

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

“A State of War Is a Most Unfavorable Period for Experiments”:

John Dahlgren and U.S. Naval Ordnance Innovation

During the American Civil War

by

Robert J. Schneller, Jr.

U.S. Naval Historical Center

It was a beautiful Sunday morning, with the kind of weather that rarely graces the nation’s capital—clear sky, pleasantly warm, ripe with the portents of spring. Commander John A. Dahlgren, one of the world’s foremost naval ordnance experts, was working in his office at the Washington Navy Yard, regretting that he had skipped church, perhaps imagining the sunlight streaming through the stained-glass windows. But the country was at war and the pressure on him was enormous, for his responsibilities included research, development, and production of the United States Navy’s ordnance. With his reputation on the line for each facet of his job, he approached these responsibilities in typical Dahlgren fashion, micromanaging details and working long hours to solve problems. His reputation was everything to him, for it had brought him to his current position and it sustained his ambition to climb even higher.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

A visit from the President interrupted the drudgery of the paperwork. Dahlgren thought his friend looked “thin and wasted.” “Frightful news,” said Abraham Lincoln. Yesterday the former U.S. frigate *Merrimac*, which the Confederates had recently converted into an ironclad warship, had attacked the blockading fleet in Hampton Roads and sank the wooden sailing frigates *Cumberland* and *Congress*. The President took the naval officer to the White House for a meeting with cabinet members and generals. Afterward, Dahlgren spent the rest of the day gathering all the information he could about the battle and making preparations to prevent the rebel vessel from ascending the Potomac and shelling Washington. At about 10:00 PM, Dahlgren received a note from Secretary of the Navy Gideon Welles. That morning, the note said, the Navy’s ironclad *Monitor* engaged the *Merrimac* for four hours and the Confederate vessel drew off about noon. “So closes the day on the first view of these events,” Dahlgren wrote in his diary.^[1]

And what a day it was. The loss of the two frigates on 8 March 1862 constituted the worst defeat the U.S. Navy had yet suffered. The duel on 9 March between the *Monitor* and the vessel the rebels renamed the *Virginia* was the first battle between ironclad warships in history. These events came to symbolize the nineteenth century naval revolution in which wooden sailing ships armed with cast-iron smoothbore cannon gave way to steam-powered armored ships armed with steel rifled ordnance.

For the man who would go down in history as the “father of American naval ordnance,” the *Monitor-Merrimac* battle was an embarrassment. The *Monitor*’s 11-inch cast-iron smoothbore guns, which Dahlgren had designed and whose performance constituted the very foundation of his reputation, had failed to inflict appreciable damage on the Confederate ironclad. On the eve of the battle of Hampton Roads, naval officers and ordnance experts at home and abroad had considered Dahlgren’s 11-incher the most powerful and reliable naval cannon in the world. After the battle, many officers and experts concluded that against armor, the 11-inch Dahlgren gun was “useless.”^[2] It was a severe blow to Dahlgren’s reputation.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

The battle soon resulted in a new and urgent task for Dahlgren. In addition to overseeing ordnance production, testing weapons, and filling requisitions, he would be given responsibility for solving the problem posed by the *Merrimac*—developing ordnance capable of defeating armor. It was, in fact, the era's most critical ordnance problem.

Dahlgren didn't relish the prospect. "A state of war," he remarked to a brother officer eight months later, is "a most unfavorable period for experiments."⁴³ Why did Dahlgren consider wartime disadvantageous for experimentation? Development of a weapons system is a multifaceted process, including theorizing, hard work, and trial and error. One facet of Dahlgren's attempt to solve the ironclad problem involved firing various kinds of heavy cannon at armored targets to determine what kind of ordnance could defeat an armored warship in battle. Much of this experimentation focused on the 11-inch gun.

In *A Nation of Steel*, Thomas Misa describes testing of ordnance against armor later in the nineteenth century. Misa found that such tests were often rigged to produce a particular outcome by manipulating the range and angle of incidence to affect the ability of armor to deflect projectiles. Did Dahlgren plan the tests to give the gun the victory over the plate, to twist a phrase borrowed from Secretary of the Navy Benjamin Franklin Tracy? Did Dahlgren's tests of ordnance against armor constitute an honest attempt to solve the ironclad problem, or was Dahlgren really only interested in reputation damage control? The answer helps to explain why the U.S. Navy emerged from the Civil War with virtually the same ordnance it had carried into it.⁴⁴

Dahlgren developed most of the ordnance that United States Navy used during the Civil War. Ordered to ordnance duty at the Washington Navy Yard in 1847, he carried out his initial assignments so well that the Chief of the Bureau of Ordnance and Hydrography assigned him ever increasing responsibilities, empowered him to expand the Yard's facilities at his discretion, and arranged for him to remain on ordnance duty

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

indefinitely. In the early 1850s, Dahlgren launched the Ordnance Establishment, the first sustained weapons R & D organization and program in American naval history. Its work fell into four broad categories: manufacturing ordnance and equipment, inspecting ordnance produced at private foundries, testing ordnance and inventions, and research and development. The facilities that Dahlgren set up at the Washington Navy Yard included a firing range along the Anacostia River dubbed the “Experimental Battery,” foundries, machine shops, and expanded office spaces. Experimentation constituted the bedrock of Dahlgren’s approach to ordnance development.

Dahlgren’s R & D efforts yielded integrated systems of shipboard armament, featuring light bronze boat guns and heavy cast-iron smoothbore shell guns. The boat guns were revered throughout the Navy and admired around the world. The heavy smoothbores, characterized by their peculiar “soda-water bottle” shape, were Dahlgren’s most famous invention. Their design stemmed from his scientific research in ballistics and metallurgy. To ensure their safety and reliability, he had them manufactured under the most innovative and comprehensive quality control program seen in the Navy to that time. The program included detailed specifications, production monitoring, and a rigorous system of proof testing. Dahlgren also instituted a gunnery-training program to teach naval officers and enlisted men how to shoot the new weapons.

These innovations made Dahlgren’s guns the most powerful and reliable heavy naval cannon in the world. In 1858, a 9-incher endured 1,531 rounds in failure testing. The first 1,509 rounds were fired with ordinary service charges. Thereafter the gun was fired with increasing amounts of gunpowder and numbers of shot. The round that finally split the barrel open consisted of twenty pounds of powder and ten 90-pound shot, filling it to the muzzle. During the test the gun consumed 15,400 pounds of gunpowder.^[5] Dahlgren guns had a service life of one thousand rounds in an era in which other kinds of cannon were not expected to last more than 500 rounds.^[6] Nine- and 11-inch Dahlgren

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

guns began entering the fleet in the mid-1850s and by the end of the decade, they had become the Navy's standard ordnance.^[7]

Naval officers and ordnance experts at home and abroad showered accolades upon the Dahlgren gun. "We have aimed to select and adopt the arm which combines the greatest strength, range, accuracy, and power," declared the secretary of the navy in 1858. "In the Dahlgren gun we have found what we want, and it is believed there is no gun in any service that surpasses it in these qualities."^[8] The next year a board of naval officers appointed to examine naval installations declared that thanks to Dahlgren, American naval ordnance was "equal, if not superior, to [that of] any navy afloat."^[9] Britain, Russia, and even Egypt tried to acquire the Dahlgren gun for their own navies.^[10]

Dahlgren himself attained a stature equal to that of his gun. Many Europeans considered him more important than Henri Joseph Paixhans, universally credited with inventing the shell gun. By the end of the decade, Dahlgren had become a regular guest at state dinners, rubbing elbows with foreign ministers, diplomats, cabinet members, and the President of the United States. He had achieved an unprecedented level of international renown for an American as a scientific inventor and ordnance innovator.^[11]

Dahlgren reveled in the glory. The "recognition he most ardently desired," noted his wife Madeleine Vinton Dahlgren, was "the recognition of posterity."^[12] Although Dahlgren had originally hoped to establish his reputation at sea in the traditional Navy way, he had found glory in ordnance work.^[13]

While Dahlgren was struggling to perfect heavy smoothbores during the 1850s, European powers were struggling to develop heavy rifled cannon. European naval ordnance was in a state of flux during the 1860s. Among the navies that had adopted the new built-up or hooped rifled cannon, there were three competing systems for rifling the barrel, at least four different combinations of the three principal gun metals (cast iron, wrought iron, and

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

steel), debates over the relative merits of breech-loading versus muzzle-loading, and four different approaches to the design and fabrication of the main tube and hoops. The leading contenders in the race to develop naval rifled cannon were British ordnance experts: Joseph Whitworth, Alexander T. Blakeley, and, most notably, Sir William Armstrong.^[14]

Despite the fact that he had staked his reputation on smoothbores, Dahlgren had tried as early as 1856 to begin research and development of rifled cannon, but inertia by ordnance chief Captain Duncan N. Ingraham prevented him from doing so. In 1859, Sir William Armstrong demonstrated several calibers of breech loading rifles that appeared to be superior in range, accuracy, and power to smoothbores of the same caliber. Dahlgren didn't want to be left behind by developments in Europe, so he determined to press forward with his own rifled ordnance R & D. To secure permission to do so, he had to go over his superior officer's head.^[15]

Battling bosses was nothing new for Dahlgren. Captain Charles Morris, Ingraham's predecessor, had had a love-hate relationship with Dahlgren's work. Morris was a hero of the War of 1812 and one of the Navy's leading officers. Although the captain appreciated the scientific rigor that Dahlgren brought to his duties, he had played a key role in instituting the very ordnance Dahlgren had meant to supplant—a system of 32-pounder shot-firing cannon and 8-inch shell guns that the Navy had adopted in 1845. To defend the old system against Dahlgren's attack, Morris denied Dahlgren time for experimentation, used elements of Dahlgren's proposals in counterproposals, attempted to acquire experimental data with which to refute Dahlgren's claims, and criticized his subordinate's work in official reports.

