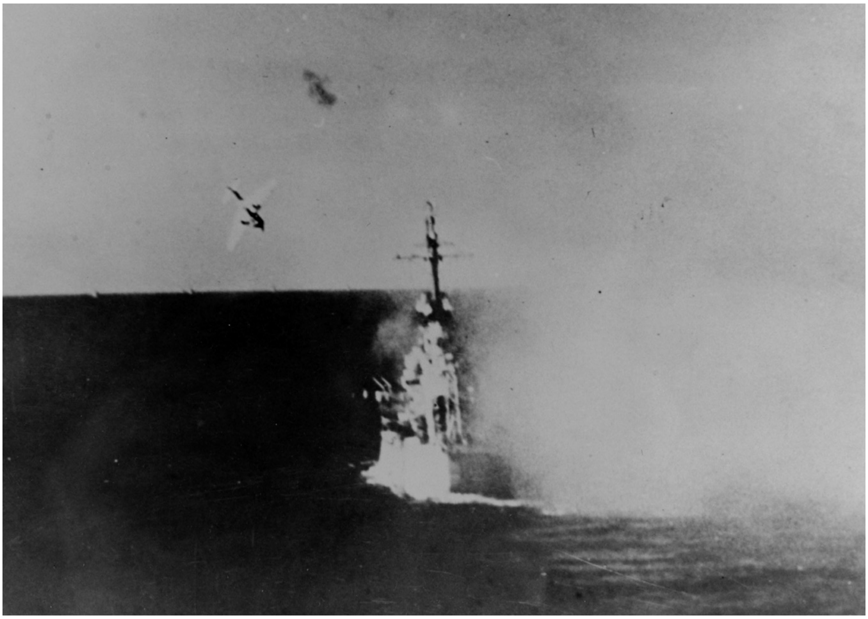
which 156 (14 percent) were shot down. Only 23 scored hits on ships (1.3 percent).[16] Out of the 130 U.S. and Allied ships hit, the largest to sink were two escort carriers and three destroyers. However, tokko attacks damaged 6 fleet, 2 light, and 10 escort carriers; 5 battleships; 1 U.S. and 2 Australian heavy cruisers; 6 light cruisers; and 1 Australian and 25 American destroyers.[17] This toll did not prevent the Allies from retaking the Philippines, but it did show that imperial Japanese airpower had become a formidable opponent once again.

The Navy immediately recognized the change in Japanese tactics. Their remorselessness and seeming disregard for human life surprised and shocked the Americans. (The Commander in Chief, Pacific Fleet [CINCPAC] war diary noted that the 25 October escort carrier attack "had to be seen to be believed.")[18] Halsey initially doubted the Japanese would be able to sustain the suicide attacks, but Admiral Chester Nimitz, Commander in Chief, Pacific Fleet and Pacific Ocean Areas, had to keep Third Fleet near the Philippines through early January 1945 to counter the tokkos and heavy Japanese aerial reinforcements. As kamikazes damaged several of his carriers, Halsey and his principal subordinate, TF-38 commander Vice Admiral John S. McCain, worked out tactics to counter them. TF-38 increased the number of fighters to 73 on the fleet carriers and 24 on the light carriers in December. In January, marine pilots flying F4Us were added to two carriers to bring their fighter complements to 91. At McCain's recommendation, Third Fleet maintained 24-hour CAP over Japanese airfields on Luzon from 14 to 16 December during the invasion of Mindoro Island, effectively suppressing all air attacks from there. The aggressive use of carrier fighter interdiction to smother Japanese land-based airpower became known as the "big blue blanket." McCain also pushed out extra destroyer pickets to help dilute the tokko

[16] Timenes, *Defense against Kamikaze Attacks in World War II*, 1:51; COMINCH, "Antiaircraft Action Summary: Suicide Attacks, April 1945," chap. 2, 1–2; COMINCH, "Antiaircraft Action Summary: World War II, October 1945," 16.

[17] Prados, *Combined Fleet Decoded*, 688.

[18] CINCPAC War Diary, 1–31 October 1944, 138, World War II War Diaries, Other Operational Records and Histories Series, Records of the Office of the Chief of Naval Operations, Record Group (RG) 38, National Archives at College Park (NACP).



Japanese kamikaze aircraft diving on *Columbia* (CL-56) on 6 January 1945, during the Lingayen Gulf operation. This plane hit the main deck by the after gun turret, causing extensive damage and casualties. (NHHC, NH 79449)

attacks by engaging them farther out from the fleet and to provide additional fighter directors to relieve TF-38 CICs.[19]

The ships of Third Fleet and Seventh Fleet also worked out methods to improve antiaircraft gun performance. Control over the medium batteries was decentralized, allowing 5-inch guns to be directed manually or with the faster 40mm gun directors, permitting the 5-inch guns to open fire more quickly and engage more targets, even without ideal solutions. To address CIC saturation, coordinated fire plans were developed for task groups. Formations divided coverage into four quadrants, each with a coordinator and a dedicated radio circuit. CICs and gun directors standardized and

[19] E. B. Potter, *Bull Halsey* (Annapolis, MD: Naval Institute Press, 1985), 309, 310, 320; Friedman, *Fighters over the Fleet*, 416–17; Timenes, *Defense against Kamikaze Attacks in World War II*, 1:66; Commander Third Fleet, "Report on the Operations of the Third Fleet, 1–29 December 1944," 10 January 1945, 1–2; Commander Third Fleet, "Report on the Operations of the Third Fleet, 30 December 1944 to 23 January 1945," 23 January 1945, 1–2, both in World War II War Diaries, Other Operational Records and Histories Series, RG 38, NACP.

practiced communication procedures. The 20mm and 40mm guns could be released to sector control and authorized to flood the sky with shells. The percentage of 5-inch VT-fuse ammunition was increased, as was the rate of fire of the 40mm guns.[20] In January 1945, Halsey optimistically reported, "The newest Japanese weapon, the suicide bomber, can be licked; increased alertness, better gunnery, strike pickets, channeling of our own air movements, and a smothering fighter CAP (fighter blanket) over enemy airfields are proper and proven answers to the challenge."[21]

Innovation also occurred at the fleet and service levels. As part of its learning culture, the Navy had developed a robust information reporting framework prior to the war. The command structure produced comprehensive action narratives at the ship, task unit/group/force, and fleet commander and staff levels. Detailed data on antiaircraft engagements had been collected since the war began. Initial action reports on kamikaze attacks were filed with Admiral Ernest J. King, Commander in Chief, U.S. Navy (COMINCH), via Nimitz's headquarters through the autumn, with campaign summaries arriving in early 1945. COMINCH headquarters released the first battle experience reports in March relaying lessons learned from the fleet defending against suicide attacks.[22] In

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[20] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 403, 762, 835, 930–31, 941–42; Timenes, *Defense against Kamikaze Attacks in World War II*, 1:1–89; COMINCH, "Anti-suicide Action Summary, August 1945," COMINCH P-0011, 31 August 1945, 9.

[21] Commander Third Fleet, "Report on the Operations of the Western Pacific Task Forces and the Third Fleet," 25 January 1945, 4, World War II War Diaries, Other Operational Records and Histories Series, Records of the Office of the Chief of Naval Operations, RG 38, NACP.

[22] Hone, *Learning War*, 212; Thomas C. Hone and Curtis Utz, *History of the Office of the Chief of Naval Operations, 1915–2015* (Washington, DC: Naval History and Heritage Command, 2020), 145–46; COMINCH, "Battle Experience: Battle of Leyte Gulf; (A) Battle of Surigao Strait; (B) Battle off Samar; (C) Battle off Cape Engano (East of Luzon), 23–27 October 1944," 1 March 1945, chap. 78, 108–21; COMINCH, "Amphibious Operations: Invasion of the Philippines, October 1944 to January 1945," COMINHC P-0008, 15 March 1945, chap. 3: "Suicide Attacks," both in Battle Reports and Analyses, World War II, Digital Collections, Special Collections & Archives, Nimitz Library, U.S. Naval Academy, accessed 31 March 2021, https://libguides.usna.edu/sca/digital; COMINCH, "Antiaircraft Action Summary: Suicide Attacks, April 1945." The detail and character of the fleet reporting can be found in the World War II War Diaries, Other Operational Records and Histories Series, Records of the Office of the Chief of Naval Operations, RG 38 at NACP, much of which is publicly available online.

April, COMINCH published an analysis of Japanese suicide tactics based on work by the Antiaircraft Operations Research Group (AAORG) in the Readiness Branch of King's headquarters. AAORG and the Special Defense Section in Nimitz's Pacific Fleet headquarters examined all aspects of Japanese air attack and U.S. defense. Their findings and recommendations were disseminated throughout the fleet. AAORG analysis suggested tactics to improve the probability of CAP interceptions. It found that larger ships should employ radical maneuvers to avoid kamikaze strikes, while smaller ships should refrain from doing so to improve the stability and aim of their antiaircraft guns. AAORG also determined that ships were safer presenting their beams to high-angle attackers but turning into or away from low-angle approaches.[23]

When Admiral Matome Ugaki took command of the IJNAF Fifth Air Fleet in February, charged with carrying out special attacks in defense of the Japanese home islands, Japan's remaining airpower suffered further from strategic attack. Submarine warfare had already caused drastic reductions in aircraft production when the long-range bombing campaign against industrial targets began in November 1944. The loss of fuel and fuel-production capabilities curtailed conventional air operations, and pilot training in mainland Japan virtually ceased. In mid-1944, Japanese carrier air crews possessed just two to six months of training and 300 hours of flying experience. This declined until the end of the war, when Japanese

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[23] "Summary Report to the Office of Field Service, O.S.R.D from the Operations Research Group Assigned to Headquarters Commander in Chief United States Fleet and Office of the Chief of Naval Operations," 1 December 1945, 33–34, Alternate Wars, accessed 30 March 2021, https://www.alternatewars.com/WW2/ORG_Summary_Report_1-DEC-45/ORG_Summary_Report_1-DEC-45.pdf; Charles R. Shrader, *History of Operations Research in the United States Army*, vol. 1, *1942–1962* (Washington, DC: Office of the Deputy Undersecretary of the Army for Operations Research, 2006), 22–23; Keith R. Tidman, *The Operations Evaluation Group: A History of Naval Operations Analysis* (Annapolis, MD: Naval Institute Press, 1984), 85–87. In 1942, the National Defense Research Committee established the Antisubmarine Warfare Operations Research Group (ASWORG) under Admiral Ernest J. King's headquarters of the Commander in Chief, U.S. Fleet, to apply scientific methods to solve military problems, a field known as operations research. King assigned ASWORG to Tenth Fleet in 1943. When most of its personnel shifted to other problems as the Allies secured victory in the Battle of the Atlantic, King renamed it the Operations Research Group (ORG) and brought it back to COMINCH in October 1944. AAORG was created within ORG in September 1944.

aviators averaged only 100 hours of flight experience. Realizing the need to preserve their pool of even poorly trained aircrew, the Japanese recruited individuals specifically for suicide attacks in order to maximize the ability of minimally trained pilots to inflict damage. Kamikaze pilots received just 30 to 50 hours of flight training.[24]

With stocks of modern aircraft dwindling, training aircraft were incorporated into the tokkos to bolster their numbers. These light monoplane and biplane aircraft carried less ordnance than combat planes, which reduced their individual lethality, but they were easier for barely trained suicide pilots to fly. IJNAF Yokosuka MXY-7 Ohka ("Cherry Blossom") rocket-powered planes developed in 1944 were also introduced. Powered by three engines and carried to the target by twin-engine bombers, they could reach 400 miles per hour and carried 2,600-pound warheads. The Ohkas proved ineffective, however. Their first attempted use reportedly occurred on 21 March 1945, but all 16 bombers carrying them were shot down by Navy fighters before the Ohkas could launch. After that initial use, it is not known how many were eventually used in combat, but only 13 were spotted in flight. Difficult to pilot, nine missed and just four hit ships.[25]

As Spruance's Fifth Fleet geared up to invade Iwo Jima (Operation Detachment) and Okinawa (Operation Iceberg) in early 1945, it had reasonable expectations for its ability to address the kamikaze threat. To further thwart the tokkos, Fifth Fleet sought to extend the big blue blanket over the Japanese mainland. TF-58 raided airfields in the Japanese home islands on 16–17 February 1945. Eleven fleet and five light aircraft carriers flew 2,761 sorties, which claimed the destruction of 500 enemy aircraft on the ground and in the air. The Japanese managed only one kamikaze attack on forces supporting the subsequent Iwo Jima landings, which sank an escort carrier, the last the U.S. lost during the war. TF-58 again raided Japanese airfields on Kyushu on 18–19 March 1945, destroying an estimated 528 enemy aircraft in the air and on the ground. The British Pacific Fleet, designated TF-57,

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[24] O'Brien, *How The War Was Won*, 432–43; Smith, *Kamikaze*, 67; Timenes, *Defense against Kamikaze Attacks in World War II*, 1:27.

[25] Timenes, *Defense against Kamikaze Attacks in World War II*, 1:58–59; Friedman, *Naval Anti-aircraft Guns and Gunnery*, 1090–91.

attacked Japanese air bases in Formosa in late March and early April, and later joined TF-58 off Okinawa. Over the successive weeks, four British carriers were hit by kamikazes (two were struck twice). Royal Navy carriers featured armored flight decks, and they sustained minimal damage, allowing flight operations to quickly resume. This protection limited losses on the carriers to 20 British sailors killed. The availability of TF-57 largely compensated for the absence of damaged U.S. carriers.[26]

Fifth Fleet commenced Operation Iceberg at the end of March, prompting an all-out Japanese effort to defeat it. The defense plan, Ten-Go (Operation Heaven), emphasized IJAAF and IJNAF attacks on the invasion force, but the crux of the operation rested on massed tokko raids (called *kikusui*, or "floating chrysanthemum"). Imperial Japanese Army forces prepared extensive defenses on Okinawa, planning to hold out to the end and force the enemy ships to expose themselves to attacks for as long as possible. As a result, U.S. naval forces fired on more enemy aircraft during the Battle of Okinawa than in any other campaign during World War II. U.S. ships engaged in more antiaircraft actions in April 1945 than in any other month of the war. The kamikaze response began slowly, with a trickle of attacks beginning in late March. The first and largest kikusui raid took place on 6–7 April 1945, consisting of 230 IJNAF and 125 IJAAF kamikazes and 340 conventional attackers. They managed hits on 33 ships, sinking a destroyer and three smaller vessels. Three more kikusui raids occurred in April, followed by four in May and two in June, none as large as the first. Altogether, the kikusui expended about 1,500 kamikaze planes. About 400 more were used in small group attacks.[27]

While the fast carrier task forces improved their performance against suicide attack, the rest of the fleet did not. Fifth Fleet established 15 picket destroyer stations around Okinawa to provide early warning and fighter

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[26] Timenes, *Defense against Kamikaze Attacks in World War II*, 1:49, 55–56.

