The "Princeton" and the "Peacemaker": A Study in Nineteenth-Century Naval Research and Development Procedures

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On February 28, 1844, a gun exploded aboard the navy's new steam frigate, the U.S.S. "Princeton," causing a multiple tragedy. Fragments struck a group of illustrious visitors, killing five men of national prominence, two of them members of the Cabinet—Abel P. Upshur, Secretary of State, and Thomas W. Gilmer, Secretary of the Navy. But for President Tyler's interest in Julia Gardiner, his wife-to-be and the daughter of one of the men killed, he might have been among the fatalities.

The story of the explosion has been told many times, but the background relating to the gun and the ship has never been fully examined. The following account studies this background as recorded in Navy Department files and presents the findings as a case study in the administration of research and development.

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The "Princeton," constructed in 1841–43, was a full-rigged sailing vessel with steam propulsion and screw propeller. She could be called epoch-making, for many of her features anticipated later practice.[1] Her

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[1] The most complete description of the "Princeton" was made in 1844 by the Committee of the American Institute and is contained in "Ericsson's Petition to the Honorable the Congress of the United States" (hereinafter cited as "Ericsson's Petition") (National Archives, R.G. 123, Court of Claims docket 15). Of the scholars who have discussed features of the "Princeton," J. P. Baxter, *The Introduction of the Ironclad Warship* (Cambridge, Mass., 1933), p. 14, singled out "the telescopic funnel, boilers designed to burn anthracite coal, and fan blowers for forcing the fires." Bernard Brodie, *Sea Power in the Machine Age* (Princeton, N.J., 1941), p. 36, added the "direct-action coupling of engine and propeller" but also mentioned burning anthracite coal. William Hovgaard, *Modern History of Warships* (New York, 1920), pp, 361–62, a Danish-American professor of naval architecture at the Massachusetts Institute of Technology, had little to say about innovation by the Swedish-American, Ericsson, but did mention iron as a material of construction in boilers. A good history of the development of steam-powered naval vessels is needed.

engines, novel in design, were coupled directly to the shaft and were mounted below the water line. Designed to burn anthracite coal, she was fitted with forced-draft boilers, feed-water heaters, and a telescopic smokestack—to minimize smoke and chance of detection. Her ordnance, the subject of this paper, was anything but a success; however, her main battery—a limited number of guns, each of maximum size, pivoted to fire in various directions, and fitted with a compressor brake recoil system—had a strong conceptual resemblance to the batteries of later capital ships. Similarly, her range finder and self-actuating gunlocks which fired the guns at a preselected elevation showed appreciation of the problems of fire control as well as ingenuity in attempting to find a practical solution.[2]

The "Princeton's" hull was built at the Philadelphia Navy Yard, but a number of private firms furnished machinery and ordnance for the "Princeton." Samuel V. Merrick and John Henry Towne, engine manufacturers at Philadelphia, fabricated her semicylindrical steam engine and various appurtenances. The Phoenix Foundry in New York City, originally owned by James Cunningham but sold in 1842 to Peter Hogg and Cornelius Delamater, provided the boilers, propeller, and centrifugal blower.[3] Ward and Company's Hamersley Forge, also in New York City, worked as a subcontractor to the Phoenix Foundry in providing forgings for guns, strengthening bands, etc. The West Point Foundry of Cold Springs, New York, provided a cast-iron gun, and its president, William Young, was involved in the original decision to design a twelve-inch wrought-iron gun. One of the guns was made by the Mersey Iron Works of Liverpool, England.

Despite the number of firms involved in the undertaking, the "Princeton" was the brain child of John Ericsson and Captain Robert F. Stockton, U.S. Navy, and was constructed under their supervision. The background of these two men should be considered carefully.