Dahlgren waged bureaucratic warfare to overcome Morris's resistance. He inundated the makers of naval policy with an endless stream of reports based largely on experimental evidence. These reports presented empirical evidence that Dahlgren's new

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

guns were indeed more powerful, more accurate, and more reliable than the guns of 1845. After years of battling the boss, Dahlgren persuaded the Navy to adopt the 9-inch gun in 1854 and the 11-inch gun in 1858. [\[16\]](#)

While Charles Morris had had at least some degree of ordnance expertise, Duncan Ingraham had none. The highlight of Ingraham's otherwise undistinguished career came in 1853, when, in command of the sloop *St. Louis*, he demanded that a prisoner who was being held on board an imperial Austrian warship be set free. A fight seemed inevitable, but Ingraham refused to back down, even though he faced a superior force. The Austrians released the prisoner at the last minute. Ingraham's deed popped right out of the mold of traditional American naval heroism. The U.S. government applauded his action, New Yorkers turned out in droves to welcome him home in 1854, and Congress gave him a gold medal. After Morris died in January 1856, the Navy, in keeping with a tradition of rewarding heroes with good-paying billets, made Ingraham chief of the ordnance bureau, despite the fact that Ingraham knew nothing about ordnance beyond what a warship captain would know. [\[17\]](#)

On 16 August 1856, Dahlgren submitted a draft of a rifled 120-pounder to Ingraham, "who very curtly declined to consider the subject of Rifled Ordnance at all," as Dahlgren later put it. Dahlgren resubmitted the request in June 1857, but Ingraham again ignored it. It may be that Ingraham feared expenditure. It may be that Ingraham disliked dealing with a prima donna subordinate and refused out of spite. [\[18\]](#)

Whatever the reasons, Dahlgren came to view Ingraham with the disdain that an expert has for a manager with little or no understanding of the technology he is supposed to manage. Dahlgren was a brilliant, dedicated, and sober officer who had earned his position through years of hard work and whose lofty ambition made him sensitive to the slightest slight. Nothing irritated Dahlgren more than superiors who lacked ordnance

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

expertise and yet interfered with his work. He had considered Charles Morris an old fogey and he came to view Ingraham as a dimwit.^[19]

In the wake of the headlines made by the Armstrong gun, in the spring of 1859 Dahlgren appealed directly to Secretary of the Navy Isaac Toucey to allow him to proceed with rifled ordnance R & D. Toucey granted him permission to do so. Dahlgren completed designs for three different calibers of rifles, patented a design for an elongated projectile for rifled ordnance, and procured three small iron rifled guns, chiefly to verify computations regarding dimensions and to study rifling pitch and bore length, as well as two 5-inch rifles to test various projectiles.^[20]

In 1860, Dahlgren designed and had built a 6-inch rifle to study rifling pitch, bore length, bore weight, and endurance of iron in heavier guns, but Ingraham did not “believe in Rifle Cannon of any kind,” as Dahlgren put it, and ordered him to stop work on rifled ordnance early in the year.^[21] Finally in September Ingraham left the ordnance bureau to take command of the sloop *Richmond*. The next month, Dahlgren received permission from Ingraham’s successor, Captain George Magruder, to resume work on rifled canon. By year’s end, Dahlgren had completed ballistic tests on three calibers of rifles and concluded that two of them were ready for the fleet.^[22]

Dahlgren’s work on the cutting edge of ordnance made him somewhat prescient with regard to the future of ship design. Given the tremendous increase in offensive power resulting from recent ordnance developments, it seemed inevitable to him that someone would try to find a defensive antidote. He knew that as early as 1825, Paixhans had advocated development of steam-powered ironclads armed with shell guns as the French answer to the Royal Navy’s wooden sailing ships of the line. In 1852, Dahlgren recommended cladding ships with iron armor to protect them from shells’ destructive power and to test ordnance against armor. Although Magruder was more pliable than Ingraham had been, the proposal fell on deaf ears.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

The appearance of the French ironclad *Gloire* in 1859 and construction of other ironclads in Britain and France led Dahlgren to resubmit the proposal to test ordnance against armor in December 1860. Again the proposal fell on deaf ears. Dahlgren had to content himself by pressing on with development of rifled ordnance.^[23]

With the firing on Fort Sumter, Dahlgren's R & D work came to a screeching halt.^[24] For months afterward, the commander focused entirely on events surrounding the crisis of secession, including assuming command of the Washington Navy Yard when the Commandant, Captain Franklin Buchanan, resigned his commission to "go South;" preparing the navy yard for a secessionist attack that never materialized; and, most of all, coping with the vastly increased demand for ordnance that came with the outbreak of war. Once again, Dahlgren had barely got started on rifled ordnance development when events beyond his control interrupted the work.

The one bright spot in these dark days was that Dahlgren finally got the kind of boss he wanted. When the Civil War started, George Magruder resigned his commission and went to Canada because he couldn't bring himself to choose sides. The Navy Department offered Dahlgren the job of ordnance chief, but he turned it down. As he saw it, the job's administrative responsibilities didn't leave enough time for experimentation. Instead, the Navy Department made Captain Andrew A. Harwood ordnance chief. Harwood handled the administration and deferred to Dahlgren's expertise in R & D.^[25]

In January 1862, Abraham Lincoln began taking steps that would reorganize the ordnance bureau to Dahlgren's liking. At the President's behest, Dahlgren described the ideal setup—the bureau chief should have an assistant to handle the administrative end so that the chief could focus on R & D. Lincoln tacitly understood these as being Dahlgren's conditions for becoming chief, with Dahlgren's old friend Henry Wise, who, as an assistant inspector of ordnance, had played a key role in the development of the Dahlgren gun, as Dahlgren's assistant. The President forwarded Dahlgren's recommendations to

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

John Hale, chairman of the Senate Naval Affairs Committee. Hale included them in a bill to reorganize the Navy Department that he introduced to Congress on 24 January.

Dahlgren must have been ecstatic. He would finally be free to do R & D work without interference from an ignorant bureau chief.^[26]

The battle of Hampton Roads changed everything. “Bang comes the blow from a clear sky,” Dahlgren began his diary entry of 9 March 1862. The battle brought a sudden and unprecedented urgency to answering the question of ordnance versus armor.

After picking up Dahlgren at the navy yard that morning, Lincoln related what he knew of the battle as the President’s carriage took them to the White House. Lincoln didn’t seem overly alarmed, Dahlgren thought, but “was in his usual suggestive mood.” The atmosphere in the Cabinet Room was decidedly darker. The secretaries of state, war, and navy were there, along with the Army’s quartermaster general and Major General George B. McClellan. When the President entered the room, everyone began talking at once, with varying degrees of panic in their voices. Secretary of War Edwin Stanton paced back and forth, his eyes glued to Secretary of the Navy Gideon Welles. Stanton feared that the *Virginia* would wreak a whirlwind of destruction on the Union, sinking every U.S. warship and putting every northern port under tribute. Stanton’s alarm soon infected the President, who began going to the window every few minutes to see if the *Virginia* was steaming up the Potomac. Dahlgren said that the ironclad drew too much water for her to cross Kettle Bottom Shoals, well downstream from the capital. Lincoln directed Dahlgren, McClellan, and the quartermaster general to block the river to prevent the *Virginia* from ascending, just in case.^[27]

Dahlgren left the White House at 2:00 P.M. and returned to the navy yard. Most of what he knew about the battle of Hampton Roads at that time came from a handful of military telegrams and a newspaper account. The former provided only sketchy information, while the latter gave full details. “Think of a newspaper being better

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

informed than the Government!” Dahlgren wrote in his diary. He spent the rest of the day carrying out Lincoln’s order and making arrangements to defend the capital against the rebel ironclad, if it came to that. Dahlgren went to bed after learning of the *Monitor*’s battle with the *Virginia*, only to be awakened at 2:00 A.M. with an order from Welles to cease operations to block the river.

Eight hours later (10:00 A.M. on 10 March), Dahlgren reported to the Navy Department. Gideon Welles said that “there had been too much alarm yesterday.” They chatted for a few minutes, then headed over to the White House.

There they met Henry Wise, who had accompanied Assistant Secretary Gustavus V. Fox down to Hampton Roads on 8 March “to see what truth there may be in a rumor that the *Merrimac* is ready to come out,” as Dahlgren put it in his diary. Wise and Fox had witnessed the duel between the *Monitor* and *Merrimac* from the deck of a tugboat. Wise mentioned that Captain John Worden, the *Monitor*’s skipper, was the only man seriously injured on the Union ironclad during the battle, when a Confederate shell exploded outside the vision slit of the *Monitor*’s pilothouse. Worden had been peering through the slit when the shell went off, driving powder fragments into his face and eyes. Nobody yet knew if he would recover his vision. Wise had brought the *Monitor*’s skipper, Captain John Worden, to a hospital in Washington and was on his way to deliver a report on the battle to the President.