[27] Roy E. Appleman, James M. Burns, Russell A. Gugeler, and John Stevens, *Okinawa: The Last Battle*, United States Army in World War II: The War in the Pacific (Washington, DC: U.S. Army Center of Military History, 1948); COMINCH, "Antiaircraft Action Summary: World War II, October 1945," chap. 5; Timenes, *Defense against Kamikaze Attacks in World War II*, 1:52, 54–55.

direction. TF-58 also deployed entire squadrons and divisions of picket destroyers between it and the mainland airfields. Barely trained tokko pilots tended to attack the first ships they encountered, which were the picket destroyers. They sank 11 and damaged 63 more during the campaign. By mid-April 1945, the picket stations were reinforced to include a destroyer or destroyer minesweeper with a fighter-director team embarked, a second destroyer to ride shotgun, one or more landing craft, and a two-plane CAP. While the radar pickets provided early warning and vectored CAP to interceptions about 60 percent of the time, a large fraction of attackers still managed to get through. Japanese radar snoopers aggressively probed the picket lines, seeking gaps and weak points. Attacks were increasingly timed to arrive at dusk and dawn, and eventually at night. The kamikazes continued to achieve tactical surprise. At Okinawa, average antiaircraft engagement ranges actually shrank for ships under attack. These averages were skewed, as combat vessels increased their average engagement range to 6,400 yards, while auxiliary and cargo types averaged only 2,800 yards. The 40mm and 20mm guns continued to splash most kamikazes shot down by antiaircraft fire; only 15 percent were downed by the 5-inch batteries.[28] The strain of the constant vigil exacted an emotional toll on top of the physical one, sapping the energy and morale of ship's crews.

Although Spruance was not scheduled to relinquish command until after the campaign ended, Nimitz directed Spruance and his exhausted Fifth Fleet staff to change places with Halsey and his Third Fleet in May. Third Fleet continued to cover operations on Okinawa until the ground fighting ended on 22 June.[29] In addition to conventional raids, IJNAF and IJAAF

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[28] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 34–35, 835, 922; Timenes, *Defense against Kamikaze Attacks in World War II*, 1:54, 57–59, 62, 72–73; COMINCH, "Battle Experience: Radar Pickets and Methods of Combating Suicide Attacks off Okinawa, March–May 1945," Information Bulletin No. 24, 20 July 1945, https://www.history.navy.mil/content/history/nhhc/research/library/online-reading-room/title-list-alphabetically/b/battle-experience-radar-pickets.html; COMINCH, "Anti-suicide Action Summary, August 1945," 5–9.

[29] Richard Hulver and Martin R. Waldman, "Battle of Okinawa: Historic Overview & Importance," Naval History and Heritage Command, last modified 13 May 2020, https://www.history.navy.mil/browse-by-topic/wars-conflicts-and-operations/world-war-ii/1945/battle-of-okinawa/okinawa-historic-overview-importance.html.

pilots flew 1,900 kamikaze sorties before the Japanese halted all air attacks in July to preserve their remaining aircraft for homeland defense. They lost at least 3,000 planes in combat and 7,000 to all causes. Although rudimentary pilot training, inferior aircraft, and improved American defense reduced the effectiveness of the tokkos per sortie compared with in the Philippines, increased numbers of attacks resulted in more Allied ships sunk and damaged. Kamikaze pilots managed to sink 26 U.S. and Allied ships and damage 225 more during the campaign, killing at least 3,389 Americans. Of 793 kamikazes that attacked U.S. and Allied ships, 181 hit and 95 achieved damaging near misses. A total of 517 missed completely. No ship larger than a destroyer sank; 86 percent of suicide attacks targeted destroyers or smaller vessels. The tokkos nevertheless damaged 8 fleet and light carriers, 4 escort carriers, 10 battleships, 5 cruisers, and 63 destroyers. Several were knocked out for the remainder of the war.[30]

In the aftermath of the Okinawa campaign, Spruance reported that suicide aircraft were the major threat his force had faced. They had inflicted real damage, and defenses against them had not been perfected. With planning for invading the Japanese home islands in November 1945 in full swing, King assigned the highest priority to several projects long underway to improve the situation. COMINCH, Bureau of Aeronautics, and Bureau of Ships had agreed in October 1944 on a crash program to deploy an airborne early warning radar system under development since 1942 to the fleet. Code-named Cadillac, airborne early warning aircraft could beam radar imagery to shipboard receivers. The program enjoyed the highest production priority, but by the end of the war, only a few aircraft had been fitted with the system and no dedicated squadron or detachment had been formed. The first three receivers were installed in carriers beginning in October 1945. An airborne CIC version, Cadillac II, was intended for operational deployment

[30] Timenes, *Defense against Kamikaze Attacks in World War II*, 1:54–55; COMINCH "Antiaircraft Action Summary: World War II, October 1945," 16–17; Prados, *Combined Fleet Decoded*, 718. In all, 36 Allied ships were sunk and 368 damaged by all causes, resulting in 4,907 sailors killed and 4,874 more wounded. United States Strategic Bombing Survey (Pacific), Naval Analysis Division, *The Campaigns of the Pacific War* (Washington, DC: U.S. Government Printing Office, 1946), 331.

by November 1945, but the end of the war delayed actual delivery of the aircraft. In April 1945, the Bureau of Ordnance established a program to develop 3-inch, 50-caliber guns—the smallest that could carry a proximity fuse—in twin mounts to replace 40mm guns and quad and twin 20mm gun mounts. The 3-inch-gun effort received overriding production priority in July 1945, but the first mountings were not available until well into 1946. Shipyards expedited replacement of torpedo tubes on destroyers with extra 40mm gun batteries.[31]

In June 1945, King created a Special Defense Section in his headquarters under Captain Arleigh A. Burke and assigned AAORG (redesignated as the Special Defense Organization) to it in July. He also formed TF-69 under Vice Admiral Willis Lee, comprising a variety of ships and aircraft, to work with Burke and tasked it with testing anti-kamikaze tactics and techniques in Casco Bay, Maine. These initially focused on improving early detection and tracking of enemy aircraft, increasing the effectiveness of antiaircraft fire, and evaluating new weapons and facilities to work out initial operating procedures. Much of this work continued on after the war as TF-69 became the Navy's Operational Development Force in September 1945 and the Operations Research Group formed a new Operations Evaluation Group, which began examining guided-missile defense.[32]

The final kamikaze attack occurred on 15 August 1945 when four picketing U.S. destroyers shot down a lone Yokosuka D4Y Suisei ("Judy") dive bomber 100 miles south of Honshu, Japan. Navy wartime innovation had mitigated the kamikaze threat, but it could not fully defeat it. Technological, tactical, organizational, doctrinal, and operational innovations developed after the Philippines campaign reduced the effectiveness of kamikaze attacks by nearly half. The United States worked intensely on further improvements in anticipation of invading Japan. As brutal as the suicide tactics were, Japan's resorting to them proved both more effective and more economical in lives of its pilots than orthodox air strikes. The combination of tactical innovation,

[31] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 838, 923–30.

[32] Friedman, *Naval Anti-aircraft Guns and Gunnery*, 933; "Summary Report to the Office of Field Service," 33–34; COMINCH "Antiaircraft Action Summary: World War II, October 1945," 24–25.

sophisticated intelligence collection and analysis, and desperate expedients to wring the remaining value from aircraft and fuel industries collapsing under U.S. strategic attack restored a measure of effectiveness to Japanese airpower decimated by U.S. naval airpower superiority. Analysis of the Okinawa campaign by the Special Defense Organization informed King's final report on U.S. Navy antiaircraft performance in the war, issued in October 1945. Both the United States and Japan understood the effectiveness of the kamikaze offensive in similar terms. IJNAF planners estimated that one in six tokko plane sorties (17 percent) would hit ships (IJAAF staff believed more optimistically that one in three would succeed). As shown in table 2, Special Defense Organization analysis estimated the following ratios of hits to sorties.

Table 2. Kamikaze Sorties and Hits, 1944–45

Campaign	Sorties	Hits		Hits + damaging near misses	
Philippines	650	115	(17.7%)	171	(26.0%)
Okinawa	1,900	181	(9.5%)	276	(14.5%)
Japan (hypothetical)	10,000	?		?	

Source: Headquarters of the Commander in Chief, U.S. Fleet, "Antiaircraft Action Summary: World War II, October 1945," Information Bulletin No. 29, 8 October 1945, 1–5.

A kamikaze pilot that reached the target area and successfully commenced an attack stood almost a one in two (47.4 percent) chance of hitting or damaging a ship. Postwar estimates credited the Japanese with more than 10,000 remaining combat-ready aircraft and the intent to commit them to homeland defense. Fortunately, this final test did not come to pass.[33]

[33] Richard B. Frank, *Downfall: The End of the Imperial Japanese Empire* (New York: Random House, 1999), 182–87; Friedman, *Fighters over the Fleet*, 404, 1154, 1158.

CHAPTER SIX

The Wild Weasel That Wasn't: Innovating Counter-Radar Tactics and the Suppression of Enemy Air Defenses during the Korean War

Peter C. Luebke

Innovation is often defined as doing something new, be it the new use of an existing technology, the creation of new technology altogether, or the implementation of a new practice. Beyond the initial stages of figuring out a new way of doing things, innovation within an organization such as the Navy relies upon repetition and codification. In other words, the institution as a whole has to adopt the innovative practice or technology. The Korean War provides a particularly illustrative example of how local actors within theater during the war innovated with their approach in the suppression of enemy air defenses—adversary radar in particular—and came up with a set of effective tactics. The Navy's use of tactical electronic countermeasures was unprecedented and, in effect, hit upon the tactics and mission set that would have to be relearned in later operations, including the Iron Hand mission and Wild Weasel concept of the Vietnam War.[1] The Navy organizations involved stretched from the

[1] A very brief discussion of U.S. Navy electronic warfare in Korea can be found in Richard P. Hallion, *The Naval Air War in Korea* (Baltimore, MD: Nautical & Aviation Publishing Company of America, 1986), 108–10. For a discussion of the Iron Hand mission and Wild Weasel tactics in Vietnam, see Jacob Van Staaveren, *Gradual Failure: The Air War over North Vietnam, 1965–1966* (Washington, DC: Air Force History and Museums Program, 2002), 167–76, 192–97; and Wayne Thompson, *To Hanoi and Back: The United States Air Force and North Vietnam, 1966–1973* (Washington, DC: Air Force History and Museums Program, 2000), 36–37, 245–47, 266–69.

operational task force off the coast of Korea to patrol aviation squadrons and intelligence centers in Japan. Over a period of less than a year, the Navy forged an effective tool for defeating a particular threat, but Navy leadership at the time—for a variety of reasons also explored here—judged this innovation to be a poor use of resources. Thus, the proverbial lesson learned was actually a lesson forgotten, a not uncommon negative example of how successful innovation does not always lead to a paradigm shift.

World War II gave rise to the widespread use of the electromagnetic spectrum in warfare. Land-based radar installations provided the British with early warning of German air attacks, enabling the Royal Air Force to marshal a successful defense against the Luftwaffe in 1940. Later methods of radar and radio guidance for bombing raids sparked a cat-and-mouse game of measures and countermeasures that became known as the "Battle of the Beams." The war also saw the introduction of smaller radar sets to ships and aircraft for early warning, range finding, direction finding, gun laying, and fire control. Most combatants during the war understood the basic scientific principles behind radar, which resulted in the proliferation of both passive and active countermeasures, such as air-dropped reflectors or jamming. Many air forces during World War II gained considerable experience

A Douglas AD-4N Skyraider. With its onboard radar and space for several crew, the AD-4N proved central to the Navy's efforts to suppress Communist radars during the Korean War. (NHHC, NH 92502) with radar and radar countermeasures, as the broadest use of the technology lay with navigation aids, early warning, and antiaircraft gunlaying. They also fielded specialist electronic warfare and electronic countermeasures (ECM) units with spoofing and jamming capabilities, such as the Royal Air Force's No. 100 Group. However, tactical employment of airborne radar equipment was largely limited to these kinds of pathfinder missions or use on night-fighter aircraft.[2]

Within the wider context of radar usage during World War II, the Navy had comparatively little experience with tactical airborne radar and radar countermeasures as most of its efforts were concentrated on patrol and strike duties, as well as fleet air defense. For example, Navy PBY Catalina aircraft used radar to navigate by night and identify Japanese targets. These so-called Black Cats also operated in conjunction with patrol boat (PT) units; the aircraft would locate targets with radar, then guide the PTs in to strike. Toward the end of the war, the Navy had to deal with Japanese kamikaze aircraft spoofing identification friend or foe signals. The Navy also experimented with the concept of airborne early warning radar. Overall, the electronic war in the Pacific was much less intense than that in Europe, partly owing to the inability of the Japanese to mount a serious electronic warfare capability. Although the Navy and its aviation elements had accrued some experience with the tactical employment of radar, the service possessed comparatively

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[2] For more on the electronic warfare aspects of World War II, see Martin J. Bollinger, *Warriors and Wizards: The Development and Defeat of Radio-Controlled Glide Bombs of the Third Reich* (Annapolis, MD: Naval Institute Press, 2010); Martin Bowman and Tom Cushing, *Confounding the Reich: The RAF's Secret War of Electronic Countermeasures in WWII; The Story of 100 (Special Duties) Group RAF Bomber Command 1943–1945* (Barnsley, UK: Pen & Sword Aviation, 2004); Louis Brown, *A Radar History of World War II: Technical and Military Imperatives* (Bristol, UK: Institute of Physics Publishing, 1999); Louis A. Gebhard, *Evolution of Naval Radio-Electronics and Contributions of the Naval Research Laboratory*, Naval Research Laboratory Report 8300 (Washington, DC: Naval Research Laboratory, 1979); Henry E. Guerlac, *Radar in World War II* (Washington, DC: National Defense Research Committee Office of Scientific Research and Development, 1947); Janine Harrington, *RAF 100 Group: The Birth of Electronic Warfare* (Stroud, UK: Fonthill Media, 2016); Derek Howse, *Radar at Sea: The Royal Navy in World War 2* (Annapolis, MD: Naval Institute Press, 1993); Alfred Price, *The History of US Electronic Warfare*, vol. 1, *The Years of Innovation—Beginnings to 1946* ([Alexandria, VA?]: Association of Old Crows, 1984); Alfred Price, *Instruments of Darkness: The History of Electronic Warfare* (London: William Kimber, 1967).

little when it came to detecting, combating, or using radar to suppress enemy electronic air defenses owing to a lack of need.[3]

Between the end of World War II and the commencement of the Korean War, the Navy gained some limited experience with electronic intelligence and electronic warfare. As the United States began to become more wary of the Soviet Union, the services began electronic intelligence collection against it and Soviet-occupied territories. The Navy participated in the Special Electronic Search Project (SESP), with patrol aircraft flying peripheral reconnaissance missions to collect information on adversary radars and transmissions. Two fleet air reconnaissance squadrons (VQs)—VQ-1 in the Pacific and VQ-2 in the Atlantic—collected this national-level intelligence. The SESP and the pair of VQ squadrons had been in operation only a short while before the outbreak of the Korean War. Their existence demonstrated the Navy's attention to the electromagnetic spectrum as a warfare domain, but the limited nature of the SESP also charted the boundaries of the Navy's practical experience dealing with adversary radar.[4]

The beginning of electronic warfare in the Korean War coincided with the commencement of hostilities. When North Korean forces pushed south on 25 June 1950, an Air Force RB-29 Superfortress flew a mission the very next day to determine if Communist forces had any radars in operation. North Korean forces had no radar, but as the Communist Chinese became

[3] For a general discussion of U.S. Navy radar, see the sources in note 2. On cooperation between PT boats and PBY Catalinas, see Robert J. Buklley Jr., *At Close Quarters: PT Boats in the United States Navy* (Washington, DC: Naval History Division, 1962), 95, 117, 133, 149–50; and Richard C. Knott, *Black Cat Raiders of World War II* (Annapolis, MD: Nautical and Aviation, 1981).