Ericsson was a versatile and extremely competent engineer. Born and educated in Sweden, he moved to England where he designed a loco-

[2] The range finder measured the angle of depression between the target and the horizon and converted this to yards from the target. No description of the self-actuating gunlock has been found. The Committee of the American Institute which examined the vessel in early 1844 described it as "a lock so constructed that it is discharged at any desired elevation, without human interference, by a peculiar mechanism, in which the law of gravitation, in connection with the rolling of the vessel, is rendered subservient to this purpose," thereby, strongly implying that it was a pendulous device ("Ericsson's Petition," pp. 17–21).

[3] Statements by Ericsson and affidavits by Merrick and Towne and by Hogg and Delamater delineate the division of work (*ibid.*, various pages).

motive which lost in competition to George Stephenson's "Rocket." He also developed screw propellers and marine steam engines and, in 1837, using a boat with two propellers, towed an Admiralty barge at a speed of ten knots. The Admiralty dismissed his device as impractical in a decision that led a British naval historian to comment, "Never, perhaps, in the whole history of mechanical progress has . . . expert opinion been so mistaken."[4] At this time Ericsson met Captain Stockton, who is credited with persuading him to come to America. There, Ericsson eventually secured his place in American history by designing the "Monitor." His interests included optical devices, steam propulsion, gun mounts, and solar energy.[5]

Stockton was a colorful officer with many abilities and interests: He served during the War of 1812; in later actions against the Barbary States; and in the African Squadron, where he participated in establishing Liberia. His controversial role in the Mexican War brought him the title "Conqueror of California." He became a U.S. senator from New Jersey and was a potential presidential candidate in the 1850's. He was also a promoter of internal improvements, including New Jersey railroads and the Delaware and Raritan Canal, which joined the Hudson and Delaware Rivers. Despite his lack of formal engineering training, Stockton had considerable mechanical insight and ingenuity.[6]

Stockton at one time proposed to the secretary of the navy and to the President that a steamship-of-war be constructed with machinery entirely out of the reach of shot.[7] It is unclear whether this was before or after he was introduced to John Ericsson by Francis B. Ogden, the enterprising American consul at Liverpool who was also a designer of engines for steamships and a backer of Ericsson's enterprises.[8] Stockton

[4] F. L. Robertson, *The Evolution of Naval Armament* (London, 1921), p. 236.

[5] W. C. Church, *Life of John Ericsson* (New York, 1890); Ruth White, *Yankee from Sweden* (New York, 1960); John Ericsson, *Contributions to the Centennial Exhibition* (New York, 1876).

[6] *Life of Commodore Stockton* (New York, 1856). This was a politically inspired biography. *The Dictionary of American Biography*, Vol. XVIII, and the Library of Congress identify the author as S. J. Bayard.

[7] Stockton to Mason, May 20, 1844, "Ericsson's Petition," p. 27. Stockton stated, "Previous to my acquaintance with Captain Ericsson, I had proposed to the President of the United States and the Navy Department, to construct a steamship of war whose machinery should be entirely out of the reach of shot." The timing is contradicted by Stockton's biographer (*Life of Commodore Stockton*, pp. 76–77), who related that in 1838 Stockton was the bearer of dispatches to the American minister in England. "While there . . . he conceived the idea of constructing a formidable steamship-of-war, with all her machinery below water line."

[8] A sketch of Ogden's life is in *The Dictionary of American Biography*.

had Ericsson construct an iron boat "with submerged wheels" (i.e., propellers) and a semicylindrical engine which was sent to America for use on the Delaware and Raritan Canal.[9]

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As their discussion turned from engines to guns, Stockton, Ogden, and Ericsson were joined by William Young, President of the West Point Foundry. As Ogden later explained, they knew the strength of wrought iron from the experience with forged steamer shafts and reasoned that such forgings could be made into heavy guns.[10] Later reports and testimony indicated several advantages such a gun was supposed to have over one of cast iron. A larger gun could be constructed of wrought iron for a given weight. In addition, larger guns supposedly could be built of wrought iron since, beyond a certain point, increasing the thickness of cast iron did not increase its strength.[11] Other advantages claimed were less erosion of the barrel, a more regular trajectory, and more destruction upon impact.[12]