Dahlgren, Wise, and Welles ascended to the Cabinet Room. The atmosphere was far less gloomy than it had been the day before. Wise gave a spirited account of the battle between the “iron-cased,” as he put it. Dahlgren must have felt uneasy when Wise told of the *Merrimac* steaming back to Norfolk, apparently unharmed. The ship remained a serious threat.^[28]

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Dahlgren spent the next week or so desperately trying to satisfy what had become an insatiable appetite for information about the battle of Hampton Roads. What degree of damage had the *Monitor* inflicted on the *Merrimac*? How many rounds had the *Monitor* fired during the battle? What kind of projectiles did she fire? With what charges? Had the *Monitor*'s guns been shortened or otherwise altered to fit into the turret, thus impairing their performance? Had the crew fought the guns according to the standard ordnance instructions or had they made some crucial error? Could the *Monitor*'s guns be depended upon should the *Merrimac* reappear?

From talking to witnesses and reading reports, newspapers, and telegrams sent over the military telegraph connecting Fortress Monroe and Washington, Dahlgren learned that the duel between the ironclads had taken place at ranges varying from almost zero to three hundred yards and that the opposing vessels had remained constantly in motion during the battle. Some thought that three 11-inch projectiles pierced the rebel ironclad's armor; others thought not. One report declared that the *Merrimac* was only "slightly injured."¹²⁹¹

As for the *Monitor*'s guns, Dahlgren discovered that they had not been altered to fit into the turret; they remained the same as the day they entered service. Nothing about their weight, density, or tensile strength marked them as unusual. Dahlgren had vent impressions taken of the guns to see if they exhibited abnormal wear. Again, nothing appeared out of the ordinary.¹³⁰¹ Fox informed Dahlgren that the *Monitor* had fired 43 rounds during the battle. "If these were divided between her two guns," Dahlgren noted, "the service would be very moderate." He had no reason to believe that they would fail if the *Monitor* had to fight the *Merrimac* again.¹³¹¹ John Ericsson, the *Monitor*'s designer and builder, opined that had the *Monitor*'s guns been pointed lower, they would have sunk the *Merrimac*. As it was, the projectiles glanced off the rebel ironclad's sloping sides, "instead of penetrating as they would if they hit point blank."¹³²¹ Dahlgren probably assumed that the *Monitor*'s crew had fired the ship's pair of 11-inch guns with the

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

standard service charge of fifteen pounds, for he had established the 15-pound charge long before the Navy had adopted the 11-inch caliber for service, and the 1860 ordnance instructions specified the 15-pound charge for “distant,” “near,” and “ordinary” firing.^[33]

Two nagging questions remained unanswered. If circumstances had differed somehow, could the *Monitor*'s 11-inchers have destroyed the *Merrimac*? What kind of ordnance could, in fact, destroy an ironclad like the *Merrimac*?

On 15 March, Captain Harwood ordered Dahlgren to answer the latter question by developing new ordnance. Harwood mentioned the kind of hoops that Blakeley in Britain and Robert P. Parrott in New York were shrinking around the breeches of their rifled cannon as a possible means to increase the strength of cannon. But Harwood didn't order Dahlgren to pursue a particular line of inquiry; he deferred to Dahlgren's expertise and left it up to him to develop the solution.^[34]

Gus Fox came up with his own answer to the ironclad question immediately after the battle of Hampton Roads. Fox had served for eighteen years in the Navy and merchant marine before becoming a business agent in 1856. In May 1861 Welles appointed him chief clerk of the Navy Department. That July he became the Navy's first assistant secretary and soon took over direction of naval operations. He was often genial, but he could also be autocratic, ruthless, and vindictive. He preferred easy solutions to those requiring intensive study. And, like Ingraham, he was no ordnance expert.^[35]

Fox considered the *Monitor-Merrimac* duel the greatest naval battle on record. Thrilled by what he considered to be a clear-cut victory for the Union contestant, the assistant secretary became an enthusiastic Ericsson devotee and more confident than ever in the Navy Department's recent decision to build ten improved monitors (the *Passaic* class). But Fox realized that the *Monitor*'s guns had not materially damaged the rebel ironclad.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

“Our present calibres,” he noted later, “are entirely inadequate to destroy such vessels.”^[36]

Shortly after the ironclad duel ended on 9 March, Fox disembarked from the tugboat and stepped ashore at Fortress Monroe. There he saw a 15-inch gun that had been designed by the U.S. Army’s premier ordnance expert, Thomas J. Rodman. Right then and there Fox decided that it was the answer for combating armored warships. “We must have more of these Boats [monitors],” he wired Dahlgren on 11 March, “with fifteen inch guns.”^[37]

Fox’s telegram must have conjured up an unpleasant sense of foreboding for Dahlgren. Here was a man with the power of position, Dahlgren no doubt thought, but utterly lacking in ordnance expertise, rashly suggesting a 15-inch gun as a solution to the most important question of the day. Could Fox be Morris and Ingraham all over again?

An order from Secretary Welles to Captain Harwood on 17 March confirmed Dahlgren’s apprehension. “This Department requires for the class of vessels like the *Monitor* at least twenty 15-inch guns,” it said. “You will take immediate measures to produce these guns in the least possible time.”^[38] Fox summoned Dahlgren to meet with him that evening at the home of Postmaster General Montgomery Blair. No doubt the conversation focused on the ironclad question. No doubt Dahlgren fretted.^[39]

The next day, Dahlgren, Fox, and the secretaries of war and state took a steamer down to Alexandria, Virginia, to meet General McClellan. Over a bottle of champagne they discussed the general’s spring campaign against Richmond up the peninsula between the York and James Rivers, the *Merrimac*, and heavy ordnance. “15 [inch] were nothing,” Dahlgren wrote in his diary afterward. “Go it. The National Team has run off, & stand clear.”^[40]

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Although the diary entry might seem like a bit of cheerleading, it was actually bitter sarcasm. “The people have gone mad on ordnance,” Dahlgren wrote a month later in notes he entitled “ordnance panic.” “The action of [*Monitor*] and [*Merrimac*] . . . drove Fox head long to 15 [inch guns]” and the assistant secretary conceived of these “monstrosities” without “due experiment.”^[41]

On 19 March, Dahlgren wrote Harwood expressing apprehension over Fox’s impulsive decision to develop a 15-incher. Although Dahlgren had never tested ordnance against armor, Fox had chosen that caliber specifically for use against armor. “A subject so important cannot be perfected with out much reflection and extensive experiment,” Dahlgren wrote. “But we lack almost the preliminary information indispensable to commence with.” Dahlgren opposed the 15-incher because he lacked data not only on the performance of ordnance against armor, but also on the endurance and safety of so large a caliber. He didn’t know whether cast iron could be made strong enough to bear for long the strain of firing a 15-inch projectile.^[42]

Dahlgren also had a personal reason for resisting a Navy 15-incher. The only weapon of this caliber then in existence was an Army weapon, a Rodman gun. The proud and vain Dahlgren didn’t want to appear to be following in anyone’s footsteps, particularly Thomas J. Rodman’s, for the two were engaged in a long-standing dispute over priority of gun design that had culminated in charges and counter-charges of plagiarism.^[43]

Dahlgren suggested an alternative to the 15-inch gun. First, “place 11-inch guns in all the turrets until the heavier ordnance were fully prepared.” Second, “Construct proper targets to ascertain what size and kind of projectile is needed to pierce, injure, or destroy plates of the thickness in use or likely to be used”—in short, to conduct tests of ordnance against armor. Finally, to “fabricate guns of the size thus indicated *whatever be the caliber*, using the forms and process needed to give uniform and proper endurance.” “I

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

would request authority to put up *without delay* plated targets for practice,” Dahlgren concluded, “and I will very shortly submit the draft of a 15-inch gun for fabrication—which may then be proceeded with at once.”^[44]

Fox duly noted Dahlgren’s objections and took responsibility for ordering its development. Dahlgren, the assistant secretary wrote in a letter to the editor of the *New York Times*, advised against the 15-inch gun. “Whatever responsibility attaches to those who strenuously urged it belongs to me,” he said, “and not to [Dahlgren].”^[45]

Fox was far more concerned about finding an answer to the armor question than whatever repercussions might follow development of a 15-inch gun. From Fox’s perspective, the threat lay not just to the south, but across the Atlantic as well. Through most of 1862, Lincoln administration officials worried about the prospect of European intervention. If Britain or France joined the war on the rebel side, the Navy would have to face far more dangerous ironclads than those produced by the rebels. “The United States Naval Ordnance has to its very great credit, led all nations in the perfection of its smooth bore guns,” Fox wrote Harwood on 15 May. “It devolves upon it to keep pace and lead if possible, in the production of smooth bore and rifled guns of such calibers and velocities as shall be irresistible against anything possible to construct which will cross the ocean.”^[46]

On 20 March, Captain Harwood wrote to the firm of Knap, Rudd, and Company, a foundry in Pittsburgh that produced many of the Army and Navy’s cast-iron cannon, asking them to produce fifty 15-inch cannon.^[47] That same day Harwood ordered Dahlgren to “cause to be erected proper targets of such material as you may deem expedient, in view of ascertaining by actual experiment what size and what kind of projectile is required to pierce, injure or destroy plates of metal of the thickness now in use or likely to be used.”^[48]

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Five days later, Welles asked the House Committee on Naval Affairs for new appropriations for ironclads, 15-inch guns, expansion of the ordnance production facilities at the Washington Navy Yard, and iron plates to serve as targets for ordnance tests. “The heaviest ordnance in present use is not sufficiently heavy and powerful to break and destroy the armature now placed on vessels,” the secretary declared.^[49]

Dahlgren rankled at statements like these, which he took as criticism of his 9- and 11-inch guns. Worse, it reflected poorly on his own reputation.