[4] John R. Schindler, *A Dangerous Business: The U.S. Navy and National Reconnaissance during the Cold War* (Fort Meade, MD: Center for Cryptologic History, n.d.), 1–7; John T. Farquhar, *A Need to Know: The Role of Air Force Reconnaissance in War Planning, 1945–1953* (Maxwell, AL: Air University Press, 2004), 143. For more on the wider strategic reconnaissance and overflight programs in the early Cold War, including imagery and electronic intelligence, see *Early Cold War Overflights, 1950–1956: Symposium Proceedings*, ed. R. Cargill Hall and Clayton D. Laurie, vol. 1, *Memoirs* (Washington, DC: Office of the Historian, National Reconnaissance Office, 2003); *Early Cold War Overflights, 1950–1956*, vol. 2, *Appendixes*; and Robert S. Hopkins, *Spyflights and Overflights: US Strategic Aerial Reconnaissance*, vol. 1, *1945–1960* (Manchester, UK: Hikoki Press, 2016).

more involved in the war, detection of adversary radar increased. The first sets detected were early American radars that the People's Republic of China had captured from the Nationalist Chinese and then put into operation. Radars came into operation south of the Yalu River in early 1951, primarily fire-control sets used for antiaircraft batteries. A year after the war started, the U.S. Air Force had identified 25 discrete sets in operation along the North Korean–Chinese border or just inside China.[5] Through mid-1952, the Navy's "interest in electronic counter-measures increased sharply and an ECM intercept program was prosecuted," though with a focus on passive interception and detection only, outside of some minor experimentation with various reflective countermeasures.[6]

The year 1952 saw an increase in the activity of Soviet-built MiG-15 jet interceptors. The MiG-15s posed an increased threat to naval carrier aviation at high altitudes, as the jet aircraft had much higher levels of performance than the prop-driven models that constituted the workhorses of the Navy's strike and interdiction efforts. The Navy and United Nations forces all noted a large increase in MiG activity in the second half of 1952, on both the west and east coasts of Korea. MiGs intercepted British Fireflies on 27 July, British Sea Furies on 9 and 10 August, Corsairs of Marine Attack Squadron (VMA) 312 on 10 September, Corsairs from attack aircraft carrier *Kearsarge* (CVA-33) on 1 October, Corsairs from *Princeton* (CVA-37) on 7 October, and VMA-312 Corsairs again on 28 November. On the east coast of Korea, where Task Force (TF) 77 operated, the MiGs seemed concentrated in the area around Wonsan and Hungnam, though they sometimes appeared as far

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[5] Alfred Price, *The History of US Electronic Warfare*, vol. 2, *The Renaissance Years, 1946 to 1964* ([Alexandria, VA?]: Association of Old Crows, 1989), 51–54; Farquhar, *A Need to Know*, 133–67. For more on the U.S. Air Force campaign in Korea, as well as how Air Force electronic warfare centered on protecting bombers during strategic air attacks, see Robert F. Futrell, *The United States Air Force in Korea*, rev. ed. (Washington, DC: Air Force History and Museums Program, 1983), 527, 528, 614, 616–17.

[6] Commander in Chief, U.S. Pacific Fleet (CINCPAC), "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 4: 1 January 1952–30 June 1952*, 6. See also CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 4*, 88; and CINCPAC, "Chapter 2: Chronology," in *Interim Evaluation Report No. 4*, 34.

south as Kojo. The larger threat from the MiG-15s would result in a Navy squadron innovating radar suppression techniques.[7]

The behavior of the MiG-15s alerted the Navy to the presence of Communist ground-control intercept radar. The commanding officer of *Princeton* noted that when the Navy sent a target combat air patrol of jets preceding or alongside a strike of the propeller aircraft, the MiG-15s stayed away. This factor, combined with the prevalence of accurate MiG-15 interceptions in the areas around Wonsan, led *Princeton*'s commanding officer to speculate that "the MIG's may operate only under the positive radar control which is available to them in the Wonsan-Hungnam area."[8] A 1952 evaluation report concurred that "an elaborate early warning defense system was in operation together with necessary communications, to allow targets to be passed from station to station."[9]

Elements of TF-77 began hunting for enemy radar sets using composite squadron aircraft. Drawn from the embarked electronic countermeasures and radar-equipped units, the composite squadrons possessed electronic countermeasures that made them more adequate than other carrier-based aircraft for detecting adversary emissions. For instance, a detachment of Fleet Composite Squadron (VC) 35 embarked in *Oriskany* (CVA-34) used two ECM-configured planes working together in an attempt to triangulate

[7] CINCPAC, "Chapter 2: Chronology," *Interim Evaluation Report No. 4*, 10, 12, 18, 30; CINCPAC, "Chapter 2: Chronology," in *Interim Evaluation Report No. 5: 1 July 1952–31 January 1953*, 8; CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 4*, 19, 20, 21, 23; Commanding Officer (CO), *Princeton* (CV-37), serial 0260, "Action Report for the Period 28 September 1952 through 18 October 1952," 31 October 1952, 2, 10–11, https://www.history.navy.mil/research/archives/digital-exhibits-highlights/action-reports/korean-war-carrier-combat/princeton-cv37.html. For more on the increase in MiG activity in this time period as well as "a few operational novelties" such as "efforts by carrier airmen to locate and demolish [radar] installations," see James A. Field Jr., *History of United States Naval Operations: Korea* (Washington, DC: [Naval History Division], 1962), 440–42.

[8] CO, *Princeton*, serial 0260, "Action Report for the Period 28 September 1952 through 18 October 1952," 2–3, 10–11.

[9] CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 5*, 70.

coordinates of adversary sets.[10] Another VC-35 radar-equipped detachment had detected transmissions while using its equipment to navigate during nighttime heckler missions. The detachment then "experiment[ed] with several methods for pinpointing enemy radar positions."[11]

Once aware of the threat, some composite squadrons moved to the next logical step—direct attack on enemy radars. A VC-33 detachment embarked in *Bon Homme Richard* (CVA-31) developed hunter-killer tactics for use against radars. VC-33, as a composite squadron, possessed models of Skyraiders with APA-70 direction finders and other advanced electronics necessary for its usual roles of night attack and antisubmarine warfare. Faced with a new threat outside of its usual mission set—enemy air defenses—the VC-33 pilots innovated. They developed a tactic where a pair of ECM aircraft would search for enemy radar and then establish bearings. Once the aircraft settled upon a suspected fix, an accompanying escort would move in to attack the suspect ground coordinates. It seems likely that the use of hunter-killer tactics was an adaptation of the familiar techniques used for locating and prosecuting enemy submarines, a mission profile for which most of the composite squadrons had trained.[12]

Local Navy leadership encouraged these early efforts. Admiral Joseph J. Clark, Commander Seventh Fleet, praised the efforts of VC-33. He forwarded a report of their actions to the Chief of Naval Operations, "not[ing]

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[10] Commander, Carrier Air Group 102, serial 031, "Action Report of Carrier Air Group ONE HUNDRED TWO for the Period 28 October through 22 November 1952," 22 November 1952, enclosure (1), VI-4, https://www.history.navy.mil/research/archives/digital-exhibits-highlights/action-reports/korean-war-carrier-air-groups.html.

[11] CO, *Valley Forge* (CVA-45), serial 061, "Action Report for Period 30 December 1952 through 25 January 1953," 8–9, https://www.history.navy.mil/research/archives/digital-exhibits-highlights/action-reports/korean-war-carrier-combat/valley-forge-cv45.html. For more on VC-35, see Ralph E. Poore, "The Value of Electronic Warfare Endures," *Proceedings* 130, no. 9 (September 2004): 36.

[12] CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 4*, 52; CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 5*, 70–71; CO, *Bon Homme Richard* (CVA-31), serial 0020, "Action Report for the Period 30 September 1952 to 5 November 1952," enclosure (1), "Supplement to Action Report Part VI, Section 6, Sub-section 5 on Electronic Countermeasures," folder 9, box 454, Post 1946 Reports, Archives Branch, Naval History and Heritage Command (NHHC), Washington Navy Yard, DC.

with pleasure the initiative shown by the BON HOMME RICHARD's Carrier Air Group SEVEN in pursing the anti-radar program" and expressing the belief that the innovative tactics would "contribute greatly to success in this relatively new field."[13]

Other efforts followed these initial sorties. Carrier Air Division 1 reported that "the practice of sending ECM planes out with a VF [fighter squadron] or VA [attack squadron] escort was continued during this period," and judged it "successful in finding and destroying some stations." The enemy, however, adapted to the new tactic, with the report stating, "Since this practice was instituted the enemy radar activity has decreased considerably, indicating a trend toward radar silence." The enemy also took steps to conceal radar installations. The report observed, "In many cases ECM planes would obtain a fix on a station but the attack planes were unable to find it in the area due either to camouflage or a forest location."[14] Commander Seventh Fleet endorsed the Carrier Air Division 1 report but added clarifying information, noting, "The primary objectives of ECM in the SEVENTH FLEET are the location and destruction of enemy radars." He also observed, "'Hunter-Killer' tactics to date have achieved only limited success due primarily to the ECM limitations of carrier aircraft. Specifically, the necessity for making a homing run on an enemy station in order to obtain an accurate bearing is both dangerous and tactically unsound in that it reveals the search plane's intentions."[15]

These comments revealed technological shortcomings in the radar-killing efforts. The "homing run," for example, stemmed from the fixed antenna of the APA-70 on the AD-4N Skyraider aircraft that required that "the aircraft fly directly toward or directly away from the signal source in order that a bearing

[13] Commander Seventh Fleet, serial 00293, "Second Endorsement on CO, USS BON HOMME RICHARD (CVA 31) sec ltr ser 0020 of 7 Nov 1952," 21 December 1952, "Supplement to Action Report Part VI, Section 6, Sub-section 5 on Electronic Countermeasures," folder 9, box 454, Post 1946 Reports, Archives Branch, NHHC.

[14] Commander, Carrier Division 1, serial 0055, "Action Report for Period 25 November to 18 December 1952," 27 December 1952, enclosure (1), 16, folder 1, box 182, Post 1946 Reports, Archives Branch, NHHC.

[15] Commander Seventh Fleet, serial 0022, First Endorsement on Commander, Carrier Division 1, "Action Report for Period 25 November to 18 December 1952," 5 February 1953, folder 1, box 182, Post 1946 Reports, Archives Branch, NHHC.

to the source be obtained." Unsurprisingly, the enemy soon figured that fact out. As Commander, Carrier Division 1 wrote, "Enemy operators are now aware of this feature and almost invariably cease radiating when an aircraft is held on a constant or near constant bearing."[16] Other operators concurred that the APA-70 limited the effectiveness of ECM flights. Aircrew from *Princeton* observed, "The present equipment necessitates the aircraft's turning toward the detected station to take bearings and in the majority of cases these stations immediately realize they have been detected and cease transmitting."[17]

As Communist forces adapted to TF-77's radar tactics, the Navy's suppression effort widened. First, TF-77 started sending photographic reconnaissance aircraft with the hunter-killer teams. With a general sense of where a radar might be, the photographic aircraft would make runs over the target area so that the photo development and intelligence divisions aboard the aircraft carrier could create mosaics and search for the radar set. This technique resulted in massive amounts of work for the organic photographic development and interpretation shops, particularly owing to the use of wet film development, the labor of cutting and pasting by hand, and the time-consuming analysis of photo mosaics using magnifying glasses. One Navy report assessed that "the long hours spent by TF 77 photo interpreters searching for radar sites hampered routine target searches." Commander, Carrier Division 5 complained, "The offensive effort required is out of proportion to the results obtained." As a result, TF-77 pushed the responsibility for the photo interpretation to a centralized intelligence unit at Naval Air Station Atsugi.[18] Additional impetus to shift responsibility to non-TF-77 units also stemmed from the fact that radar-equipped aircraft organic to TF-77 bore responsibility for a wide range of missions—ECM hunter-killer, nighttime nuisance-attack, radar-controlled

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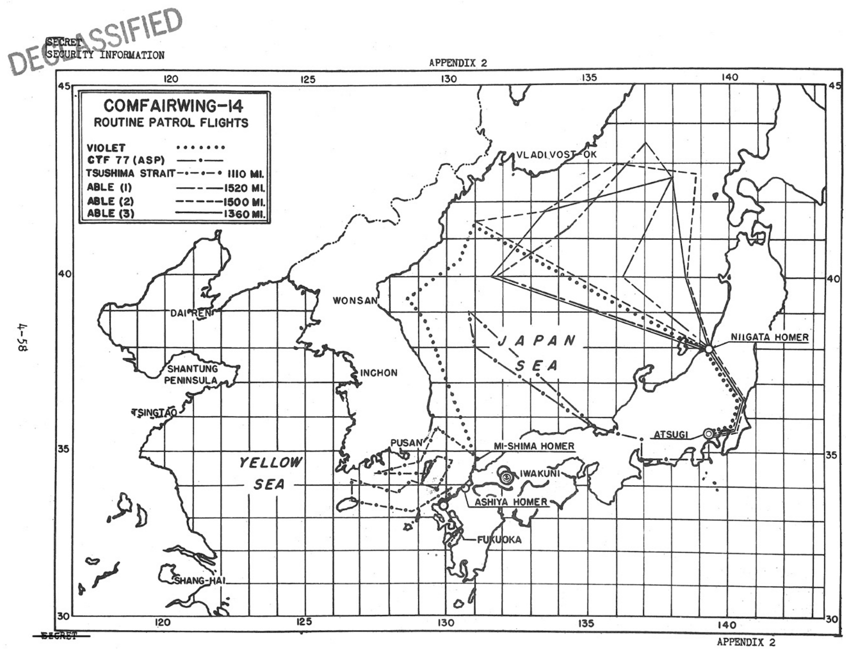
[16] Commander, Carrier Division 1, serial 0012, "Action Report for Period 15 May through 4 June 1953," 8 June 1953, enclosure (1), 7, folder 3, box 182, Post 1946 Reports, Archives Branch, NHHC.