Stockton therefore determined that a wrought-iron gun of twelve-inch bore was feasible and arranged with Ogden to have such a gun constructed.[13] As Ericsson later described the negotiations: "Captain Robert F. Stockton . . . consulted me regarding the possibility of constructing naval ordnance of wrought iron. Being an advocate of that material, I readily met the wishes of Captain Stockton, and at once prepared drawings of a gun of 12-inch calibre. The Mersey Iron-Works near Liverpool being willing to enter into a contract with Captain Stockton, received forthwith an order from the enterprising and spirited officer to build the gun at his expense."[14] Ogden shipped this gun

[9] Robertson, *op. cit.*, p. 237; also Thomas Hornsby, "Oregon and Peacemaker, 12-inch Wrought Iron Guns," *American Neptune*, VI, No. 3 (July, 1946).

[10] Testimony of Francis B. Ogden, March 9, 1844, before a Court of Inquiry to investigate the causes of the recent accident on the steamship "Princeton," in *House Report 479* (28th Cong., 1st sess.), pp. 4–6.

[11] Bernard Brodie, pp. 184–85. The generally recognized maximum limits of the size of cast-iron guns may not have been considered by Stockton and his associates. As will be noted, in addition to the twelve-inch wrought-iron guns, Stockton obtained a twelve-inch cast-iron gun. Dahlgren and Rodman were later able to produce very large guns of cast iron by using new configurations and casting techniques. In 1864, Rodman supervised the casting of a twenty-inch piece (A. L. Holley, *A Treatise on Ordnance and Armor* [New York, 1865], pp. 108–21).

[12] Stockton to Crane, December 23, 1842, in *House Report 479*, pp. 32–34.

[13] *House Report 479*, pp. 4–5.

[14] Ericsson, p. 400.

to America in 1841 on Captain Mallett's "John Taylor," and it was carried on the bill of lading as a hydraulic tube.[15]

The above account, based on Ericsson's and Ogden's statements, conflicts with the tradition that this was the "Ericsson gun" that he designed and brought to America. The gun was a joint effort and did not spring from Ericsson's mind full blown but grew out of consultation and collaboration with other people of appropriate technical background. Of the four men involved, Ericsson and Ogden had considerable knowledge of the properties of wrought iron stemming from their work in the design of steam engines; William Young was a gunfounder, while Stockton, and possibly Ericsson, had experience in handling and using naval ordnance.

Stockton, having made his arrangements, returned to America, where, in the spring of 1840, he proposed that Ericsson's steam machinery be installed in the "Raritan," a frigate of about 1,700 tons that was then under construction. The navy commisisoners rejected this proposal but maintained that they were not declining a trial of the machinery in a different manner and on a smaller scale.[16] Stockton then argued that he intended to install guns that could not be used advantageously on a small vessel and was again rebuffed by the commissioners, who suggested that Stockton participate in determining the "comparative capacity" of the guns before a vessel was built for their use.[17] After this, Stockton turned to politics and campaigned for the Harrison and Tyler ticket.[18]

A year later, his political position enhanced by the Harrison-Tyler victory, Stockton sent a model for a steamship-of-war to the Secretary of the Navy, George E. Badger, and requested that Lieutenants E. R. Thompson and William Hunt be ordered to Philadelphia to assist in preparing detailed plans.[19] Badger complied and further directed

[15] Bill of lading and invoices attached to Stockton's letter of September 15, 1842, to Board of Navy Commissioners (National Archives, R.G. 74). This invoice and bill of lading have been largely overlooked. Church implied that Ericsson brought his gun with him to America on the "Great Western." White said that Ericsson and his gun arrived on the "British Queen." Baxter, p. 33, referred to the two wrought-iron guns and continued, "One of these named the Oregon, Ericsson had designed, brought from England."

[16] Warrington to Stockton, April 29, 1840, in Navy Commissioners Letters to Officers (National Archives, R.G. 45).

[17] Warrington to Stockton, May 16, 1840 (National Archives, R.G. 45).