Nevertheless, he completed plans for a 15-inch gun and forwarded them to Fox on 26 March.^[50] A week and a half later, he submitted to Harwood another memorandum objecting to the 15-inch gun. “We know that guns as large as the 11-inch can be made uniformly reliable,” he declared, “but the mass of a 15-inch gun is at least three times as great.” He said that only three guns larger than the 11-incher had ever been made in the United States: a 12-inch smoothbore, a 12-inch Rodman rifle, and Rodman’s 15-incher. “There is no certainty as to the uniform resistance of any description of metal when made into a gun [as large as a 15-incher]”, he said, “and exposed to such great shocks.” He warned that if such a large cannon exploded inside a monitor turret, the ship could sink. He raised the question of whether a smaller caliber might be sufficient to deal with the thicknesses of armor then appearing on warships. Even the 11-incher might prove sufficient. “We know that the *Monitor* fired shot of 170 pounds at the *Merrimac*, and it is said that the damage inflicted has been sufficient to detain the *Merrimac* under repairs for three weeks or more; but we are not informed what the nature of those injuries was,” he declared. “Whether a larger number of 11-inch shot would have disabled the *Merrimac* entirely or not, no one can say.”^[51]

Dahlgren must also have wondered what effect shot striking the *Merrimac* with greater momentum would have had. This thought raised a key question. How could he increase the power of the Navy’s ordnance without compromising its safety? Although he

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

didn't raise the specter of the "Peacemaker" disaster in his memoranda objecting to the 15-incher, the thought must have crossed his mind. On 28 February 1844, a 12-inch wrought-iron cannon dubbed the "Peacemaker" exploded during a gala live-fire demonstration on board the USS *Princeton*, killing the secretary of the navy, the secretary of state, and other government officials. The tragedy spurred both the Army and the Navy to take greater pains to ensure the safety of their cannon. Safety and power had been the principal selling points of the Dahlgren gun. The purpose of the cannon's peculiar shape, detailed production specifications, and rigorous proof testing program was to minimize the danger of barrel failure and thus ensure that the crew could fire it safely in combat.^[52]

Insistence upon standard service charges constituted one of the primary means Dahlgren had instituted to ensure safety. Dahlgren knew that firing a gun weakened its metal. His theory of a gun's endurance or service life can be likened to a glass of water. Firing a gun with standard service charges drained its endurance a drop at a time. Firing it with greater than the standard charge drained its endurance by the ounce. Early in the 11-incher's development, Dahlgren had established the standard service charge as fifteen pounds of gunpowder.

Dahlgren knew that before the Navy had adopted his gun, the established proof procedure to determine the soundness of a gun's metal involved firing it with charges greater than would be used in service. If the gun didn't fail or demonstrate signs of weakness, it was accepted for service.^[53] Dahlgren also knew that, contrary to the ordnance instructions; 11-inchers in service had often been fired with charges as high as twenty-five pounds of powder instead of the regular 15-pound charge, and there were no reports of failure in such instances.^[54] Higher charges increased muzzle velocity, thus increasing the momentum of a projectile and therefore the force of the blow it delivered to the target. Could the *Monitor*'s 11-inch guns, he must have wondered, have done fatal

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

damage to the *Merrimac* if they had been fired with heavier charges? Could the 11-inch gun bear higher charges in protracted firing?

These were precisely the questions that Dahlgren most eagerly wanted to answer by experiment. On 31 March, he requested permission from Harwood to test an 11-inch gun with increased powder charges and solid shot.^[55] His goal, as he later reported to his boss, was “to ascertain the capability of the 11-inch gun to endure higher charges than those intended for it.”^[56] Harwood gave him permission to use an 11-incher manufactured by Cyrus Alger and Company of Boston, with foundry number 214.^[57] By 8 May, Dahlgren had fired 120 rounds of 165-pound solid shot from 11-incher no. 214, including one round with fifteen pounds of powder, twenty-two rounds with twenty pounds of powder, and ninety-seven rounds with twenty-five pounds of powder. “The gun exhibits no symptom of giving way under so severe a trial,” he reported to Harwood.^[58]

On 7 May, Dahlgren began firing no. 214 against armored targets. Instead using the Experimental Battery at the Washington Navy Yard, he used an alternative site for most of these tests. The Experimental Battery lay on the waterfront, with its line of fire down the Anacostia River toward the Potomac. Even before the war, Dahlgren had found it prudent not to fire when river traffic appeared downrange. With the war came a higher volume of shipping on the Potomac, resulting in even longer delays and more frequent interruptions at the Experimental Battery, thus necessitating the alternative, dubbed the “Pencote Battery,” located across the Anacostia River from the navy yard on the grounds of the U.S. Insane Asylum (now St. Elizabeth’s Hospital).^[59]

Experiments with ordnance against armored targets were conducted several days per month at the Pencote Battery through the summer and fall of 1862. Mechanics and laborers from the Washington Navy Yard constructed a wide variety of targets, made from varying thicknesses of iron plates bolted to a wooden backing, sometimes interlaced

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

with scrap iron, railroad rails, cable, or inch-thick sheets of rubber. Many of these targets were, in fact, armor systems designed by private inventors. Mostly, however, the targets consisted of a 4- to 4.5-inch thick iron faceplate, bolted to about 20 inches of wood, sometimes with an inch-thick iron back plate, set up against a solid bank of clay. These thicknesses corresponded to those reported on Confederate and European ironclads.

The tests also involved a wide variety of projectiles, many of which were designed by private inventors: “Stafford’s Sub-calibre Shot;” “Hopkins cast iron cylindrical shot” with “square ends;” “Cloverdale cast iron Cylindrical Shot” with “flat heads;” “Rifled cast-iron Shot, hardened by Mr. Donovan,” etc. Mostly, however, the projectiles fired were simple wrought-iron or cast-iron shot. The cannon used through the end of 1862 were almost exclusively Dahlgren guns, including a 150-pounder rifle, a 50-pounder rifle, the first 15-inch gun, and, overwhelmingly, in terms of number of firings, 11-incher no. 214. The range to the target was generally ninety feet.^[60]

Dahlgren himself was absent most of the time. Lieutenant Commander William Mitchell, recently assigned to ordnance duty, supervised the tests, recorded data, and reported results to Dahlgren, who was often too busy filling ordnance requisitions, designing cannon, overseeing ordnance production, running the Washington Navy Yard, and testing civilians’ inventions to cross the bridge to the Pencote Battery.^[61] For each test, Mitchell noted the date; dimensions, composition, and angle of the target; gun fired; type of projectile fired; type and weight of powder charge; range to the target; and number of rounds fired, as well as the effect of each shot on the target. His reports included detailed colored drawings, showing the damage inflicted by each round.^[62]

Commander Mitchell fired 11-incher no. 214 with twenty-five-pound charges at the first four targets. On 28 May, he upped the ante and began firing the 11-incher with thirty-pound charges. Thereafter, he fired no. 214 exclusively with thirty-pound charges. By 18 November, the gun had been fired a total of 157 times. In most cases, the shot penetrated

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

clean through the target and embedded itself deep in the clay bank, even with the target angled as steeply as fifteen degrees.^[63]

Mishaps occurred from time to time. On one occasion, the shot penetrated the faceplate but shattered, scattering chunks of iron in all directions. One piece struck a shed at the end of battery 110 feet from the target, another piece flew through the woods behind the battery, and several other pieces landed in a meadow 140 yards away. On another occasion, the first shot of the day knocked over the target, delaying the next shot for an hour and a half while the laborers and mechanics set it back up. The next shot knocked the target over again and it took the men two more hours to set it back up. No injuries were reported as a result of the tests, but there were several close calls.^[64]

Sometimes distinguished visitors dropped by. At Dahlgren's invitation, the President came to the Pencote Battery on 20 May, with the entire Cabinet in tow. Dahlgren fired no. 214, then a 50-pounder rifle with seventeen pounds of powder. The projectile from the latter penetrated nearly an inch into the 4 5/8-inch faceplate of the target. The heat generated by the force of the blow was so intense that it welded a fragment of the plate to the shot. Several people tried to pry the fragment off with a crowbar. Nobody, not even Lincoln, with his legendary rail-splitter's strength, could do it. Numerous government officials and Army and Navy officers attended a test of the first 15-inch gun against an armored target on 8 November, including Gideon Welles, Montgomery Blair, Gus Fox, and Dahlgren. Commander Mitchell fired a 400-pound cast-iron cored shot with forty pounds of powder at a target built up from five one-inch iron plates and one 4.5-inch plate secured to eighteen inches of oak backing. The 15-inch projectile dented and cracked the outer plate and flew to pieces, scattering in all directions, with one piece landing on a wharf some 235 yards away from the target.^[65]

The more Dahlgren studied rifled cannon, the more skeptical he became of their safety and endurance. His skepticism resulted not only from their performance at Pencote

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Battery, but also from their performance in combat. By the end of the year, the ordnance bureau had amassed a record of rifled cannon failures sufficient to dampen the spirits of even their most ardent proponents. By February 1862, Dahlgren had received reports of six rifled cannon exploding in combat and in practice.^[66] His own 30- and 80-pounder rifles had proven so unreliable that the ordnance bureau ordered many of them withdrawn from service that same month.^[67] Even British rifles left him unimpressed. In a November 1862 report to Congress, he noted that despite numerous tests, the British “have arrived at no final decision” in regard to the effectiveness of rifled ordnance against armored warships. After examining data from tests of the latest Armstrong rifles against armor with data from his own experiments, he concluded that his 11-inch gun “bears comparison with the best forged British guns of the latest design.”^[68] In short, Dahlgren had determined his 11-incher to be equal to the Armstrong rifle.