[17] CO, *Princeton* (CVA-37), serial 0191, "Action Report for the Period 8 March 1953 through 3 April 1953," 12 April 1953, 19, https://www.history.navy.mil/research/archives/digital-exhibits-highlights/action-reports/korean-war-carrier-combat/princeton-cv37.html.

[18] Quoted in CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 5*, 71.

bombing, and night-fighter—where demand far outstripped capacity. The commander of Carrier Division 1 observed that "the benefits of an active sustained ECM program appear to justify a greater effort," but an effort that was out of reach until airframe and manning numbers increased.[19]



Navy patrol aircraft added Track Violet (seen here as the dotted line running from Atsugi north then west to the coast of China and Korea) to their set of patrol routes in order to detect Communist radar emissions. Track Violet represented an important collaboration between Task Force 77 and shore-based aviation of Naval Forces Far East. (Commander in Chief, U.S. Pacific Fleet, "Chapter 4: Patrol Squadron Operations," in *Interim Evaluation Report No. 5: 1 July 1952–31 January 1953*, 58.)

With the shift of photographic interpretation to Atsugi in the fall of 1952, Navy patrol squadrons became aware of the tactical radar effort underway in TF-77. The patrol squadrons at Atsugi already had the responsibility of collecting electronic intelligence along the Chinese coast, but Commander TF-77 now asked the patrol squadrons "to supplement and

[19] Commander, Carrier Division 1, serial 0012, "Action Report for Period 15 May through 4 June 1953," 8 June 1953, enclosure (1), 7, folder 3, box 182, Post 1946 Reports, Archives Branch, NHHC.

aid carrier ECM radar destruction teams." Aware that the fleet wanted electronic intelligence on radar along the Korean Peninsula, Task Element 96.22 added an additional standard patrol route to its set of mission profiles. This new route—Track Violet—aimed to collect emissions along the east coast of Korea. Task Element 96.22 flew the first of these missions on 31 October 1952. As with the carrier-based aircraft, much of the equipment used by the patrol squadrons could not monitor the lower wavelengths used by the Communist ground-control intercept radars, but some of the planes had sets that could receive in that range. Initially, Patrol Squadron (VP) 772, equipped with the older P4Y-2 Privateer, flew the Violet missions, but modifications to VP-29 P2V-5 Neptunes allowed them to fly the missions, too. The initial cooperation yielded excellent results, as after October 1952 intercepts of enemy radar increased by a factor of 10.[20]

Communist radars adapted to the Navy patrol aircraft, which in turn sparked refined tactics by the patrol squadrons. One Navy report observed of the Violet profile, "Missions were so stereotyped that the track (Violet) was flown like an airline schedule, offering no deception whatsoever." To address this problem, the squadrons began varying their mission parameters such as flying at different altitudes, airspeeds, and so forth. The deception worked, and the squadrons logged more interceptions.[21]

In support of Violet operations, in 1953 TF-77 implemented emissions control orders so that passing patrol aircraft could better detect Communist radars. The emissions control orders specified times and bands when and where the fleet would not transmit so as to reduce interference with the patrol aircraft. Navy reports had noted that "the constant use of shipborne radars close to the coast has, at times, made it impossible to determine bearings of enemy radar stations."[22] Poor weather often forced TF-77 to transmit during the blackout periods, however, hurting the overall effort. Nonetheless, the effort "was the first attempt at coordination between reconnaissance aircraft

[20] CINCPAC, "Chapter 4: Patrol Squadron Operations," in *Interim Evaluation Report No. 5*, 10, 14, 20–21, 31.

[21] CINCPAC, "Chapter 4: Patrol Squadron Operations," in *Interim Evaluation Report No. 6: 1 February 1953–27 July 1953*, 21.

[22] CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 5*, 71.

and the task force." The Navy ultimately realized that "the situation that existed in the Far East theater presented an excellent opportunity for evaluation of an interforce doctrine for ECM reconnaissance."[23]

The advent of TF-77 and Atsugi patrol antiradar efforts coincided with the foundation of the Joint Electronic Intelligence Center (JEIC) in October 1952. An effort between the Army and the Navy, the JEIC served as "a central agency for the coordination, joint processing, analysis, evaluation, and dissemination of electronic (non-communication) intelligence."[24] The JEIC compiled electronic orders of battle; information from TF-77 aircraft as well as the patrol squadrons went in reports that JEIC recirculated to the operational units. The reports logged known enemy signals, as well as positively identified friendly signals, which allowed the operational units to narrow down the wavelengths for which they searched. As Communist radars began operating intermittently to avoid detection or destruction, the JEIC reports became even more important, as Navy aircraft needed to find enemy transmissions much more quickly.[25]

The increased focus on hostile radars in the area bore results. The JEIC collated results from the patrol squadrons flying Track Violet and pushed that intelligence back to the fleet. Carrier-borne aircraft used the frequencies reported by the JEIC to hone in their interception searches and rule out friendly emissions. According to Commander, Carrier Division 1, "Results were good." Thirty-six ECM missions (which comprised 1.8 percent of all Carrier Division 1 offensive sorties) resulted in nine coordinate fixes.[26] The ratio of ECM missions to overall sorties held about constant; the next reporting period saw 45 of them flown (1.9 percent of all Carrier Division

[23] CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 6*, 86.

[24] Wyman H. Packard, *A Century of U.S. Naval Intelligence* (Washington, DC: Office of Naval Intelligence and Naval Historical Center, 1996), 197.

[25] CINCPAC, "Chapter 4: Patrol Squadron Operations," in *Interim Evaluation Report No. 5*, 29; CINCPAC, "Chapter 4: Patrol Squadron Operations," in *Interim Evaluation Report No. 6*, 20–21.

[26] Commander, Carrier Division 1, serial 0012, "Action Report for Period 15 May through 4 June 1953," 8 June 1953, enclosure (1), 7, folder 3, box 182, Post 1946 Reports, Archives Branch, NHHC.

1 offensive sorties).[27] The period after that saw 56 sorties (1.6 percent of all Carrier Division 1 sorties).[28]

General awareness of ECM and radar intercepts spread to other units working near Korea. Task Unit (TU) 95.1.1—escort carriers and air wings dedicated to close air support that operated off the west cost of Korea near Seoul—began logging radar intercepts. Vessels in TU-95.1.1 started building their own electronic order of battle so that they could filter out friendly emissions detected during their passive collection, as the latest official list of friendly United Nations radars in the area dated back to August 1950. TU-95.1.1 also instituted an intermittent electronic emission control plan to facilitate interception of adversary signals. The measures taken resulted in success, with Task Unit 95.1.1 detecting and logging the operation of Russian radar sets along the Chinese coast.[29]

Yet, despite the advances outlined above, the Navy failed to codify the lessons learned into a doctrine. In a familiar pattern, the end of the war meant the end of the practice. Local units had developed solutions in theater to counter an identified threat. The general techniques for suppression of enemy air defense radar—such as the need for tactical electronic warfare and the necessity of compiling an electronic order of battle in a joint environment—had been hit upon, but not codified, in part owing to a shift to blue-water operations and antisubmarine warfare concerns. TF-77 leadership, while initially supportive of the antiradar mission, ultimately decided

[27] Commander, Carrier Division 1, serial 0016, "Action Report for Period 14 June to 28 June 1953," 6 July 1953, enclosure (1), 6, folder 6, box 182, Post 1946 Reports, Archives Branch, NHHC.

[28] Commander, Carrier Division 1, serial 0112, "Action Report for Period 14 July to 27 July 1953, 15 August 1953, enclosure (1), 6, folder 8, box 182, Post 1946 Reports, Archives Branch, NHHC.

[29] CO, *Bataan* (CVL-29), and Commander, Task Unit 95.1.1, serial 0051, "Action Report 15 February through 26 February 1953," 9 March 1953, 15, https://www.history.navy.mil/research/archives/digital-exhibits-highlights/action-reports/korean-war-carrier-combat/bataan-cvl29.html; CO, *Bataan*, and Commander, Task Unit 95.1.1, serial 060, "Action Report 6 March through 16 March 1953," 4 April 1953, 14–15, https://www.history.navy.mil/research/archives/digital-exhibits-highlights/action-reports/korean-war-carrier-combat/bataan-cvl29.html; CINCPAC, "Chapter 3: Carrier Operations," in *Interim Evaluation Report No. 6*, 29–30.

that the amount of effort yielded too little in the way of results. And the other partner in an air campaign—the Air Force—had initially refused to partner with the Navy at the Joint Intelligence Center, Far East. At any rate, the Air Force's focus remained on paving the way for strategic bombers, not tactical electronic warfare in support of interdiction or deep interdiction efforts. Thus, the lessons of the Korean War would need to be relearned again with the Iron Hand and Wild Weasels of Vietnam and Desert Shield and Desert Storm.

The story of how the Navy innovated effective tactics to suppress enemy air defenses, including the coordination of TF-77 forces with reconnaissance aircraft from Japan and the establishment of the JEIC, demonstrates the challenges of innovation that lasts. Although the suppression of enemy air defenses was deemed to be a relatively minor problem that did not justify the investment of resources, the advent of surface-to-air missiles and their subsequent deployment gave increasing urgency to the problem. As noted, even during the Korean War itself, some leaders were skeptical of ECM's efficacy and found that its costs vastly outweighed the benefits in terms of overall execution of mission. Thus, innovation lasted for about eight months. In hindsight, the decision made here was shortsighted, which points to the fact that innovation should not only be based on current requirements but also anticipate future needs. So long as there was a perceived need, the innovation lasted; absent that, the tactics were forgotten, a pattern seen elsewhere, such as in the areas of counterinsurgency, riverine operations, and minesweeping. The return of tactical suppression of enemy air defenses came only during the Vietnam War, when increasing aircraft losses drew focused attention from the Navy and the Air Force in order to address the threat.[30]

[30] James R. Brungess, *Setting the Context: Suppression of Enemy Air Defenses and Joint War Fighting in an Uncertain World* (Maxwell, AL: Air University Press, 1994), 4–15; Robert M. Burch, *Tactical Electronic Warfare Operations in SEA, 1962–1968*, Project Contemporary Historical Evaluation of Combat Operations Report (n.p.: Headquarters Pacific Air Forces, 1969), 13–23; Adam R. Grissom, Caitlin Lee, and Karl P. Mueller, *Innovation in the United States Air Force: Evidence from Six Cases* (Santa Monica, CA: RAND, 2016), 43–53.

CHAPTER SEVEN

The Individual Innovating: Raye Jean Jordan Montague, Pioneering Ship Designer, Engineer, and Mentor

Regina T. Akers

Change, challenge, and crisis often require innovation and persistence to overcome. Invention, modernization, and investment are critical to the Navy's ability to meet its missions, deter war, engage its foes when necessary, advance its warfighting capabilities, and maintain its status as the best sea service in the world. Often, the success of innovation stems from the motivation, drive, and dedication of an individual. Such is the case with Raye Jean Jordan Montague, a Naval Sea Systems Command (NAVSEA) engineer who distinguished herself as the first woman program manager of ships and who developed the Navy's first computer-generated draft for a warship design.

Montague began her 34-year career as clerk-typist at the lowest civilian grade (General Schedule [GS] 3) and rose to the highest General Schedule grade for a civilian (GS-15), setting several pioneering milestones for women and African Americans. As the Navy's expert on computer-aided design and manufacturing, she advised colleagues across the Department of Defense. In spite of the racism, sexism, and misogyny she encountered, she excelled in a male-dominated profession and became an international icon for women in the fields of science, technology, engineering, and mathematics (STEM). Her photographic memory, outstanding math and science skills, analytical ability, determination, on-the-job training, and

Raye Montague, a U.S. Navy "hidden figure." Montague is pictured at her desk at the Naval Ship Engineering Center, circa 1970. (Todd A. Hurley, "Raye Montague, a U.S. Navy 'Hidden Figure,'" NAVSEA.)

background in computer courses proved critical to her success. She found creative ways to work around individuals and situations posing barriers to her professional advancement. Montague answered constant skepticism and prejudice with self-confidence, determination, and outstanding performance. Her personal traits, developed as a result of her life experiences before and after working for the Navy, aided her in developing new ideas, effectively arguing for their adoption, and working with others to ensure the success of her innovations.

Raye Jean Jordan was born on 21 January 1935 in Little Rock, Arkansas, to Rayford Jordan and Flossie Graves Jordan. From her youth, she loved and excelled in math and science, and she benefitted from having a photographic memory. Her family provided tremendous support, encouragement, and reassurance. One of her mother's admonitions proved motivational throughout her life: "You're female, you're black, and you're going to have a segregated school education—so you're going to have three strikes against you. But you can do anything you want to do and you can be anything you want to be."[1] Her mother also told her, "But you've got to be educated and work hard." Jordan's family values taught her the importance of pursuing education, being self-sufficient and proactive, and helping and respecting others. She grew up around strong Black women, several of whom operated their own businesses despite the prevalent segregation and racial discrimination enforced by law, tradition, and custom in the South. Her mother took Raye with her when she voted because she believed voting was essential to ending segregation. As a child, Jordan preferred reassembling toy trucks and locomotives to playing with dolls. Though her parents divorced at age four, she found encouraging role models in her grandfather and neighbors.[2]

At age seven, during World War II, her grandfather took her to see a captured German miniature submarine sunk off the coast of the Carolinas,

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[1] Rhonda Owen, "Raye Jean Jordan Montague," *Arkansas Democrat Gazette*, 16 December 2012, https://www.arkansasonline.com/news/2012/dec/16/raye-jean-jordan-montague-20121216/.