[18] The last paragraph of the April 29 letter, cited in n. 16, advised Stockton that if he again requested a furlough, it might be granted. *Life of Commodore Stockton*, pp. 78–79, describes Stockton's part in the campaign of 1840.

[19] Stockton to Badger, May 27, 1841, in "Ericsson's Petition," p. 29.

Charles Stewart, the commandant at Philadelphia, to furnish Captain Stockton with such facilities as could "be granted without injury to the service."[20]

Three months later Badger directed the navy commissioners "to cause to be built, two steam vessels of war: [including] one on Captain Stockton's plan not exceeding six hundred ton."[21] This was about one-third the size of Stockton's first choice, the "Raritan."[22] According to the arrangements, Stockton, although reporting to the commandant of the Philadelphia Navy Yard, would determine the form and dimension of the vessel. If requested, Naval Constructor Lenthall would assist in preparing plans. The commandant was to advise the commissioners as to the best methods of procuring timber, equipment, and machinery.[23]

Confusion as to the relationship between Stockton and the commandant at Philadelphia apparently was dispelled in the directive to Stockton: "You will superintend the building of said steamer under the direction of the Commandant of the Navy Yard at Philadelphia, making to him from time to time, during the progress of the work, such suggestions as you may think proper."[24] Construction of the "Princeton" (as the vessel was named a year later) apparently was to be handled routinely. None of the correspondence gave Stockton authority to operate outside of normal channels. The fact, however, that Stockton, when rebuffed over the "Raritan," had deferred the matter rather than dissociate the gun from the ship clearly indicated his determination to keep his freedom of action in developing a new system of warfare.

Administrative responsibility, already fuzzy, was further confused by the abolition of the Board of Navy Commissioners and the adoption of the bureau system. Some continuity was provided, however, in that the commissioners were appointed bureau chiefs. One of these, William M. Crane, as chief of the Bureau of Ordnance and Hydrography, became a tragic figure.

Stockton's freedom resulted from his own political position, the loose working arrangement initially set down, the complete change in Navy Department organization, and a succession of secretaries (Badger, Up-

[20] Badger to Stockton, June 1, 1841, and Badger to Stewart, Navy Yard, Philadelphia, June 1, 1841, both in "Ericsson's Petition," pp. 29–30.

[21] Badger to Warrington, September 11, 1841, in "Ericsson's Petition," p. 30.

[22] Ericsson, p. 394, gave the "Princeton's" "measurement burthen" as 673 tons and her displacement as 954 tons at a sixteen-and-one-half-foot draught or 1,046 tons at an eighteen-foot draught.

[23] Warrington to Stewart, September 21, 1841, in "Ericsson's Petition," p. 30.

[24] Simms (Acting Secretary of the Navy) to Stockton, September 22, 1841, in "Ericsson's Petition," p. 31.

shur, Henshaw, and Gilmer). Conflicts with a new commandant of the Philadelphia Navy Yard, G. C. Read, arose, for example, over powder tanks and hand weapons. Stockton argued with Crane that it was the intention of the government to allow him to proceed in "any way I may see fit considering my entire responsibility in the matter."[25] Lewis Warrington, acting for Crane during the latter's absence, backed down and advised Read that Stockton was acting under an understanding with the department in relation to experiments.[26] Read later complained that he had had to suspend all ordnance work except that on the "Princeton," and Stockton continued to make further demands.[27]

Similar indications of Stockton's independence occurred in proof-testing the ordnance. In November, 1842, Crane had directed an ordnance officer, Alexander Wadsworth, to prove the two twelve-inch guns introduced by Captain Stockton and to ascertain their strength and efficiency but not to injure them.[28] Proof tests were merely a formality since the government, contrary to usual practice, had already paid for the guns.[29] Stockton desired that the shot be covered with felt, and the secretary, after agreeing with Crane that the tests should be conducted with plain shot, later authorized the use of felt-covered shot.[30]

It appears that Stockton, despite the views of Navy Department officials, was permitted to follow his own course. Since only specific disagreements were discussed in official correspondence, the documents do not indicate the extent of his freedom. In all recorded instances,

[25] Stockton to Crane, November 13, 1843 (National Archives, R.G. 74).