The results at Pencote Battery with no. 214 convinced Dahlgren that the 11-inch gun could safely endure firing rounds with heavier charges. On 3 June, he raised the issue in a letter to the chairman of the Senate Naval Affairs Committee. “Recent well known events must change entirely the system of Naval attack and defence as practiced at this time,” he declared. “It is not yet certain that the existing heavy Ordnance cannot be utilized in some degree, and I am now engaged in a course of practical investigation which will lead to some conclusion in this regard.”^[69] On 22 July, he reported to the Navy Department that 25-pound charges with shells could safely be used in 11-inch guns against masonry, “if the case demands it urgently, but to no great extent.”^[70] Two days later, he issued a circular to the fleet. “The XI in gun may be fired with 20 pounds of powder for shot or shell,” it said. “When iron sides are to be battered, even 25 pounds of powder may be used, not exceeding 50 fires per gun, provided the gun has not been much used previously, and commanders are enjoined to exercise great care when such a heavy strain is imposed on the gun.”^[71]

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

The tests also convinced Dahlgren that the 11-incher would serve as an adequate short-term answer to the armor question until long-term research and development provided the ultimate answer. Dahlgren presented this view on 22 November 1862 in the ordnance bureau section of the secretary of the navy's annual report to Congress. "Our 9-inch and 11-inch guns," he declared, "are found to be, in a measure, available against iron plating, because they will endure solid shot fired with one-half greater, and even double, the original charges. So that we have the leisure to consider and devise any other species of ordnance that may be better adapted to the purpose, and are not precipitated into hasty or questionable measures."⁷²¹

With righteous indignation, Dahlgren discussed the 11-incher, its critics, the battle of Hampton Roads, and the tests of ordnance against armor in detail. "The 11-inch guns of the *Monitor* were designed chiefly for shells," he said. "But since that time, the same class of gun has been ascertained to be capable of throwing solid shot of 169 pounds, with a charge of 30 pounds." He reported that 11-incher no. 214 had been fired 155 times with charges greater than fifteen pounds. "The gun is not burst," he said, "nor does it exhibit any indication of giving way." The 11-inch gun was indeed capable of enduring heavier charges. Eleven-inch guns firing shot driven by heavy charges, he said, had penetrated 4.5-inch armor regularly on the proving ground. "These guns are not idle against armor plates," he declared triumphantly. He then implied that the *Monitor*'s 11-inchers could have defeated the *Merrimac*'s armor, if fired with heavier charges. "The proper mode of increasing the power of the *Monitor*'s guns," he argued, "was to have increased the charge, which the gun was capable of enduring safely, to the extent of 30 pounds; but this was not known at the time, and all will admit that the occasion was not one when any risk was to be incurred unnecessarily."⁷³¹

Misunderstanding of this conclusion gave rise to the famous "half-charge rule" myth, which held that some time before the battle of Hampton Roads, the ordnance bureau issued an order specifying that the *Monitor*'s guns were to be fired with only half

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

their normal service charge. No such order exists. Fodder for the half-charge rule myth includes accounts like that in the anonymously edited book, *The Monitor and the Merrimac: Both Sides of the Story* (New York: Harper, 1912), purported to be “the first-hand story” as told by John L. Worden, the *Monitor*’s skipper, Samuel D. Greene, her second in command, and H. Ashton Ramsey, the *Virginia*’s chief engineer. “The fact that the powder charges for [the *Monitor*’s] Dahlgren guns were officially limited to fifteen pounds, although thirty and even fifty pounds were used with safety afterward,” states the publisher’s introduction, “invites speculation upon the results if she had fought with a free hand.” The “free hand” question, however, was moot. During the battle neither Worden nor Greene knew that heavier charges were safe to fire. Dahlgren discovered that fact months later. What Worden and Greene did know was that fifteen pounds of powder was the service charge specified in the ordnance instructions for the 11-inch gun.^[74]

Unlike some of those who conducted tests of ordnance against armor later in the nineteenth century, Dahlgren never had any hidden agenda. Right from the start, Dahlgren’s purpose was to prove the critics wrong by demonstrating that the 11-inch gun was indeed powerful enough to deal effectively with enemy ironclads. The *Monitor*’s guns had barely cooled off after the battle of Hampton Roads when Dahlgren set about gathering the evidence he needed to do so. Certainly he meant to vindicate the gun’s reputation as well as his own, stained as they were by those who declared that the 11-incher was useless against armor.

In all his correspondence with Harwood, Fox, and Welles, Dahlgren stated clearly and plainly the purpose for the tests. Dahlgren was not only interested in proving the 11-incher capable of damaging ironclads, but he was also interested in finding a workable interim answer to the armor question until due experiment revealed the proper type of ordnance to use against armor. Furthermore, he wanted to moderate the pace of development of the 15-inch gun. He emphatically didn’t want new cannon of unknown safety issued to the monitors, as safety remained his paramount concern.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Dahlgren never attempted to falsify the results to make the 11-incher look better than it really was. It would have been foolish to declare the 11-incher safe to fire with heavier charges without empirical evidence to back up the claim. To have done so was to risk guns having guns blow up and kill sailors, which would have dealt Dahlgren's reputation a far worse blow than having the tests confirm the view that the 11-incher was inadequate against armor. Fortunately, for the sake of sailors' safety as well as Dahlgren's reputation, the tests of ordnance versus armor proved the 11-inch gun to be even better than anyone had previously thought.

Even as Dahlgren was devising a satisfactory interim answer to the armor question, however, he was losing interest in finding a permanent solution. On 5 July 1862, Congress passed a version of the legislation to reorganize the Navy Department that Senator Hale had introduced the previous January. Dahlgren became chief of the new Bureau of Ordnance, received a promotion to captain, and was permitted to continue to do R & D work.

Unfortunately for research and development, the new job increased Dahlgren's administrative burden by an order of magnitude. Not only was he working on the answer to the armor question, but he also faced other problems of significant national importance. Mostly the problems involved shortages—shortages of a critical component of gunpowder (niter), shortages of cannon for the fleet, even shortages of qualified officers to help him run the bureau. Whereas before the July reorganization, the bureau chief handled administration and Dahlgren did the R & D, Dahlgren now did both, because he didn't want to delegate the big problems to a subordinate. Generally, he spent mornings on administrative work and afternoons on R & D. [\[75\]](#)

Dahlgren solved the big administrative problems. The niter shortage disappeared by the summer of 1863, the staff at the Washington Navy Yard quintupled, and the national production of ordnance grew tremendously. In March 1861, the Navy possessed

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

305 9-inchers and 32 11-inchers. By 1 November 1863, Northern foundries had turned out 503 new 9-inchers and 291 new 11-inchers, increases of 165 percent and 909 percent, respectively. Union foundries had also turned out thirty-six 15-inch guns and 691 Parrott rifled cannon for the Navy, all under the eyes of new assistant inspectors of ordnance.^[76]

The tests of ordnance against armor continued into 1863. Dahlgren no longer limited the experiments to his own cannon, but tested as many different types and calibers of guns as he could get his hands on, including the 15-incher and various British rifled ordnance. He also tried new smoothbore cannon he designed specifically for use against armored warships, including a 13-incher, an 11-incher with a straight muzzle, and a heavy 10-incher that fired solid shot exclusively. All bore Dahlgren's hallmark soda-water-bottle shape. Only the 13-incher and straight-muzzle 11-incher saw active duty.^[77]

Dahlgren thought he should be rewarded for the work he was doing. In the summer of 1862, he campaigned to get promoted to the newly established rank of rear admiral. Gideon Welles's policy, however, was to limit promotions to those who had distinguished themselves in combat. Nevertheless, Dahlgren managed to get what he wanted with a little help from his friend. Under pressure from Lincoln, Welles promoted Dahlgren to captain on 5 August 1862 and rear admiral on 11 March 1863.^[78]

Unwanted work still consumed much of the time Dahlgren had for R & D. During the year following the battle of Hampton Roads, he tested scores of weapons invented by civilians. He rankled at having to use his limited R & D time to test "Shaler's Cartridges of .58 calibre," "Mr. Alfred Birney's combustion shell," "Day's Carbine," "Beal's Patent Revolver Pistol," and the like, instead of working on the armor question, which he considered much more important. A month after becoming ordnance chief, he asked Secretary Welles to give someone else the "onerous" duty of testing civilian inventions, but nothing came of the request. At the same time, Assistant Secretary Fox was

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

pressuring him to hasten the development of the 15-incher. This unwanted task also absorbed countless hours that Dahlgren would have preferred to devote to other tasks.^[79]

Dahlgren was becoming fed up by superiors' interference in his bailiwick. The frustration had been growing for years. The protracted battles with Morris the old fogey and Ingraham the dimwit had been bad enough. But the situation had gotten worse, not better. Even though he had gotten the ordnance bureau reorganized and had risen to the rank of rear admiral, he now had to deal with Fox the tyrant. Most galling had been the assistant secretary's insistence on developing the 15-inch gun over his strenuous objections. "Nothing," Dahlgren later wrote in his diary, "could exceed the insolent tyranny of Fox."^[80]

The assistant secretary's order to develop the 15-incher was the last straw. Dahlgren concluded that the Navy would never give him complete authority over ordnance development, despite his unparalleled reputation. Renown without such power wasn't good enough. Dahlgren concluded that a reputation made in a bureau could never measure up to glory won at sea. At the moment the country needed his ordnance expertise the most—to come up with the long-term answer to the armor question—Dahlgren divorced himself from ordnance work to seek a berth where he could win glory the old fashioned way.