[2] Naval Sea Systems Command (NAVSEA), "A Conversation with Raye Montague, Part 1," 14 April 2017, YouTube video, 27:52, https://www.youtube.com/watch?v=cNR1IOQX0Ok; Brigit Katz, "Raye Montague, a Barrier-Breaking Naval Ship Designer, Has Died at 83," *Smithsonian*, 22 October 2018.

which was touring the nation to support the war bond drive.[3] Years later, she recalled being utterly intrigued as she "looked through the periscope and saw all these dials and mechanisms." When she asked the tour guide about the requirements to operate the sub, he replied, "You'd have to be an engineer, but you don't have to worry about that." Not realizing she had been insulted, she decided to become an engineer. Her mother taught her "there was no such thing as women's work or men's work." Thus, Jordan did not consider her dream unusual, unrealistic, or unobtainable. When she shared her career plan to become an engineer with her classmates, they laughed at her. She found a supporter in her eighth-grade social studies teacher, Irma Holiday, who urged, "Aim for the stars. At the very worst you'll land on the moon."[4]

Raye Jordan participated in the debate and business clubs and played the piano while attending Merrill High School, established in 1886 for Black people. She found inspiration in the school's guest speakers: 1936 Olympian Jesse Owens, American educator and civil rights activist Mary McLeod Bethune, and champion heavyweight boxer Joe Lewis. She planned to study engineering at the University of Arkansas at Fayetteville, but the program did not admit women. Instead, she attended Arkansas Agricultural, Mechanical and Normal College (today the University of Arkansas at Pine Bluff), majoring in business administration and secondary education. An on-campus car accident on 13 February 1953 damaged her right hip and broke her leg. In partial compensation for the accident leaving her permanently disabled, the school

[3] Arkansas PBS, "Arkansas Women's Hall of Fame: Raye Montague," 11 October 2019, YouTube video, 3:13, http://www.youtube.com/watch?v=RcVo0Laga6s. Montague reported in her presentations that she saw the captured German submarine *5622*. There is mention and a photo of the submarine on display in her interview with the Arkansas Women's Hall of Fame. However, her son's coauthored biography notes it was the *HA-19*, a Japanese midget submarine captured at Pearl Harbor after the December 7th surprise attack. See Paige Bowers and David R. Montague, *Overnight Code: The Life of Raye Montague, the Woman Who Revolutionized Naval Engineering* (Chicago: Lawrence Hill Books, 2021), 26.

[4] Craig O'Neill and Michael Buckner, "Raye Montague Broke Barriers as Arkansas' Own 'Hidden Figure,'" 2 February 2017, https://www.thv11.com/article/news/local/raye-montague-broke-barriers-as-arkansas-own-hidden-figure/91-387386067.

paid her tuition for the remainder of her enrollment. She graduated in 1956, making her the third generation of her family to receive a college degree.[5]

In search of postcollege employment, she moved to Washington, DC, where she met and married Weldon A. Means.[6] Her sister-in-law helped her secure a GS-3 clerk-typist job in 1956 at the Navy's Applied Mathematics Lab at David Taylor Model Basin in Carderock, Maryland, established on 4 November 1940. The facility, comprised of a building complex and five basins of varying sizes, studied ship models to test ship performance under near-realistic conditions.

For much of the Cold War, Carderock drove innovation within the Navy. Some of its more noteworthy design achievements included the small-water plane twin-hull concept for ships; the submarine propeller and the bulb-shaped bow for the *Skipjack* class, the Navy's first high-speed nuclear submarine; and highly skewed propellers reducing vibration and noise for surface ships and subs. In the late 1960s and 1970s, scientist Charles Dawson created a revolutionary computational method that enhanced the ability of hydrodynamicists to more accurately calculate Kelvin wave systems. The loss of the submarine *Thresher* (SSN-593) in 1963 prompted the Navy to prioritize pressure hull studies, the development of improved buoyancy systems, and hulls capable of withstanding pressure while submerged. The Navy also focused on deep submersibles, such as *Alvin* (DSV-2), for research and rescue.

The Applied Mathematics Lab was but one of a number of scientific endeavors the Navy embarked upon following World War II. In 1946, the Navy established the Office of Naval Research and the Naval Research

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[5] Bowers and Montague, *Overnight Code*, 1–55. Her grandmother's brother completed college in 1902 and Meharry Medical College in 1910; her mother had completed college in 1927. NAVSEA, "A Conversation with Raye Montague, Part 1"; Angelita Faller, "Montague Mother and Son Duo Say Education is the Key to Breaking Barriers," University of Arkansas at Little Rock, 24 February 24 2017, https://ualr.edu/news-archive/2017/02/24/david-raye-montague-breaking-barriers/; Raye J. Montague, interview by Jajuan S. Johnson, 29 January 2009, ID montague_090129, recording (audio/mpeg, 1:15:45), Butler Center for Arkansas Studies, Central Arkansas Library System, https://arstudies.contentdm.oclc.org/digital/collection/p1532coll1/id/12700/.

[6] Raye Jordan would divorce Means and marry David H. Montague in 1965. She would remarry a third time, to James Parrott, in 1973. After divorcing Parrott, she returned to using Montague as her last name.

Advisory Committee, which prepared annual recommendations of research and development. During the Cold War, Russian competition prompted naval research and development of aircraft, missiles, nuclear weapons, and submarines. The Navy also explored the expanded use of computers, advanced the launch of the guided-missile system, and in 1955, commissioned *Nautilus* (SSN-571), the first operational nuclear-powered submarine in the world and the first to transit under the North Pole in 1958. Equally noteworthy, in 1967, the Navy replaced the F-8 Crusader with the F-4 Phantom jet, equipped with missiles to better counter Russian MiGs.[7]

This climate of rapid change and innovation within the Navy gave Jordan the chance to flourish. Not content to remain a clerk-typist, she sought opportunities to use her abilities. The location of Carderock next to the Universal Automatic Computer (UNIVAC) I, serial 2, allowed her to interact with scientists who had worked on the Manhattan Project and specialists with Ivy League degrees. This daily exposure enhanced her interest in computers. Her duties involved comparing metallic tapes containing typed data with the UNIVAC computer tapes to find errors. Based on her findings, Jordan recommended changes to the computer systems operator. Her manager denied her requests for computer training, but that did not discourage her. She observed as much as possible and took night classes. Her persistence paid off. On 20 October 1957, a problem arose when the computer systems operators were absent. She diagnosed the problem and made the adjustments to resolve the issue. Her performance prompted her manager to give her a job

[7] Rodney P. Carlisle, *Where the Fleet Begins: A History of the David Taylor Research Center, 1898–1998* (Washington, DC: Naval Historical Center, 1998), 242–72, 292–95, 349–54; Rodney P. Carlisle, *Navy RDT&E Planning in an Age of Transition: A Survey Guide to Contemporary Literature* (Washington, DC: Navy Library/Center Coordinating Group and the Naval Historical Center, 1997), 11–32; Maryland Historical Trust, "Buildings 1-4, 4E, & 4S (David Taylor Model Basin), NSF Carderock," Maryland Inventory of Historic Properties (MIHP), M:29-47, https://mht.maryland.gov/secure/medusa/PDF/Montgomery/M;%2029-47.pdf; *The David Taylor Model Basin: A Historical Mechanical Engineering Landmark* (West Bethesda, MD: Naval Surface Warfare Center, Carderock Division, 30 January 1998), https://www.asme.org/wwwasmeorg/media/resourcefiles/aboutasme/who%20we%20are/engineering%20history/landmarks/197-david-taylor-model-basin-1939.pdf; "Rear Adm. David W. Taylor," Warfare Centers, NSWC Carderock Division, NAVSEA, accessed 27 May 2021, https://www.navsea.navy.mil/Home/Warfare-Centers/NSWC-Carderock/Who-We-Are/Rear-Adm-David-W-Taylor/.

as a computer operator. She further improved her knowledge by mastering operating, coding, and debugging the UNIVAC I program.

As Raye Jordan's expertise grew, she taught other civilian nonengineers. When she noticed that her former trainees received promotions, she requested one too, but her manager indicated that she did not qualify because she could not work at night. As nighttime public bus service was unavailable, Jordan purchased a used car despite not having a license. She accepted the risks of driving without a permit to meet her manager's requirements. Eventually, she would obtain a driver's license, but for the time being, she continued to focus on improving her knowledge of computers by helping the morning staff and waiting to leave until after rush hour, when she felt more comfortable driving. Once again, determined to succeed, Raye found a way to work around her manager's challenges.

Jordan later managed the UNIVAC LARC (Livermore Advanced Research Computer) for hydrodynamic simulations of nuclear weapons design at the Applied Mathematics Lab. Despite her having positions of increased responsibility that required advanced skill sets, management continued to deny her promotions given to less-qualified men. Jordan's supervisor deemed her ineligible for promotion because she was not a trained engineer or mathematician. In 1961, Betty Holberton, a former colleague of computer pioneer Grace Murray Hopper after World War II and the head of software systems development at the Applied Mathematics Lab, recognized Jordan's abilities (as well as the discrimination she faced) and hired her as her software systems analyst and developer with a salary increase.[8]

Raye Jordan's personal life also witnessed change. She dated David H. Montague, a local barber. Despite learning he did not support his child, struggled with addiction, and had a criminal record, his charisma won her heart. They married on 15 October 1965, a year after she finalized her divorce from Weldon Means. They welcomed her first and only child, David Raye Montague Jr., on 10 August 1966. David Sr.'s womanizing and other marital problems worsened after the birth of the couple's son. When David

[8] NAVSEA, "A Conversation with Raye Montague, Part 1." For a discussion of the discrimination Montague faced and overcame, see Bowers and Montague, *Overnight Code*, 1–64.

abandoned Raye and their nine-week-old son, her mother moved in with her to provide support. As David Jr. grew, his father's interest in him declined. David Sr. interacted with Raye only when he needed something, especially money. Though her father had not seen Raye in more than 30 years, he visited her when he read about his grandchild. She found herself dealing with a failing marriage, adjusting to single parenthood, and trying to balance the needs of motherhood with the challenges of both her job and persistent racism. Her mother made a difficult situation manageable for Raye, who would ultimately file for divorce from David Sr. in 1970.

Despite these personal challenges, Raye Montague would continue to thrive professionally, joining the computer-aided ship design and construction (CASDAC) program in March 1971. Established in 1966 and building on earlier efforts exploring the use of computers in ship design dating back to 1948, the purpose of the CASDAC program was to reduce the amount of time required to create new ship designs by using a computer to resolve different engineering requirements. Owing to the high cost of shipbuilding in the United States, President Lyndon B. Johnson had asked Congress to consider allowing foreign shipbuilders to construct Navy warships, but Johnson's successor, Richard M. Nixon, argued that the country should build its own ships and proposed a 300-ship fleet by 1980. Nixon requested Navy leadership undertake accelerated shipbuilding to address fleet modernization and to make the United States more competitive with the Soviet Union. CASDAC would be critical to this effort.

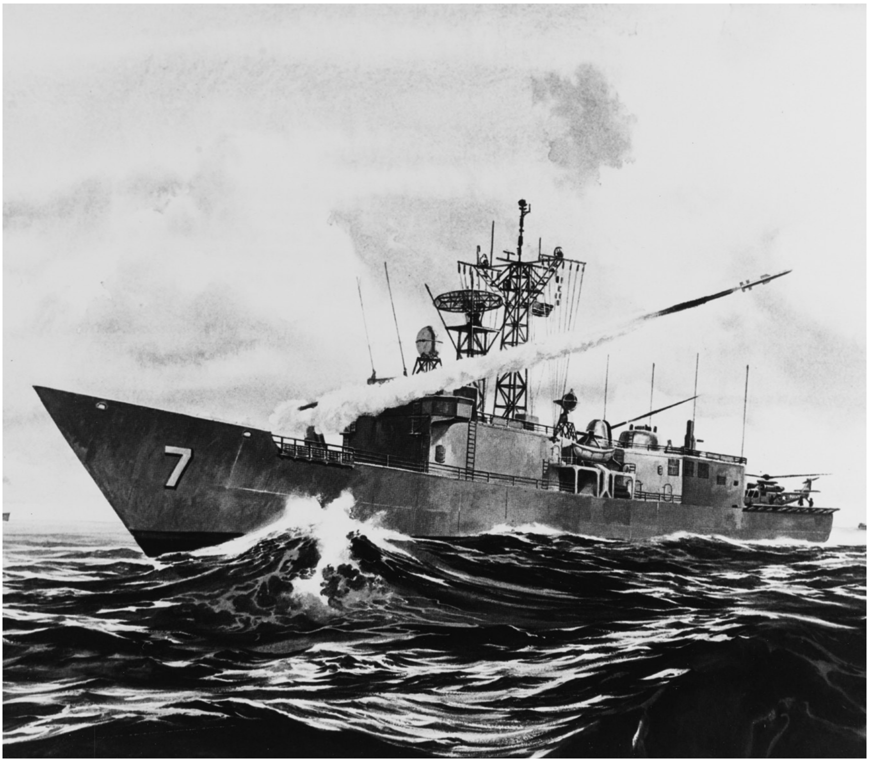
Montague welcomed the opportunity to join the CASDAC program because it offered the chance to learn more, promotion potential, and a shorter commute. Wally Dietrich, her new supervisor, expected a white male engineer. When he met her, he was reluctant to shake her hand and asked in disbelief, "You are Raye Montague?"—a reaction she had heard many times before. Prior to her becoming a member, the CASDAC team had spent the last six years and more than $600,000 researching ship specifications. Upon assuming her duties, Montague traveled to New York City to work with M. Rosenblatt & Son, the assigned contractor. It did not take long for her to begin developing a revised plan. The challenges, simply stated, involved integrating the various computer programs in ship design so that adjustments to a ship's design could be made more quickly and with greater facility. The amount of specialists and systems involved in ship design and the volume of information and formats complicated the effort.[9]

When President Nixon learned about their work, in anticipation of a new class of ship, he asked NAVSEA to produce ship plans in two months, a process that usually required two years to produce a rough draft. Montague's manager gave her one month to complete the job, expecting her to fail. The process necessitated accessing the computer-automated system at night. He tried to hinder her progress by insisting she could not work alone. To work around this restriction, Montague had her son and mother accompany her as escorts. When her manager complained that relatives were not employees, Montague replied that he had not specified who qualified as an escort. Her manager then assigned staff to work with her from 4:00 p.m. to midnight. Raye and her team produced the first computer-generated draft ship design for the *Oliver Hazard Perry*–class frigate before the due date. She wrote a birth certificate on an IBM computer card for the achievement: "Generated by a computer. Proud Mother, Raye J. Montague. Gestation period: 18 hours and 26 minutes."[10]

The new *Oliver Hazard Perry*–class ship, its namesake commissioned in 1977, became one of the Navy's longest-serving platforms, demonstrating its exceptionally sound design and adaptability as a surface warship. Between 1977 and 2004, Bath Iron Works and Todd Pacific Shipyards built a total of 71 hulls. Nicknamed "the little ship that could," the new frigate replaced World War II–era destroyers and was designed to protect military and mercantile convoys, detect and attack submarines, neutralize antiship missiles, and destroy hostile surface ships. It incorporated a host of new design concepts, such as vertical and horizontal missile launchers, the light airborne multipurpose system helicopter, and an Italian 76-millimeter OTO Melara

[9] Bowers and Montague, *Overnight Code*, 65–108.