[26] Warrington to Read, August 7, 1843 (National Archives, R.G. 74). Warrington, Crane's brother-in-law, was at this time chief of the Bureau of Yards and Docks and signed the letter as "Acting Chief of the Bureau of Ordnance and Hydrography." He had been president of the Board of Navy Commissioners. After the death of Gilmer in 1844, he became secretary of the navy, ad interim, and after the death of Crane in 1846, chief of the Bureau of Ordnance and Hydrography. His many peripheral involvements with Stockton and his guns appear to have been limited to implementation of decisions reached elsewhere. A word about rank and title may also be in order. The senior naval officers mentioned herein were, by order of precedence (or seniority), Charles Stewart, Lewis Warrington, William M. Crane, Alexander S. Wadsworth, George C. Read, Beverly Kennon, and Robert F. Stockton. All held the *rank* of captain but were addressed by the *courtesy title* of commodore, indicating they had commanded squadrons or shore stations.

[27] Read to Crane, December 7, 1843 (National Archives, R.G. 74).

[28] Crane to Wadsworth, November 7, 1842 (National Archives, R.G. 74).

[29] Crane to Warrington (Secretary of the Navy, ad interim), March 11, 1844 (National Archives, R.G. 74), and inclosed index of letters to and from the Bureau of Ordnance in relation to the Stockton guns.

[30] *Ibid,* items 6–15.

however, Crane and Read eventually acceded to Stockton's requests even though they originally may have been upheld by the secretary. Thus, Stockton's independence was probably as complete as has ever been allowed an officer undertaking a research and development project.

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To return to the gun, upon its arrival in America it was sent to Philadelphia, where trunnions were installed. In 1842 it was shipped to Sandy Hook and, while lying in the sand, was proved with one charge of 35 pounds of powder and a 212-pound shot.[31] When a small crack developed near its breech, Stockton employed the Phoenix Foundry to construct reinforcing bands or hoops.[32] These were fabricated at Hamersley Forge and shrunk on the gun at Sandy Hook.[33]

As a companion piece, Stockton had obtained a twelve-inch cast-iron gun from the West Point Foundry.[34] This gun was intended for the "Princeton," and a gun carriage and friction gear were obtained for it.[35] Stockton fired both guns at Sandy Hook for comparative purposes. The cast-iron gun broke after about eighteen rounds, but the wrought-iron gun was fired about fifty times without apparent change.

Stockton immediately requested permission from Crane to order a wrought-iron gun to replace the broken cast-iron piece[36] and submitted a report of his 1842 tests at Sandy Hook which, he claimed, proved that the wrought-iron gun was superior to cast-iron guns.[37] His evi-

[31] Testimony of Lieutenant William E. Hunt and Fireman Edward Kelly, in *House Report 479*.

[32] Hogg and Dalamater Deposition, in "Ericsson's Petition," p. 13.

[33] Ericsson Statement, in "Ericsson's Petition," p. 13, listed "hooping of English Gun" as being superintended by him at both New York and Sandy Hook. Information on the hoops is contradictory. Ericsson, apparently confusing the two wrought-iron guns, said the hoops were "put on in two tiers, shrunk one over the other in such a manner as to break joint." Lieutenant Hunt and Ogden said the band was three and one-half inches in depth (*House Report 479*, pp. 5 and 7). Alexander Wadsworth removed one of the hoops, and it was two and three-quarters inches in depth (Wadsworth to Crane, December 21, 1842, in *House Report 479*, p. 40).

[34] Crane to Upshur, December 20, 1842 (National Archives, R.G. 74).

[35] Merrick and Towne deposition, in "Ericsson's Petition," pp. 10–12.

[36] Stockton to Crane, November 21, 1842 (National Archives, R.G. 74).