Dahlgren aimed high, setting his sights on getting command of the South Atlantic Blockading Squadron, potentially the most prestigious berth in the fleet. In the fall of 1862, the Navy Department was planning an attack on Charleston, South Carolina, the "cradle of the rebellion." If Charleston fell to a naval attack, the squadron commander would become the most famous naval officer in the North, perhaps eclipsing even Farragut's victory at New Orleans. Dahlgren launched a campaign to get the command on 1 October 1862. With a lot of help from providence and a little from Lincoln, he became

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

commander of the squadron in the spring of 1863. The admiral left Washington for South Carolina that June.^[81]

Instead covering himself with glory in a victorious battle, Dahlgren presided over the Union navy's most frustrating campaign—the failure to capture Charleston.^[82] The failure precipitated a storm of controversy in the North. Major General Quincy Gillmore, commander of Union Army forces at Charleston, wrote a book implying that Dahlgren was to blame. Dahlgren testified before Congress that Gillmore was to blame. While some naval historians agree that Dahlgren made the best of a bad situation, Dahlgren also has his detractors. Whatever historians think, the controversy dealt his reputation a worse blow than had the *Merrimac*. After the Civil War, Dahlgren commanded the South Pacific Squadron for a year and a half before returning to Washington in 1868 to become chief of the Bureau of Ordnance once again.^[83]

Meanwhile, the 11- and 15-inch guns proved themselves to be adequate answers to the armor question as it arose in naval combat during the Civil War. Although General McClellan's ill-fated Peninsula Campaign ultimately failed, Union operations in the vicinity of Norfolk caused the rebels to destroy the *Virginia* on 11 May 1862 to prevent it from falling into Union hands. The U.S. Navy rather handily dispensed with the most significant rebel ironclads that followed. On 17 June 1863, the *Passaic*-class monitor *Weehawken* made short work of the Confederate ironclad *Atlanta*, forcing the grounded rebel ship to strike its colors after firing only two rounds from her 15-inch gun. The CSS *Tennessee* stood nary a chance during the battle of Mobile Bay on 5 August 1864 as Union wooden and ironclad ships swarmed around the hapless vessel, ramming and firing away. The Union monitor *Chicasaw* nearly stove in the aft end of the *Tennessee*'s casemate with her 11-inchers firing 30-pound charges. The *Tennessee*, too, struck her colors. After wreaking havoc among the Union ships off Plymouth, North Carolina, the CSS *Albemarle* fell victim on 27 October 1864 to a torpedo-boat attack led by the Civil War's boldest junior naval officer on either side, Lieutenant Commander (later

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Commander) William B. Cushing. During the battle of Trent's Reach on 23-24 January 1865, the Confederate ironclads *Virginia No. 2* and *Richmond* retreated when 15-inchers on board the double-turreted monitor *Onondaga* began to speak with devastating effect.

Otherwise, the question of ordnance against armor in combat just didn't come up that much. The Confederates laid down or contracted for approximately fifty ironclads during the war. Of these fifty, twenty-two were commissioned and placed in operation. Mostly they functioned as sort of "*Merrimacs* in being." Instead of steaming into action offensively, they tended to sit in Confederate harbors, where their presence posed a threat to attacking forces. Serving as floating batteries was about all rebel ironclads were capable of, for they tended to be thinly armored, underpowered, unwieldy, unseaworthy, and mechanically unreliable. Most rebel ironclads shared the fate of the *Virginia*, scuttled by their own crews to prevent Union forces from capturing them. The far more ominous threat of European intervention never materialized.^{[184](#)}

Captain Henry Wise, who had run the Bureau of Ordnance while Dahlgren dealt with Confederate ironclads and worse problems at Charleston, had proven a competent administrator. But Wise was no innovator. The pace and direction of ordnance development in the bureau had always depended on the competence, perception, and motivation of the chief. Henry Wise lacked Dahlgren's inventive genius and political skill. Content with the performance of Dahlgren and Parrott guns during the Civil War, Wise perceived no need for innovation. In reports to Gideon Welles, he advocated retaining the Navy's current system of armament until the Europeans demonstrated conclusively that some other system proved superior. For the time being, he was satisfied with the 15-inch gun and increased charges in the 11-incher as the answer to the armor question. Although he occasionally stressed the necessity of resuming systematic experimentation, he persuaded neither Welles nor Congress to provide funds. As a result, American naval ordnance stagnated while Dahlgren was at sea.^{[185](#)}

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

You might think that it would have been “logical” or “natural” for Dahlgren to have pushed for the development of rifled ordnance upon his return to the bureau in 1868, given contemporary European developments and 20-20 hindsight. The British had begun issuing Armstrong breech-loading rifles to their fleet in 1861. By May 1862, every class of warship in the Royal Navy carried at least one Armstrong gun, from the 9-pounder used in launches to the 110-pounder carried in large ships. The accuracy of the 32-pounder Armstrong at 3,000 yards was seven times better than that of a comparable muzzle-loader. Breech loading meant that the crew did not have to run the gun in for loading. Breech loading eliminated the possibility of double-charging the gun in battle as well as the possibility that burning fragments from the previous charge might ignite the second round. The Armstrong was the first modern breech-loading rifle in regular service.^[86]

Dahlgren, however, perceived no threat from the Armstrong gun, or from any other piece of rifled ordnance. “The rifle has not entirely lost its interest,” he wrote, “tho’ with us it has so far abated as to leave much less pressure to improve than before—If rifle cannon had been safe—they might have ruled—but they have not.”^[87]

Dahlgren’s disdain was not unfounded. Sir Alexander Milne, commander-in-chief of the British North American and West Indian Station from 1860 to 1864, was skeptical of the Armstrong gun from the beginning. He found that its breech was prone to explode during firing, and that its unreliable vent piece, delicate ammunition, and low carriage made it difficult to operate. In a letter to the Admiralty written in December 1863, Milne declared the Armstrong gun “not suitable for service afloat.” The Royal Navy returned to muzzle loaders as its main armament the next year. Not until 1880 was an improved breech-loader introduced, finally ending the long reign of muzzle-loaders.^[88]

Although Dahlgren had been a proponent of rifled ordnance before the war, its performance during the war reversed his opinion. “No heavy rifled cannon has been made

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

which meets, even in a moderate degree, the requirements for arming ships of war,” he declared in a report to Congress on 15 April 1864.^[89] During the attacks on Fort Fisher in December 1864 and January 1865, so many 100-pounder Parrott rifles exploded in action that, according to North Atlantic Blockading Squadron commander Rear Admiral (later admiral) David D. Porter, the officers and men “lost confidence in them.”^[90] In contrast, not a single 9- or 11-inch Dahlgren gun that had passed proof ever burst prematurely in service. Henry Wise said that “the advantages claimed for rifled cannon over smoothbores are in many respects visionary, and do not bear the test of actual combat.”^[91] Admiral Porter summed up the prevailing view in the United States Navy at the end of the Civil War: “Rifled cannon had not at that time made such an advance as to satisfy us that it would be the gun of the future.”^[92]

Dahlgren fully embraced this view. “Having seen a great deal of experimental practice, and witnessed as much protracted firing in action with the enemy as fell to the lot of most officers,” he declared in a December 1865 memorandum, “I am satisfied the *Naval smooth bore Ordnance will not be superceded by Rifles . . . the smooth bore and its round projectile is better than the Rifle gun and the conical shell.*”^[93]

American naval officers, officials, and ordnance experts shared this view. Gus Fox believed that the 9- and 11-inchers were the best shell guns in existence. Captain James Alden, skipper of the steam sloop *Brooklyn* for most of the war, said that the 9-incher was the “best gun ever made. . . . Them men stand around them and fight them with as much confidence as they drink their grog.”^[94] Alexander Lyman Holley, an American steel maker and ordnance expert, declared that, against non-armored targets, Dahlgren’s 9- and 11-inchers were “comparatively perfect.”^[95] Admiral Porter said that they were “the best of [their] kind in the world.”^[96] Writing in 1868, historian Charles B. Boynton predicted that “‘built-up’ guns of all kinds, will be abandoned . . . the form of the Dahlgren cannon will in the main be adopted.”^[97] In sum, the prevailing view held that Dahlgren’s guns were so good and rifles so bad that there was no need for change.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Why did innovation in American naval ordnance stall during the Civil War? The answer has three parts: time, interest, and need.