[10] Dale Debakcsy, "Naval Engineer Raye Montague and the Tale of the World's First Computer-Designed Naval Vessel," Women You Should Know, 17 February 2021, http://www.womenyoushouldknow.net/naval-engineer-raye-montague-first-computer-designed-vessel; Montague, interview. See also Carlisle, *Where the Fleet Begins*, 395; Bowers and Montague, *Overnight Code*, 65–108.



Oliver Hazard Perry (FFG-7), artist's conception. (NHHC, KN-23677)

automatic cannon. The ship had two gas turbines that required less fuel than steam engines, went from full speed to a complete stop in 60 seconds, and had a maximum speed of 29 knots and a cruising range of 4,500 nautical miles. Despite these substantial capabilities, it required only a small crew of 16 officers and 176 enlisted personnel. The design reflected the Navy's minimum manning concept: an automated data logger allowed four to five men instead of 10 to stand watch, a throttle control required one person to drive the ship from the bridge, and a more efficient maintenance system further reduced personnel needs. The duration of service of *Oliver Hazard Perry*–class vessels—they served not only in the U.S. Navy but in the Turkish, Egyptian, Polish, Pakistani, and Spanish navies into the 21st century—testifies to the excellence of the design.[11]

Impressively, this ship class remained in the fleet for the remainder of Raye's career. Equally important, her innovation led the Navy's transition to the use of computer-aided design and computer-aided manufacturing. The Navy deemed her implementation of an automatic ship specification system one of the most important developments in the long history of U.S. Navy ship design, construction, and repair. Her work had the potential to save the Navy millions of dollars. In recognition of this achievement, Raye received the Navy's Meritorious Civilian Service Award, the third-highest honor that can be conferred upon a Department of the Navy civilian, in 1972. The receipt of this award forever changed Raye's career.[12] Her citation read in part:

> Due to your astute judgment and technical expertise, the heretofore impossible task of producing in one volume the thousands upon thousands of items that compromise a total ship's specifications was accomplished. This marked the first time in history that accurate specifications could be found at one time in one location. This achievement

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[11] "*Oliver Hazard Perry* Class Guided Missile Frigate," Naval Technology, 24 September 2008, https://www.naval-technology.com/projects/oliver-hazard/; Jeremiah D. Foster, "USS *Oliver Hazard Perry* (FFG-7), 1977–1999," Naval History and Heritage Command, last modified 18 December 2019, https://www.history.navy.mil/research/histories/ship-histories/danfs/o/oliver-hazard-perry-ffg-7.html; Tyler Rogoway, "The Navy's Rationale for Not Reactivating Perry Class Frigates Does Not float," War Zone, updated 13 November 2017, https://www.thedrive.com/the-war-zone/16035/navys-rationale-for-swatting-down-perry-class-frigate-reactivation-doesnt-float; Peter Suciu, "The *Oliver Hazard Perry*-Class: The Best U.S. Navy Frigate Ever?," *National Interest* (blog), 9 January 2021, https://nationalinterest.org/blog/buzz/oliver-hazard-perry-class-best-us-navy-frigate-ever-176152.

[12] "Raye Montague, Naval Engineering Pioneer, Passes at 83," *Maritime Executive*, 22 October 2018, http://www.maritime-executive.com/article/raye-montague-naval-engineering-pioneer-passes-at-83; Raye Montague, "Honoring a Real-Life 'Hidden Figure,'" interview by Robin Roberts, *Good Morning America*, ABC News, 20 February 2017, https://abcnews.go.com/Entertainment/meet-the-woman-who-broke-barriers-hidden-figure-US-Navy-/storyid=45566924; NAVSEA, "A Conversation with Raye Montague, Part 2," 14 April 2017, YouTube video, 30:05, https://www.youtube.com/watch?v=6MVjtNCYFjo; Joyce Conyers, "African American Woman, Gifted Naval Engineer: Raye Montague," *CHIPS*, 22 February 2019, http://www.doncio.navy.mil/chips/ArticleDetails.aspx?ID=12207.

> heralds a new era in ships which will produce a total ship specification in eight weeks rather than nine months. By your conscientious performance, you significantly enhanced the Navy's ability to procure better ships, faster and more economically. Well done.[13]

Many did not believe Raye deserved the award. Others expressed their jealousy. Threats on her life led the Navy to relocate her office and parking space.[14]

Montague later designed the *Seawolf*-class nuclear submarine, the Navy's first helicopter-carrying amphibious assault ship, and the *Nimitz*-class aircraft carrier *Dwight D. Eisenhower* (CVN-69). She went on to hold senior positions as the program director of NAVSEA Integrated Design, Manufacturing, and Maintenance Program and as the deputy program manager of the Navy's Information System Improvement Program. Her increased prominence led to numerous newspaper and journal articles and media interviews that highlighted her achievements and her strategy for success. Montague further distinguished herself when she earned an engineering certification from the California State Board of Registration for Professional Engineers and international licenses from the United Kingdom and Canada.[15]

Over time, Wally Dietrich and Raye's relationship changed from adversarial to that of mentor and mentee. He advised her how to build on her achievements and increase her credibility. She lectured at the U.S. Naval Academy and with the Kellogg Foundation series. He assigned her to brief the Joint Chiefs of Staff on ship design and engineering, and nominated her for the Federal Woman's Award. When Dietrich received an invitation to the Department of Defense's Manufacturing Advisory Group, he declined and recommended that Montague replace him as the Navy representative. Consequently, she traveled the globe to learn more aboutmanufacturing technologies in order to make recommendations to the Department of Defense.

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13 K. E. Wilson, Acting Commander, Naval Ship Systems Command, to Raye Montague, 2 November 1972, in the possession of Tiara Robinson, public affairs specialist, NAVSEA.

14 Bowers and Montague, *Overnight Code*, 108–9.

15 Todd A. Hurley, "Raye Montague, a U.S. Navy 'Hidden Figure,'" 24 March 2021, https://www.navsea.navy.mil/Media/News/Article/2549135/raye-montague-a-us-navy-hidden-figure/.

Raye found her own mentoring just as meaningful. She actively participated in the Federal Women's Program and the Naval Ship Engineering Center's Equal Opportunity Committee and helped establish a Navy upward mobility program. She shared her experiences in media interviews and before local schools and other organizations. In particular, she encouraged students to consider STEM professions and to dream big, often emphasizing the importance of thinking outside the box, refusing to take no for an answer, preparing for opportunities, and believing in oneself.

Along similar lines, Raye often made time for one-on-one discussions. Tiara Robinson, a public affairs specialist at NAVSEA, recalled a life-changing conversation in which Montague shared the following pieces of wisdom:

- "The barriers are like an oyster. You have to pry it open carefully with grace, patience, and a smile. You don't want to destroy the pearl while breaking barriers."
- "Turn your opponents into your advocates."
- "Find the reason why someone should say yes!"[16]

Raye retired on 31 January 1990 as a GS-15, the highest regular civilian grade (equivalent to the uniformed grade of O-6). After returning to Little Rock, Arkansas, in 2006, she enjoyed being a grandmother, traveling, playing bridge, solving crossword puzzles, and dancing. She continued community service with the LifeQuest of Arkansas, the Links, Incorporated, the Alpha Kappa Alpha Sorority, and the American Association of University Women in Arkansas. She also worked with the reentry program at the Arkansas Department of Corrections Pine Bluff Unit.[17]

[16] Tiara Robinson, interview by Regina Akers, 22 December 2020, teleconference.

[17] John Joyce, "When the Chips Fall, Be Ready to Take Charge—Navy's 'Hidden Figure' Advises DoD Audience," Defense Visual Information Distribution Service (DVIDS), 19 April 2017, http://www.dvidshub.net/news/230876/chips-fall-ready-take-charge-navys-hidden-figure-advises-dod-audience; Bowers and Montague, *Overnight Code*, 148–67; NAVSEA, "A Conversation with Raye Montague, Part 2"; Paula Rogo, "Raye Montague, Arkansas Hidden Figure, Dead at 83," *Essence*, 14 October 2018, https://www.essence.com/culture/raye-montague-arkansas-hidden-figure-dead/.

In 1978, Raye became the first woman professional engineer in the United States to receive the Society of Manufacturing Engineers Achievement Award. Her other special recognitions include the Presidential Citation from the National Association for Equal Opportunity in Higher Education (1985) and the National Computer Graphics Association Award for the Advancement of Computer Graphics (1988). Further recognition came after retirement. The 2016 film *Hidden Figures*, which portrayed female African American mathematicians Mary Jackson, Katherine Johnson, and Dorothy Vaughan, who determined the calculations for John Glenn's first orbit launch, placed a spotlight on women whose excellence in STEM fields had long gone unrecognized. In response, NAVSEA officially designated Raye Montague as its "hidden figure" in 2017. Consequently, she appeared on such high-profile shows as *Good Morning America* with Robin Roberts on 20 February 2017 and *Harry*, the Harry Connick Jr. talk show, on 12 October 2017. Former mentee Trenita Russell described Raye's work ethic during the *Good Morning America* segment: "She had to keep proving herself. . . . But she took that with a smile too, and she was able to rise above those types of things."[18] Raye was subsequently inducted into the Arkansas Women's Hall of Fame and was posthumously awarded an honorary doctor of law from the University of Arkansas at Pine Bluff in 2018.[19]

Raye Jean Jordan Montague died on 10 December 2018, having received more than 100 honors. Her modernization efforts, skills, and vision forever changed ship design and represent a significant milestone in naval innovation during the Cold War. Her timeless wisdom continues to motivate: Don't let people control you, you control the situation, and although you might have a setback and go in a different direction, you can still achieve. As a pioneering ship designer, Montague remains a model for all pursuing STEM

[18] Raye Montague, "Honoring a Real-Life 'Hidden Figure,'" interview by Robin Roberts.

[19] NAVSEA, "A Conversation with Raye Montague, Part 1"; NAVSEA, "A Conversation with Raye Montague, Part 2"; Bowers and Montague, *Overnight Code*, 179–216; "Raye Montague, Naval Engineering Pioneer, Passes at 83"; "Raye J. Montague of Little Rock, AR, 1935–2018," *Arkansas Democrat Gazette*, 14 October 2018, https://www.arkansasonline.com/obituaries/2018/oct/14/raye-montague-2018-10-14/; Betty Sorensen Adams, "Raye Jean Jordan Montague (1935–2018)," CALS Encyclopedia of Arkansas, updated 6 February 2023, https://www.encyclopediaofarkansas.net/entries/raye-jean-jordan-montague-5565/.

careers, especially women and minorities, and her life as a whole is a reminder that one's demographics or background does not predetermine or limit one's ability to dream. Diverse groups are more productive than one-dimensional ones, and success involves helping others reach their goals. Raye later recalled, "Only in the United States would we have had an opportunity to do these things. In spite of the system, I was able to accomplish—not because of the system."[20] Her accomplishments demonstrate that individuals often drive innovation and must also push the systems that they work within to adapt.

[20] NAVSEA, "A Conversation with Raye Montague, Part 2."

CHAPTER EIGHT

Innovating Policy: The Maritime Strategy and the Navy in the 1980s

Ryan A. Peeks

Many naval innovations take the form of technical or tactical shifts that allow their inventors to fight more effectively than their opponents. We will examine something different: the Maritime Strategy, an innovative framework for discussing naval operations, strategy, and programming that formed the foundation of U.S. Navy policy from approximately 1982 to 1989. Rather than a single idea, or moment, the Maritime Strategy was an innovative *process* that built on preexisting operational, technical, and intelligence innovations to recast the mission of the entire service.

In essence, the new strategy explained how the U.S. Navy would function across the entire spectrum of conflict, from peacetime all the way to nuclear war with the Soviet Union. It showed how naval forces could contribute to the country's national security policy at all levels: reassuring allies in times of crisis, opening second fronts and holding Soviet installations at risk in a conventional war, and affecting the balance of nuclear strength by sinking heavily defended Soviet ballistic missile submarines. This strategy, especially its offensive focus, made a tremendous contribution to what one author has called the U.S. Navy's "renaissance" in the 1980s.[1]

The 1970s were a difficult decade for the U.S. Navy. Most obviously, the Navy was heavily involved in the Vietnam War and, after U.S. intervention

[1] Frederick H. Hartmann, *Naval Renaissance: The U.S. Navy in the 1980s* (Annapolis, MD: Naval Institute Press, 1990).

ended, dealt with the shocks of the all-volunteer force and shrinking budgets. Against that grim background, the service also faced the need to replace hundreds of aging World War II–era warships and compete with a Soviet Navy increasing in size, sophistication, and capability, with a quantitative and qualitative lead over the U.S. Navy in the category of antiship missiles. In the early 1970s, Chief of Naval Operations (CNO) Elmo Zumwalt (1970–1974) declared that the U.S. Navy could not be certain of prevailing in a fight against its Soviet counterpart. This belief, controversial to say the least among his fellow officers, shaped Zumwalt's policies during his time as CNO.

The new Soviet threat was twofold. In addition to its already-imposing submarine fleet, the Soviet Navy heavily relied on cruise missiles to provide striking power, as opposed to the U.S. Navy, which viewed carrier aircraft as its main offensive arm. The first use of surface-launched missiles to sink a warship, Egypt's sinking of the Israeli destroyer INS *Eilat* in 1967, was with Soviet-made SS-N-2 Styx missiles. In the following years, the Soviets fielded an increasingly impressive array of surface-, submarine-, and air-launched cruise missiles.