[37] Stockton to Crane, December 23, 1842, in *House Report 479*, pp. 32 ff. Stockton also sought to show that "formula laid down in the books on the art of gunnery . . . are inapplicable to the present experiments" and that the flight of a projectile was foreshortened "within a circle" by atmospheric resistance. It was undoubtedly this contention that Lieutenant James H. Ward referred to in derisive terms: "Harwood

dence was its longer life, its greater accuracy, and its greater destructiveness compared to service weapons. A few rounds from the twelve-inch gun had destroyed a target representing a seventy-four-gun ship, and he had sent one round through a four-and-one-half-inch thick wrought-iron target representing the armor of the Stevens Battery—the first ironclad ordered by the navy. He said little about the gun carriage other than that recoil did not exceed three feet. Alexander Wadsworth, who inspected the wrought-iron gun after Stockton had completed his tests, gave some support to Stockton's claims; neither the bore nor the crack in the breech had enlarged.[38]

Crane forwarded Stockton's report to Lieutenant Colonel Talcott of Army Ordnance. Talcott agreed that large projectiles were more destructive than smaller ones and that their trajectories were predictable. He maintained, however, that the greater accuracy, if any, of the wrought-iron gun resulted from the fact that its projectiles had been wrapped in felt, which cut down the windage. He believed that twelve-inch guns were too heavy for use aboard ship and specifically questioned the use of welding in fabricating guns. Prophetically, he pointed out that there was "uncertainty of . . . [such guns] being homogeneous and actually welded throughout as they must of necessity be composed of many pieces, which may be welded on the exterior while many fissures exist in the interior of the mass."[39]

In light of Talcott's derogatory opinion, Stockton, in the spring, returned to Sandy Hook to further prove his claims.[40] Although no report of these tests has been found, he fired the English gun another seventy to one hundred times. His associates later maintained there was no discernible change in either the crack or the bore.

The above provided the basis for Stockton's decision to construct a second wrought-iron gun. As Lieutenant Hunt later testified: "a gun . . . made of American iron [would be] sufficiently strong to stand any number of pounds of powder."[41] Ogden, who had some knowledge of metallurgy, noted that the English gun withstood repeated firings,

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. . . has seen it—some of it he says is rich—especially Stockton's deputation on the parabolic theory" (Ward to Goldsborough, March 11, 1844 [National Archives, R.G. 45, area 7, box 15]).

38 Wadsworth to Crane, December 21, 1842.

39 Talcott to Crane, January 3, 1843 (National Archives, R.G. 74).

40 Crane to Stockton, January 12, 1843, and January 25, 1843 (both in National Archives, R.G. 74); Stockton to Upshur, April 28, 1843 (National Archives, R.G. 45).

41 *House Report 479*, p. 7.

even though it "had lost all tenacity" and "depended alone on bands 3½ inches thick." He believed that the new gun "with these bands *welded* upon two inches greater diameter . . . , would be perfectly safe under any trial."[42]

Ogden glossed over a basic design change, welding (rather than shrinking) the strengthening bands. None of the other recapitulations of events even mentioned that such a design change was made. Thus our knowledge of this crucial change is very limited.

The inadequacies of the experience supporting the decision to procure a second gun of a new design were paralleled by the methods of implementation. Secretary Upshur, through Crane, had indicated that a second wrought-iron gun could not be obtained unless it were superior to a cast-iron gun.[43] Nothing specific, however, was said as to who would decide that superiority had been demonstrated. In late June, Upshur became acting secretary of state,[44] a position that left him little time to worry about details of naval ordnance. Stockton acted quickly and through the Phoenix Foundry ordered a gun fabricated at Hamersley Forge.[45]

If, as the cited documents appear to prove, the gun brought from England was not an "Ericsson gun," neither was the American gun strictly a "Stockton gun." Ericsson's account, being in the passive tense, avoided attributing responsibility: "A 12-inch smoothbore, of much heavier metal, was forged at Hamersley Forge, bored and turned in New York, and considered at the time to be a remarkable specimen of good workmanship."[46] Ogden testified that he and Ericsson had watched the boring of the gun and examined the shavings.[47] An affidavit signed by the owners of the Phoenix Foundry stated that Ericsson "had furnished and executed" drawings of the American twelve-inch wrought-iron gun to "one and one-half inch scale [possibly those shown in Fig. 1], and a vertical section of the after part of the breech, full size"; boring and finishing were "under the personal superintendence and instructions of Captain John Ericsson."[48] Lieutenant William

[42] *Ibid.*, p. 5.