The exigencies of production demanded so much of Dahlgren's time that he didn't have much left for experiment. Before the July 1862 Navy Department reorganization, administration and R & D had each been full time jobs, with the chief doing the former and Dahlgren the latter. When Dahlgren became chief, he spread himself too thin, trying to fulfill both responsibilities by working half a day on each. With his reputation more or less on the line for each facet of ordnance work, Dahlgren was loath to delegate responsibility, particularly when the national interest was at stake. So he tried to do it all himself and innovation suffered accordingly.

When Dahlgren didn't get to run the Bureau of Ordnance without interference from above, he lost interest in innovation. Instead of the freedom to develop the ultimate answer to the ironclad, Welles and Fox compelled him to test and develop other people's ideas. This rankled the proud and vain inventor and led him to seek a fighting berth afloat, where superiors were hundreds of miles away instead of right next door.

Mostly, however, the Navy didn't innovate its ordnance during the war because it didn't need to. Necessity is the mother of invention, goes the old saying. But because of the unreliability of rifled ordnance, the utter reliability of the Dahlgren gun, and the adequacy of Dahlgren guns in meeting the demands of Civil War naval combat, naval officials perceived no pressing need for innovation.

As a result, the Navy retained Dahlgren guns long past the point of obsolescence. In his memoirs, Alfred Thayer Mahan described an incident that happened while he was in command of a sailing steamer on the South Pacific Station in the mid-1880s. A French naval officer, making a courtesy call, paused on leaving the ship to gaze wistfully at the Dahlgren smoothbores on her deck. They reminded him of his days as a midshipman; of

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

his youth. He quoted a line from the fifteenth-century French poet Francois Villon: “*Ou sont les neiges d’antan?* [Where are the snows of yesteryear?]”^[98]

NOTES

Abbreviations

Diary John A. Dahlgren Diaries, John A. Dahlgren Papers, Syracuse University Library, Syracuse NY

DLC John A. Dahlgren Papers, Library of Congress, Washington DC

RG45 NA Naval Records Collection of the Office of Naval Records and Library, Record Group 45, National Archives, Washington DC

RG74 NA Records of the Bureau of Ordnance, Record Group 74, National Archives, Washington DC

^[1] Diary, 9 March 1862 entry. Although renamed the *Virginia* by the Confederates, most northerners during and after the war continued to refer to her as the *Merrimac*, spelling her name without the “k” at the end. This article is based largely on my book *A Quest for Glory: A Biography of Rear Admiral John A. Dahlgren* (Annapolis: Naval Institute, 1996). I’ve gone back to the original sources, however, to reexamine in greater detail the climate in Washington and Dahlgren’s tests of ordnance against armor in the months following Hampton Roads.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

^[2] “Other Experiments with Guns and Armor Targets,” *Scientific American* 7 (1 November 1862): 283. This article quotes the London *Times* as follows: “. . . the American cast iron Dahlgren guns ‘are useless against iron sides.’”

^[3] Ammen to Dahlgren, 9 November 1862, box 5, DLC.

^[4] Thomas J. Misa, *A Nation of Steel: The Making of Modern America, 1865-1925* (Baltimore: Johns Hopkins, 1995), 106-108

^[5] “Casting Heavy Guns,” *Scientific American* 14 (30 October 1858): 60.

^[6] Edward Simpson, *A Treatise on Ordnance and Naval Gunnery, Compiled and Arranged as a Text Book for the U.S. Naval Academy*, 2nd ed. (New York: Van Nostrand, 1862), 100; U.S. Navy Department, Bureau of Ordnance, *Ordnance Instructions for the United States Navy*, 4th ed. (Washington: Government Printing Office, 1866), 33-34.

^[7] For development of the Dahlgren gun, see Schneller, *Quest for Glory*, chapters 5-10.

^[8] *Annual Report of the Secretary of the Navy, 1858*, 6-7.

^[9] U.S. Congress, House, *Reports of the board of officers ordered to examine into the condition of the navy yards*, H. Exdoc. 34, 36th Cong., 1st sess., 1859-60, 76.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[10\]](#) Schneller, *Quest for Glory*, 156-57, 163.

[\[11\]](#) Schneller, *Quest for Glory*, 165.

[\[12\]](#) Madeleine Dahlgren to Charles Cowley, 10 March 1890, John A. Dahlgren Papers, Syracuse University Library, Syracuse NY.

[\[13\]](#) Dahlgren to [?], 7 February 1856 (1855 folder), box 2, DLC.

[\[14\]](#) Richard D. Glasow, "Prelude to a Naval Renaissance: Ordnance Innovation in the United States Navy during the 1870s" (Ph.D. dissertation, University of Delaware, 1978), 18, 51-56.

[\[15\]](#) Dahlgren to Ingraham, 2 June 1857, Entry 201 #5, RG74 NA; Diary, 24 September 1860 entry; William Hovgaard, *Modern History of Warships, Comprising a Discussion of Present Standpoint and Recent War Experiences* (London: E. & F. Spon, 1920), 387-88.

[\[16\]](#) *Regulations for the Proof and Inspection of Cannon, Shot and Shells, Adopted by a Board of Officers, Consisting of Commodore C. Morris, Commodore L. Warrington, Commodore W.M. Crane, Commodore A.B. Wadsworth, Commodore W.B. Shubrick, and Approved by the Secretary of the Navy, June 1845* (Washington: C. Alexander, 1845). For examples of Dahlgren's arguments in selling the Dahlgren gun, see John Dahlgren, "Reorganization of the U.S. Naval Ordnance, No. 1," 10 August 1852, box 22, DLC; John Dahlgren, "Reorganization of the U.S. Naval Ordnance (The Eleven Inch Shell-gun) No. 2," 31 May 1853, box 22, DLC; John Dahlgren, "Reorganization of the U.S. Naval Ordnance No. 3: Comparative Accuracy at 1300 yards, of Present and Proposed Cannon," 9 December 1853, box 22, DLC; John Dahlgren, "Reorganization of U.S. Naval Armament No. 4," 21 January 1854, box 22, DLC. For examples of Morris's resistance to the Dahlgren gun, see Morris to the Secretary of the Navy, "Remarks upon

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

Lieut. Dahlgren's propositions for substituting heavier guns for the present armaments of our ships of war," 30 May 1853, vol. 1, Entry 1, RG74, NA; Morris to the Secretary of the Navy, 19 December 1853, vol. 1, Entry 1, RG74, NA; Morris to the Secretary of the Navy, 30 January 1854, vol. 1, Entry 1, RG74, NA.

[\[17\]](#) *Dictionary of American Biography*, s.v., Duncan N. Ingraham.

[\[18\]](#) Dahlgren to Ingraham, 2 June 1857, Entry 201 #5, RG74 NA; Diary, 24 September 1860 entry; Dahlgren to Harwood, 8 July 1862, Entry 201 #5, RG 74, NA.

[\[19\]](#) Diary, 24 September 1860 entry.

[\[20\]](#) Diary, 19 and 23 March 1859, 4 April 1859, and 24 September 1860 entries; Toucey to Dahlgren, 26 March 1859, box 4, DLC.

[\[21\]](#) Dahlgren to Drayton, 13 June 1860, Captain Percival Drayton Papers, Drayton Collection, Historical Society of Pennsylvania, Philadelphia.

[\[22\]](#) Dahlgren to Magruder, 8 October 1860, Entry 201 # 5, RG 74, NA; Dahlgren, "Practice with 50-pdr & 15-pdr Rifle Cannon," 12 December 1860, box 25, DLC; Dahlgren to Magruder, 12 December 1860, Entry 201 #5, RG74, NA; Dahlgren to Harwood, 8 July 1862, Entry 201 # 5, RG 74, NA.

[\[23\]](#) Dahlgren to Magruder, 10 December 1860, Entry 201 #5, RG74 NA.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[24\]](#) Dahlgren to Harwood, 8 July 1862, Entry 201 #5, RG74, NA.

[\[25\]](#) Schneller, *Quest for Glory*, 187-88.

[\[26\]](#) Robert V. Bruce, *Lincoln and the Tools of War* (Indianapolis: Bobbs-Merrill, 1956), 207; Lincoln to Hale, 28 January 1862, Abraham Lincoln, *The Collected Works of Abraham Lincoln*, ed., Roy P. Basler, 8 vols. (New Brunswick: Rutgers University Press, 1953), 5: 112-13.

[\[27\]](#) Diary, 9 March 1862 entry.

[\[28\]](#) Diary, 9-12 March 1862 entries.

[\[29\]](#) Dahlgren, notes dated 8 March 1862, box 5, DLC; Headquarters Army of the Potomac to Operator Navy Yard, 9 March 1862, box 5, DLC; Wise to Dahlgren, 12 March 1862, vol. 14, Entry 6, RG74, NA.

[\[30\]](#) Wise to Dahlgren, 12, 15, and 19 March 1862, vol. 14, Entry 6, RG74, NA.

[\[31\]](#) Dahlgren to Harwood, 19 March 1862, Entry 201 #5, RG 74 NA.

[\[32\]](#) Dahlgren to Harwood 17 March 1862, Entry 201 # 5, RG74 NA.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[33\]](#) U.S. Navy Department, *Ordnance Instructions for the United States Navy*, second edition (Washington: George W. Bowman, 1860), 141; Schneller, *Quest for Glory*, 137-138.