Due to its doctrinal focus on carrier strikes, the U.S. Navy was well behind the Soviet Union in developing missiles for use against surface targets. CNO Zumwalt sped up development of the Harpoon antiship missile, a weapon with a smaller warhead and shorter range than many of its Soviet counterparts. He also inaugurated the development program that would lead to the introduction of the Tomahawk cruise missile. Both programs would, it was hoped, give the Navy's ships, submarines, and aircraft the range to strike Soviet ships before they could launch their missiles without exposing manned aircraft to strong Soviet air defenses. However, both missiles spent some time in development: Harpoon did not enter the fleet until the late 1970s, and Tomahawk was introduced in the early 1980s.[2]

In the meantime, Soviet missiles threatened to overwhelm the U.S. Navy's air defense infrastructure, which was designed to handle crewed aircraft with bombs and short-range missiles. Programs were already under development to

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[2] Malcom Muir Jr., *Black Shoes and Blue Water: Surface Warfare in the United States Navy, 1945–1975*, Contributions to Naval History 6 (Washington, DC: Naval Historical Center, 1996), 215–21.

mitigate this threat—the efforts that eventually led to the Aegis weapon system and the F-14 Tomcat were underway by the mid-1960s—but the nature of the Soviet threat, Zumwalt and like-minded officers claimed, inevitably pushed Navy strategy in a defensive direction. Rather than securing command of the seas, the Navy's chief war aim was now the more limited "sea control," the ability to "exert . . . control temporarily in an area while moving ships into position to project power ashore or to resupply overseas forces."[3]

At the same time, the Navy's budget generally declined in inflation-adjusted terms over the course of the decade, making it difficult for the Navy to contemplate purchasing the ships and systems needed to backstop an offensive strategy.[4] Likewise, the fleet shrank from 743 ships in 1970 to 533 in 1979. In some ways, this decline was a benefit to the fleet, as aging, maintenance-heavy, legacy platforms were replaced by a smaller number of higher-capability ships.[5] Mainly, though, this decline reflected the fact that the Nixon, Ford, and Carter administrations, especially the latter two, viewed naval power as simply an adjunct to matters on land. For example, President James Earl Carter's Secretary of Defense, Harold Brown, declared in 1978 that the Navy's main job in a war with the Soviet Union was simply to protect the sea-lanes between the United States and Europe to allow for resupply of North Atlantic Treaty Organization (NATO) forces.[6]

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[3] Stansfield Turner, "Missions of the U.S. Navy," reprinted in *U.S. Naval Strategy in the 1970s: Selected Documents*, ed. John B. Hattendorf (Newport, RI: Naval War College Press, 2007), 39.

[4] Peter M. Swartz with Karin Duggan, *The U.S. Navy in the World (1970–1980): Context for U.S. Navy Capstone Strategies and Concepts* (Arlington, VA: Center for Naval Analyses, December 2011), 31, slide 61, https://www.cna.org/cna_files/pdf/D0026418.A1.pdf. The nadir for Navy funding came in 1975; by the end of the decade, the Navy budget had climbed part way to its 1970 total. This report is 1 of 17 in Swartz's Capstone Strategy Series he produced while working at the Center for Naval Analyses. The entire series, which provides a comprehensive history of the development of Navy strategy in the context of national policy, the global environment, and naval operations between 1970 and 2010 is available at https://www.cna.org/archive/research/capstone-strategy-series.

[5] "US Ship Force Levels, 1886–Present," NHHC, last modified 17 November 2017, https://www.history.navy.mil/research/histories/ship-histories/us-ship-force-levels.html.

[6] Alva M. Bowen Jr. and Ray Frank Bessette, *Aircraft Carrier Force Levels*, Congressional Research Service Report, 28 April 1978, 2.

By 1977, elements of the Navy had begun to challenge this defensive, Western Europe–focused view of seapower on operational and strategic grounds. On the operational side, Admiral Thomas B. Hayward, who became commander of U.S. Pacific Fleet in 1977, noted upon taking command that his fleet had no real plans for conventional war against Soviet forces in the area. Instead, in the event of a Soviet war, Pacific Fleet was to release most of its aircraft carriers to the Atlantic Fleet for use in Europe. Concerned that these ships would arrive too late to tip the balance in Europe, as well as the effect of such an abandonment of East Asian allies, Hayward had his staff look at options to use those ships in the Pacific region.[7]

The resulting studies, dubbed "Sea Strike," argued that, even with the growing strength of the Soviet Union, American carrier battle groups (CVBGs) could successfully operate in the teeth of Soviet defenses, and strike heavily guarded targets in the Soviet Far East, reassuring allies and tying down Soviet forces. While Sea Strike changed very little in terms of concrete policies,[8] it was very influential within the Navy and the wider defense community, and led to Hayward's appointment as CNO in 1978.[9]

In Washington, Secretary of the Navy W. Graham Claytor Jr. started a review of naval strategy in August 1977 in response to what he saw as the Carter administration's dismissive view of naval power.[10] That review, *Sea Plan 2000*, challenged prevailing beliefs about the necessity for a defensive naval strategy. Instead, argued *Sea Plan 2000*, the new defensive capabilities of the fleet, as exemplified by the F-14 and the soon-to-enter-service Aegis cruisers, did not just protect against Soviet attacks, but also provided a firm

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[7] James M. Patton, "Dawn of the Maritime Strategy," *Proceedings* 135, no. 5 (May 2009): 57–58.

[8] Although it convinced the Joint Chiefs of Staff, which agitated for keeping Pacific Fleet carriers in the Pacific, Secretary Brown ultimately vetoed that recommendation.

[9] Hartmann, *Naval Renaissance*, 27–30; John B. Hattendorf, *The Evolution of the U.S. Navy's Maritime Strategy, 1977–1986* (Newport, RI: Naval War College Press, 2004), 17–19; Patton, "Dawn of the Maritime Strategy," 58–59; Steven L. Rearden with Kenneth R. Foulks Jr., *History of the Joint Chiefs of Staff*, vol. 12, *The Joint Chiefs of Staff and National Policy, 1977–1980* (Washington, DC: Office of Joint History, 2015), 236–37.

[10] Hattendorf, *Maritime Strategy*, 13–14.

Admiral Thomas B. Hayward, father of the "Sea Strike" strategy, 1978. (NHHC, NH KN-26599) base for *offensive* operations against the Soviet Union, even a "second front" in a NATO–Warsaw Pact war.[11]

In fact, *Sea Plan 2000* suggested a radical shift in the Navy's understanding of the balance of power at sea. With tanker support, a combat air patrol of two to four F-14s could take up station as much as 600 nautical miles from their carrier. Armed with the long-range Phoenix missile, they could shoot down Soviet bombers in the outer air battle *before* they launched their cruise missiles (contemporary advances in the undersea realm suggested something similar for antisubmarine warfare). By shooting the archer, not the arrow, the Navy could inflict unsustainable attrition on the striking arm of the Soviet fleet and provide enhanced protection for its own battle groups.[12]

Around this time, new and high-quality intelligence on Soviet intentions reached the Navy. Since the early 1970s, most official assessments of Soviet intentions had posited that in wartime the Soviets would use their large submarine fleet and long-range bombers to attack the sea-lanes between North America and Europe, threatening supply lines for NATO forces on the continent, and putting the U.S. Navy on the defensive. This new intelligence showed that the Soviet Navy's primary missions were homeland defense and the protection of secure "bastions" for Soviet ballistic missile submarines. Freed from the specter of another Battle of the Atlantic, the Navy could safely turn toward the offensive in its war plans.[13]

These strategic, operational, and intelligence cases for an offensive posture were matched with political support in 1981 when John. F. Lehman

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11 "Sea Plan 2000 Naval Force Planning Study: Unclassified Executive Summary," March 1978, 20, folder 5, box 10, John F. Lehman Jr. Papers, Operational Archives Branch, NHHC.

12 Norman Friedman, *Fighters over the Fleet: Naval Air Defence from Biplanes to the Cold War* (Annapolis, MD: Naval Institute Press, 2016), 383–86. Likewise, advances in electronic warfare suggested that American carriers operating under a tight emissions control regime, and with the use of sophisticated electronic warfare equipment, could effectively evade detection and effective targeting from Soviet space- and air-based systems.

13 Christopher A. Ford and David A. Rosenberg, *The Admiral's Advantage: U.S. Navy Operational Intelligence in World War II and the Cold War* (Annapolis, MD: Naval Institute Press, 2005), 77–108. The precise nature of this intelligence and its original source remain classified, despite public speculation from some unaffiliated authors. This material is taken from the best available discussion of this intelligence (and one that conforms to Navy public release guidelines).

Jr. became Secretary of the Navy in the Reagan administration. Lehman, a naval reservist who had served as a naval flight officer in the A-6 Intruder, had been involved in *Sea Plan 2000* as a civilian analyst and wanted a larger fleet with an offensive mission. Indeed, Lehman was able to insert a demand for a "600-ship Navy" into the 1980 Republican Party platform. As one senior admiral put it, "[Lehman] concluded before he was appointed secretary that the United States should have a 600-ship Navy, and by God we were going to have a 600-ship Navy. It was a simple vision [and] in that political environment it was right on target."[14] With 600 ships, Lehman argued, the Navy would possess the strength needed to take an aggressive stance toward the Soviet Union, with a fleet centered on 15 CVBGs, up from 12 in the fleet he had inherited.[15]

Even before Lehman's vision could be turned into hard budgetary facts, he pushed for a demonstration of what the new Navy would look like. In the summer of 1981, Lehman used the Ocean Venture '81 exercise to push the bulk of the Norfolk-based Second Fleet into the Norwegian Sea, where it operated unlocated by Soviet forces.[16] As Lehman put it to sailors aboard *Dwight D. Eisenhower* (CVN-69) shortly after the exercise, it was intended to show the Soviets that if a war came, the Navy "would kick their ass at sea, and from the sea," part of a coordinated strategy to highlight NATO's naval superiority even on the Soviet Union's doorstep.[17]

In truth, Ocean Venture '81 was something of a bluff. While the systems needed to operate effectively near the Soviet Union were in the pipeline, or just entering service, the Navy lacked the full capability needed to make good

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14 William J. Crowe Jr. with David Chanoff, *The Line of Fire: From Washington to the Gulf, the Politics and Battles of the New Military* (New York: Simon & Schuster, 1993), 240. The 600-ship target nearly matched the most optimistic projection, 585 hulls, from *Sea Plan 2000*.

15 Ryan A. Peeks, *Aircraft Carrier Requirements and Strategy, 1977–2001* (Washington, DC: Naval History and Heritage Command [NHHC], 2020), 47–48; Hattendorf, *Maritime Strategy*, 50.

16 John F. Lehman Jr., *Oceans Ventured: Winning the Cold War at Sea* (New York: Norton, 2018), 65–88; Hartmann, *Naval Renaissance*, 346.

17 Lehman, *Oceans Ventured*, 82, 87.

on the exercise's promise.[18] For that, Lehman and the Navy needed to convince Congress and the White House to increase the Navy's budget to buy the ships, aircraft, and weapons that had started development in the 1970s—and the well-publicized success of the exercise gave Lehman and other Navy leaders an example of what they wanted the Navy to be able to do.

However, the key innovation of this period was the calculated weaving of these operational, strategic, political, and financial strands into what became known as the Maritime Strategy. In late 1981, the Vice Chief of Naval Operations, Admiral William N. Small, suggested that the Navy needed to make sure that programming and acquisition had a firm grounding in strategy. Small's suggestion was met with favor inside the Office of the Chief of Naval Operations (OPNAV), and in mid-1982, the Strategic Concepts Branch (OP-603) of OPNAV was tasked with developing a briefing on the strategic inputs that should govern Department of the Navy policy. By early November, Vice Admiral Arthur Moreau, the Deputy Chief of Naval Operations for Plans, Policy, and Operations (OP-06, analogous to today's N3/N5), had delivered the briefing to the Department of the Navy's senior leadership, including Secretary Lehman, the commandant of the Marine Corps, and the new CNO, Admiral James Watkins.[19]

All three men agreed that this briefing formed an ideal foundation for all aspects of naval policy by turning the Navy's desire for offensive *operations* into a coherent *strategy* for utilizing the fleet and the Marine Corps across the spectrum of conflict up to war with the Soviet Union. This support from leadership turned the briefing from a discussion of maritime strategy to *the* Maritime Strategy. At this direction, the briefing was promulgated throughout OPNAV as the basis for programming the budget. It was also useful for explaining Navy goals to external audiences—CNO Watkins used the briefing as the basis for his posture statement in front of the House Armed Services Committee in February 1983.[20]

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[18] Lehman, *Oceans Ventured,* 96–97.

[19] John B. Hattendorf and Peter M. Swartz, eds., *U.S. Naval Strategy in the 1980s: Selected Documents* (Newport, RI: Naval War College Press, 2008), 19–20. The declassified briefing itself is on 21–43.

[20] Hattendorf, *Maritime Strategy*, 72–74.

Critically, this was not a static document, but one updated as Navy force structure and capabilities changed. Its presentation also shifted. In 1983, Moreau and Watkins opted to turn the briefing into a standalone publication that could be distributed across the fleet.[21] This version started by telling the reader:

> This is the U.S. Navy's Maritime Strategy. It is the Navy's current determination as to the best overall conventional maritime strategy for global war today. It is the Navy's *preferred strategy*, considering national and coalition guidance, the threat, force levels, and trade-offs among conflicting aims. It is a *baseline strategy*, around which our other strategic options are centered.
>
> Before discussing the role of the Navy in a conventional global war, it must be emphasized that the Navy serves the U.S. government across the *entire range of conflict possibilities:* from peacetime presence through strategic nuclear war. While the strategy outlined here focuses on global conventional war, the Navy's role in it cannot be understood completely without some mention of other kinds of conflict. Therefore, it will initially focus briefly on the Navy's two other major roles: peacetime presence and crisis response.[22]

The publication went on to explicitly lay out the role of the Navy in national and coalition strategy, the naval strategy of the Soviet Union, and the U.S. Navy's current posture and role in a global war, before concluding with a discussion of "uncertainties": factors that could complicate the strategy, like the possibility of unenthusiastic allies or a nuclear escalation.

Critically, the Maritime Strategy did not spend much time on force structure and the size of the fleet. A noticeably short section before the

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[21] Hattendorf, *Maritime Strategy*, 77–81.

[22] "The Maritime Strategy, 1984," in Hattendorf and Swartz, *Naval Strategy in the 1980s*, 48. Italics in the original. This collection of documents, along with companion volumes featuring Navy strategy publications from the 1970s and 1990s, as well as Hattendorf's standalone history of the Maritime Strategy, is free to download as part of the Naval War College's Newport Papers series at https://digital-commons.usnwc.edu/newport-papers/.