[\[34\]](#) Harwood to Dahlgren, 15 March 1862, box 4, Entry 6, RG74, NA.

[\[35\]](#) Schneller, *Quest for Glory*, 191-93.

[\[36\]](#) Fox to Harwood, 15 May 1862, roll 2, microcopy 480, Entry 13, RG45 NA.

[\[37\]](#) Fox to Dahlgren, 11 March 1862, box 5, DLC.

[\[38\]](#) Welles to Harwood, 17 March 1862, box 4, Entry 16, RG74 NA.

[\[39\]](#) Wise to Dahlgren, 17 March 1862, and Dahlgren to Harwood, 18 March 1862, box 4, Entry 6, RG74 NA.

[\[40\]](#) Diary, 18 March 1862 entry.

[\[41\]](#) Dahlgren, "ordnance panic," 26 April 1862, box 27, DLC.

[\[42\]](#) Dahlgren to Harwood, 19 March 1862, box 5, DLC.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[43] Dahlgren to Floyd, 13 October 1860, box 27, DLC; Rodman to Ripley, [?] September 1861, box 5, DLC; Dahlgren to Stanton, 31 March 1862 (1863 folder), box 27, DLC.

[44] Dahlgren to Harwood, 19 March 1862, box 5, DLC.

[45] U.S. Navy Department, *Report of the Joint Committee on the Conduct of the War*, vol. 2., *Heavy Ordnance* (Washington: Government Printing Office, 1865), 128.

[46] Fox to Harwood, 15 May 1862, box 4, Entry 16, RG 74 NA.

[47] Harwood to Knap, Rudd & Co., 20 March 1862, box 4, Entry 6, RG74 NA.

[48] Harwood to Dahlgren, 20 March 1862, box 4, Entry 6, RG74 NA.

[49] U.S. Congress, House, *Letter from the Secretary of the Navy Addressed to the Committee on Naval Affairs, in Relation to Iron-clad Ships, Ordnance, &c.*, House Misc. Doc. 82, 37th Cong., 2nd sess., 25 March 1862.

[50] Dahlgren to Fox, 26 March 1862, Entry 201 #5, RG74 NA.

[51] Dahlgren, "Memoranda Connected with the Draft of X^Vin gun," 7 April 1862, box 27, DLC.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[52\]](#) Schneller, *Quest for Glory*, 67-69, 89.

[\[53\]](#) Schneller, *Quest for Glory*, 137-38.

[\[54\]](#) Dahlgren to Harwood 19 March 1862, Entry 201 #5, RG74 NA.

[\[55\]](#) Harwood to Dahlgren, 31 March 1862, box 5, Entry 6, RG74 NA.

[\[56\]](#) Dahlgren to Harwood, 8 May 1862, Entry 201 #5, RG74 NA.

[\[57\]](#) See vol. 2, Entry 98, RG74 NA.

[\[58\]](#) Dahlgren to Harwood, 8 May 1862, Entry 201 #5, RG74 NA.

[\[59\]](#) Eugene B. Canfield, "The Pencote Experimental Battery," *Military Collector and Historian* 44 (Spring 1992): 20-23.

[\[60\]](#) Vol. 2, Entry 99, RG74 NA.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[61\]](#) For an indication of how much time Dahlgren spent filling requisitions and testing other people's inventions, see boxes 4-6, Entry 6, RG74 NA.

[\[62\]](#) Vol. 2, Entry 98 and 99, RG74 NA.

[\[63\]](#) Vol. 2, Entry 98, RG74 NA.

[\[64\]](#) Tests conducted 19 June and 26 July 1862, vol. 2, Entry 98, RG74 NA.

[\[65\]](#) Dahlgren, notes entitled "Practice at Iron Plates May & June 1862," box 27, DLC; test of 15-incher conducted 8 November 1862, vol. 2, Entry 98, RG74 NA.

[\[66\]](#) Dahlgren, notes entitled "Rifled Cannon Bursting," 14 February 1862, box 27, DLC.

[\[67\]](#) Bureau of Ordnance and Hydrography, Circular, 17 February 1862, box 189, Entry 464, RG45 NA.

[\[68\]](#) *Annual Report of the Secretary of the Navy 1862*, 711-21.

[\[69\]](#) Dahlgren to Hale, 3 June 1862, box 5, DLC.

[\[70\]](#) Dahlgren to Wise, 22 July 1862, Entry 201 #5, RG74 NA.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[71\]](#) Dahlgren to Du Pont, Circular, 24 July 1862, Entry 6, RG74 NA.

[\[72\]](#) Dahlgren, "Report to the Navy Department," 22 November 1862, box 27, DLC.

[\[73\]](#) Dahlgren, "Report to the Navy Department," 22 November 1862, box 27, DLC.

[\[74\]](#) U.S. Navy Department, *Ordnance Instructions for the United States Navy*, 141.

[\[75\]](#) Diary, 6 February 1863 entry.

[\[76\]](#) Alfred D. Chandler, Jr., "DuPont, Dahlgren, and the Civil War Nitre Shortage," *Military Affairs* 13 (Fall 1949): 142-49; *Annual Report of the Secretary of the Navy 1862*, 710, 724; *Annual Report of the Secretary of the Navy 1863*, 841-46.

[\[77\]](#) *Annual Report of the Secretary of the Navy 1862*, 711-20; Vols. 1-2, Entry 98, RG74 NA; Harwood to Knap, Rudd, and Co., 13 June 1862, vol. 19, Entry 6, RG74 NA; Missroon to Wise, 29 October 1862, vol. 2, Entry 51, RG74 NA; "Experiments with a New Gun," *Scientific American* (29 November 1862), 342; Dahlgren to Knap, Rudd, and Co., 9 December 1862, Fort Pitt vol. 1, Entry 4, RG74, NA.

[\[78\]](#) Schneller, *Quest for Glory*, 212-16, 233-34.

[\[79\]](#) Diary, 24 June 1862 entry; Bruce, *Lincoln and the Tools of War*, 214-15. See boxes 4-6 of Entry 6, RG74 NA, for orders Dahlgren received regarding civilian inventions.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[80\]](#) Diary, 3 June 1866 entry.

[\[81\]](#) Schneller, *Quest for Glory*, 231-47.

[\[82\]](#) Robert J. Schneller, Jr., "A Littoral Frustration: The Union Navy and the Siege of Charleston, 1863-1865," *Naval War College Review* 49 (Winter 1996): 38-60.

[\[83\]](#) See Schneller, *Quest for Glory* and Robert M. Browning, Jr., *Success Is All That Was Expected: The South Atlantic Blockading Squadron during the Civil War* (Washington: Brassey's, 2002).

[\[84\]](#) U.S. Navy Department, Naval History Division, *Civil War Naval Chronology, 1861-1865* (Washington: GPO, 1971), V: 22-26; Robert J. Schneller, *Cushing: Civil War SEAL* (Washington: Brassey's, 2004), 80-85; William N. Still, Jr., *Iron Afloat: The Story of the Confederate Armorclads* (Nashville: Vanderbilt University Press, 1971), 227; Schneller, *Quest for Glory*, 209, 246.

[\[85\]](#) Glasow, "Prelude to a Naval Renaissance," 17-18, 34-39, 50; "Naval Ordnance," *Army and Navy Journal* (17 December 1864): 260; *Annual Report of the Secretary of the Navy 1866*, 149.

[\[86\]](#) Regis A. Courtemanche, *No Need of Glory: The British Navy in American Waters, 1860-1864* (Annapolis: Naval Institute Press, 1977), 161-62.

[\[87\]](#) Dahlgren, notes entitled "Report for 1868," box 29, DLC.

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[88\]](#) Courtemanche, *No Need of Glory*, 165-66.

[\[89\]](#) John Dahlgren, *Report to the Joint Committee on the Conduct of the War*, vol. 2, *Heavy Ordnance*, Senate rept. 142, 38th Cong., 2nd sess., 1865, 114.

[\[90\]](#) David Dixon Porter, *The Naval History of the Civil War* (New York: Sherman Publishing Co., 1886), 726.

[\[91\]](#) U.S. Congress, Senate, *Report of the Joint Committee on Ordnance on Experiments on Heavy Ordnance*, Senate Report 266, 40th Cong., 3rd sess., 1869, 158.

[\[92\]](#) Porter, *Naval History of the Civil War*, 361.

[\[93\]](#) Dahlgren, "Memorandum," 20 December 1865m box 6, DLC. Emphasis added.

[\[94\]](#) *Report to the Joint Committee on the Conduct of the War: Heavy Ordnance*, 172.

[\[95\]](#) Alexander L. Holley, *A Treatise on Ordnance and Armor* (New York: Van Nostrand, 1865), 133.

[\[96\]](#) Porter, *Naval History of the Civil War*, 361.

A Global Forum for Naval Historical Scholarship

International Journal of Naval History

Volume 2 Number 3/Volume 3 Number 1

December 2003/April 2004

[\[97\]](#) Charles B. Boynton, *The History of the Navy During the Rebellion*, 2 vols. (New York: D. Appleton, 1867-1868), 2: 480-81.

[\[98\]](#) Quoted in Klaus Knorr, ed., *Historical Dimensions of National Security Problems* (Lawrence, KS: University of Kansas Press, 1976), 274.