"uncertainties" noted the Navy's "*strategy-force mismatch*";[23] before the achievement of the 600-ship, 15-CVBG fleet target, the strategy was "risky," and forced the deemphasis of some areas like the Indian Ocean in favor of keeping forces in the northern Atlantic and Pacific Oceans. However, this material mismatch increased risk; it did not "appreciably change the essence of the Maritime Strategy," which remained offensive and forward even with then-current forces.[24]

This new approach to Navy strategy built on the work done in the late 1970s with *Sea Plan 2000* and, especially, Sea Strike. When tied to Lehman's 600-ship fleet, it became a powerful political and budgetary tool. In the words of Peter Swartz, a naval officer who coauthored the 1984 Maritime Strategy, instead of touting the impact of new technologies, Lehman could tell Congress, "This is what we're going to do against the Soviets. And I need more ships now, and I need more money now, and I'm going to save you money by the way in which I procure those ships and aircraft." Swartz recalled, "That was his three-part message: strategy, 600 ships, and affordability."[25] The strategy itself served as the Navy's baseline planning document in the Pentagon's Planning, Programming, and Budgeting System, formally tying it into the budgeting cycle.[26]

A prime example of Lehman's success in securing funds for naval expansion came from the fiscal year 1983 budget. Soon after entering office, the Reagan administration approached Congress to add more money to the Carter administration's last two budgets.[27] The fiscal year 1983 budget, though, would be the first controlled by the new administration from start

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[23] "The Maritime Strategy, 1984," 94. Italics in the original.

[24] "The Maritime Strategy, 1984," 94–96.

[25] Peter Swartz, "The Maritime Strategy: Oral History of Captain Peter M. Swartz, USN (Ret.)," interview by Ryan Peeks and Justin Blanton, NHHC, August 2019, 27–28, https://www.history.navy.mil/research/library/oral-histories/navy-strategy/swartz-oral-history.html.

[26] John Allen Williams, "The US Navy under the Reagan Administration and Global Forward Strategy," in *Defense Policy in the Reagan Administration*, ed., William P. Snyder and James Brown (Washington, DC: National Defense University Press, 1988), 278–79.

[27] Daniel Wirls, *Buildup: The Politics of Defense in the Reagan Era* (Ithaca, NY: Cornell University Press, 1992), 35.

to finish. Desiring to build the carrier fleet up, and aware that Congress's largesse would not last forever, one of Lehman's assistant secretaries, George Sawyer, came up with the heretofore unprecedented idea of buying two carriers in the same fiscal year.

This plan would hit all three elements of Lehman's Maritime Strategy messaging: calling for more carriers to increase the Navy's offensive power, adding two more carriers to hit the 15-CVBG target in the 600-ship plan (and create a need for more escort and supply ships), and, despite the cost of two carriers, arguably saving money. As Sawyer's suggestions noted, a two-carrier buy would allow for economies of scale in purchasing components for the two ships, which could be combined with a renegotiated contract for the under-construction *Theodore Roosevelt* (CVN-71).[28] When faced with opposition from Congress and inside the Department of Defense, Lehman and his supporters were able to use the arguments of cost saving, administration policy on the 600-ship fleet, and strategy to push the carriers through.[29]

This episode gives a sense of how the Maritime Strategy affected the naval buildup. The goal was not to develop new weapon systems but to procure sufficient numbers of extant systems to add mass to a service that already believed itself operationally superior to its adversary.[30] During Lehman's time in office, the size of the Navy's fleet grew from 521 hulls to 594—not quite 600, but nonetheless a dramatic expansion over a six-year period.[31]

It would be a mistake, however, to view the Maritime Strategy as a static document. During the 1980s, the Navy embarked on an intense program

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[28] John F. Lehman Jr., *Command of the Seas* (New York: Scribner, 1988), 174–75.

[29] This paragraph summarizes a very complex process. It is covered in the author's *Aircraft Carrier Requirements*, 56–60. See also Gregory L. Vistica, *Fall From Glory: The Men Who Sank the U.S. Navy* (New York: Simon & Schuster, 1995), 113, 169–76; Lehman, *Command of the Seas*, 174–75, 192–94; and Chase Untermeyer, *Inside Reagan's Navy: The Pentagon Journals* (College Station, Texas A&M University Press, 2015), 208n19.

[30] Indeed, many *new* programs started in the early 1980s, like the SSN-21 submarine and the A-12 attack plane, proved far too expensive or incompletely developed for full-scale production by the late 1980s. For the entire history of the A-12 program, see James P. Stevenson, *The $5 Billion Misunderstanding: The Collapse of the Navy's A-12 Stealth Bomber Program* (Annapolis, MD: Naval Institute Press, 2001).

[31] "US Ship Force Levels," NHHC.

Admiral James D. Watkins. As CNO, Watkins built upon Hayward's concepts and worked with senior leadership of the Department of the Navy to put forth the Maritime Strategy. (NHHC, L38-94.05.02)

of realistic exercises, many of them, like Ocean Venture '81, taking place in the Norwegian waters where the U.S. Navy expected to encounter the main strength of the Soviet fleet.[32] To give one example, by 1985, the Second Fleet's exercises anticipated using terrain masking in Norwegian fjords to complicate

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[32] As commander of the U.S. Navy's Second Fleet and NATO's Striking Fleet Atlantic, Vice Admiral Henry C. Mustin used these exercises to create, test, and promulgate a highly influential operational doctrine for his fleet. Mustin's Fighting Instructions, though still classified, remain a major influence on U.S. Navy operational thought.

Soviet targeting solutions rather than relying on the electronic warfare and radio silence in the open ocean that had worked so well in Ocean Venture '81.[33]

As new information came in from the fleet, the Office of Naval Intelligence, and bodies like the CNO's Strategic Studies Group at the Naval War College, successive iterations of the Maritime Strategy changed to reflect those inputs within the framework set in 1982, a deliberate policy put in place by CNO Watkins. For example, the 1984 version of the Maritime Strategy placed a greater emphasis than the 1982 briefing had on multilateral operations, integration with Army and Air Force service strategies, and the intelligence community's most recent assessments of Soviet intentions.[34] Likewise, the final 1989 version focused more on the Pacific and, for the first time, discussed issues like humanitarian assistance operations, drug trafficking, and other noncombat missions.[35]

At the same time, the Department of the Navy aggressively pushed the Maritime Strategy as the key document in naval strategy, operations, and programming. Successive iterations of the Maritime Strategy, written at the secret classification level, were socialized throughout the fleet, shore establishments, and professional military education schools. Even at the Naval Postgraduate School, where most students studied scientific and engineering topics, Lehman ensured the creation of a mandatory course for every attendee "so that every man, woman, and child . . . would get 'Maritime Strategied.'"[36] In essence, this served to short-circuit the sort of internecine debates that plagued the service in the 1970s: the wide dissemination of the Maritime Strategy within the service ensured that everyone understood the Navy's mission and policy, and could focus on fulfilling his or her role in the plan.

The Maritime Strategy was also widely disseminated outside of the Department of the Navy. In January 1986, the U.S. Naval Institute's *Proceedings* carried a 48-page pamphlet on the Maritime Strategy. This first

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[33] Lehman, *Oceans Ventured*, 169, 274; Friedman, *Fighters over the Fleet*, 391.

[34] *Naval Strategy in the 1980s*, 45–46.

[35] *Naval Strategy in the 1980s*, 269–71.

[36] Swartz, "Oral History of Captain Peter M. Swartz, USN (Ret.)," 83.

unclassified version of the strategy was packaged with essays from the CNO, the commandant of the Marine Corps, and Secretary Lehman explaining the concept, its relation to the 600-ship force structure target, and how it meshed with then Marine Corps' amphibious strategy.[37] Even before 1986, the Maritime Strategy had been a critical part of the Navy's messaging to Congress; Lehman, Hayward, Watkins, and other senior officials used the existence of the strategy (and, at least in closed sessions, its particulars) to demonstrate that their requests for more ships, weapons, and funding rested on a sound strategic footing, and were not just an insatiable desire for a larger share of the defense budget.[38]

The Maritime Strategy—which effectively governed naval operational planning and programming from 1982 to the end of the Cold War—is, beyond a doubt, the most influential declared strategy produced by the Department of the Navy and a key factor behind the "naval renaissance" of the 1980s. It is true that the Maritime Strategy's framing coincided with a political situation favorable to high military spending, but, as has been discussed, the Navy's successes during the decade were not just financial in nature. Indeed, it is likely that the Navy's coherent strategy contributed to its budgetary successes.

However, the Maritime Strategy was not just influential. It was *innovative*. Strategy documents from the 1970s, like *Sea Plan 2000*, or *Strategic Concepts for the U.S. Navy*, were generated by a narrow base of assistants to a particular CNO or Secretary and, in many cases, sought to dramatically change prevailing practices or suggest directions for future development.[39] In contrast, the Maritime Strategy built on Admiral Hayward's influential Sea Strike operational concepts and was continually refreshed by the

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[37] *Naval Strategy in the 1980s*, 203–6. The essays themselves are on 206–58. For more on the creation of the 1986 pamphlet, see Swartz, "Oral History of Captain Peter M. Swartz, USN (Ret.)," 28–29, 33, 36–38.

[38] See, for example, House Armed Services Committee, Seapower and Strategic and Critical Materials Subcommittee, *The 600-Ship Navy and the Maritime Strategy*, 99th Cong., 1st sess., 24 June; 5, 6, and 10 September 1985.

[39] See John B. Hattendorf, ed., *U.S. Naval Strategy in the 1970s: Selected Documents* (Newport, RI: Naval War College Press, 2007) for examples of Navy strategy documents from that decade.

revolving door of officers shifting to posts in OPNAV or the Secretariat following operational tours. This allowed the strategy to provide a framework for the employment of the currently existing fleet (remember, Sea Strike was based on the assets of the late-1970s Pacific Fleet) *and* signposts for the future growth of the service.

The importance of alignment within the Department of the Navy cannot be overstated. It is beyond the scope of this essay, but Secretary Lehman had a difficult relationship with the Navy's senior officer corps throughout his time in office.[40] Despite that, "there was very little daylight between Lehman and the flags when it came to the Maritime Strategy. . . . They were all pretty much together on the strategy."[41] This meant that, even as senior officers shifted billets or retired, the essential adherence to the Maritime Strategy endured long after its initial framers had moved on. Indeed, Watkins's successor as CNO, Carlisle A. H. Trost, unsuccessfully tried to use the Maritime Strategy as the basis for the Navy's post–Cold War policy in 1990, arguing that it was an adversary-neutral framework for approaching naval policy.[42]

The structure of the successive iterations of the strategy, based as they were on a narrative of the use of maritime forces from peacetime through crisis through the various stages of an anti-Soviet war, also played a role in its success, laying out the Navy's priorities in a format anyone could understand. Coauthor of the 1984 Maritime Strategy Peter Swartz, who also helped prepare the 1986 *Proceedings* version of the document, noted the importance of this aspect in a 2019 oral history:

> I honestly believe that "we broke the code." We knew how to present Navy strategy in a way that was compelling and truthful. . . . We told a story. I learned . . . when I did war games, one of the reasons

[40] Lehman, *Command of the Seas*, 36–38, 418; Thomas C. Hone and Curtis Utz, *History of the Office of the Chief of Naval Operations, 1915–2015* (Washington, DC: NHHC, 2020), 329–35.

[41] Swartz, "Oral History of Captain Peter M. Swartz, USN (Ret.)," 30–31.

[42] Peeks, *Carrier Requirements*, 92–93. Trost's argument was a not unreasonable interpretation of the Maritime Strategy, at least as it was understood by most of its framers. However, after nearly a decade of the Navy holding it up as a framework for confronting the Soviet Union, that argument was a nonstarter among policymakers outside of the Navy.

why war games are so effective as a teaching device . . . is because the scenario in the war game *tells a story* and stories are powerful. And, we told a story: "You start off in peace and then all hell breaks loose and there's a crisis and then there's a war and the war starts, you've got guys mobilizing and transporting themselves and then bullets start to fly, and then, finally, you kill them. Oh, and then—hey, here's all the problems with the story I just told you." So, that was a story, that was a powerful message. Some [other Navy strategies] . . . you really don't want to turn that page on some of this other stuff. . . . Who can keep that stuff straight? Ours, I thought we could keep straight.[43]

Within the Navy's strategy community, the Maritime Strategy remains a touchstone, and for good reason. None of the Navy's succeeding strategy documents have had the depth, impact, or longevity of the Maritime Strategy.[44] By harnessing the fleet's offensive zeitgeist, the political environment of the day, and constant feedback from across the service, Lehman, Hayward, Watkins, and many others were able to create a comprehensive blueprint for the Navy's expansion and operational blossoming in the 1980s.

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43 Swartz, "Oral History of Captain Peter M. Swartz, USN (Ret.)," 40–41. Italics in the original.

44 See Peter D. Haynes, *Toward a New Maritime Strategy: American Naval Thinking in the Post–Cold War Era* (Annapolis, MD: Naval Institute Press, 2015) for an in-depth examination of Navy strategy from the late 1980s through the early 2010s.

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ACRONYMS AND ABBREVIATIONS

AAF	Army Air Forces
AAORG	Antiaircraft Operations Research Group
APD	high-speed transport
ASCO	assault signal company
ASW	antisubmarine warfare
ATB	amphibious training base
CAFAC	Commander, All Forces, Aruba-Curaçao
CAP	combat air patrol
CASDAC	computer-aided ship design and construction
CIC	combat information center
CINCPAC	Commander in Chief, Pacific Fleet
CNO	Chief of Naval Operations
CO	commanding officer
COMINCH	Commander in Chief, U.S. Fleet
CSF	Caribbean Sea Frontier
CVBG	carrier battle group
ECM	electronic countermeasure
FTP	fleet training publication
GS	General Schedule
IJAAF	Imperial Japanese Army Air Force
IJN	Imperial Japanese Navy
IJNAF	Imperial Japanese Navy Air Force
JASCO	joint assault signal company
JEIC	Joint Electronic Intelligence Center

LARC	Livermore Advanced Research Computer
LCVP	landing craft, vehicle, personnel
LVT	landing vehicle, tracked
NATO	North Atlantic Treaty Organization
NAVSEA	Naval Sea Systems Command
NCDU	naval combat demolition unit
NHHC	Naval History and Heritage Command
OPNAV	Office of the Chief of Naval Operations
PT	patrol boat
S&R	Scouts and Raiders
SEAL	sea, air, land
SESP	Special Electronic Search Project
STEM	science, technology, engineering, and mathematics
TF	task force
TU	task unit
UDT	underwater demolition team
UNIVAC	Universal Automatic Computer
VC	fleet composite squadron
VMA	marine attack squadron
VP	patrol squadron
VQ	fleet air reconnaissance squadron
VT	variable time

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This volume presents a series of eight case studies to illustrate how the U.S. Navy went about innovation amid the great power struggles of the twentieth century. The eight chapters cover nearly the full span of the century, ranging from the naval arms race prior to World War I to the Navy's strategy renaissance of the 1980s. Presenting innovations achieved and implemented both during wartime and outside it, each case study provides examples of innovative changes in technology, doctrine, or strategy. Several show the complex interplay among these factors.