[43] Crane to Stockton, January 12, 1843.

[44] *Biographical Directory of the American Congress 1774–1961* (Washington, D.C., 1961), p. 17.

[45] "Report on the Explosion of the Gun on board the Steam Frigate 'Princeton' " (hereinafter cited as "Report on the Explosion"), *Journal of the Franklin Institute*, VIII (September, 1844), 208–9.

[46] Ericsson, p. 401.

[47] *House Report 479*, p. 5.

[48] Hogg and Delamater Affidavit, in "Ericsson's Petition," pp. 13–14.

Hunt and gunner Robert S. King, of the "Princeton" crew, testified that Ericsson had examined the gun after proof shots were fired.[49]

The extent of Ericsson's participation in the original decision to order the gun and in its design is unknown. However, he did make the drawings, supervise the boring, and examine the piece after it was proof-tested. He as well as Stockton must have believed that its strength was sufficient.

* * *

While this gun was under construction the "Princeton" was completed, and on October 17, 1843, having taken on her crew the previous day, she proceeded down the Delaware to New York.[50] When returning, she outdistanced the steamer "'Great Western" in a race in which both ships used sails and steam. Against flood tide, the "Princeton" had required one hour and thirty-one minutes to go from Castle Garden to Sandy Hook Point, more than twenty-one miles. Thus she had a speed of more than fourteen miles per hour (about twelve knots), and Stockton boasted that she was "the fastest sea-going steamer in the world."[51]

When the "Princeton" returned to Philadelphia, she was opened for inspection and was visited by the members of the Corporation of Philadelphia and James M. Porter, Secretary of War. Various finishing touches were then made, including installation of an "icebreaker" and the carriage and brass rail for the "Big Gun." On New Year's day she again left for New York and upon her arrival the carronades and the English gun were hoisted aboard and mounted.[52]

By this time the American gun was completed. When the navy agent sought to get funds to pay for it, the secretary directed that Stockton should first prove it.[53] Thus, while at New York, Stockton had the gun loaded aboard the station ship, "Anchor Hoy," which the "Princeton" then took in tow. They headed down the bay, "came too [*sic*] outside the Narrows and fired the *Peace Maker* on board the *Anchor Hoy*." This curiously rash expression of confidence began with 14 pounds of powder and in five firings worked up to 45 pounds of pow-

[49] *House Report 479*, pp. 7, 10.

[50] Log of the "Princeton" (National Archives, R.G. 24).

[51] Stockton to Henshaw, October 21, 1843, in Secretary of the Navy, *Annual Report, 1843*. Particularly since Stockton built the ship and then made the trials, these were not formal "acceptance trials."

[52] Log of the "Princeton," November and December, 1843; January, 1844; esp. November 10, November 22, December 20, December 21, January 1, January 11.

[53] Crane to Warrington, March 11, 1844, items 52–55.

der and a 212-pound shot.[54] Stockton's official report jibed at the Navy Department's meticulous insistence upon the formalities of proof-firing: "P.S. The men who made it deserve their money. It is worth all the guns on board of any frigate."[55]

The next morning was a gala day as the big gun was hoisted aboard the "Princeton." The watch officer recorded that they "christened it *Peace Maker* with six cheers" and then, with fitting liberality, "spliced the Main Brace."[56]

The armament was complete when a committee from the American Institute visited the "Princeton."[57] This group included a shipbuilder, an engineer and chemist, an author of improvements in steel manufacture, and an artist and designer, all of whom had some military or naval background. Other members of the committee, from their names, were scions of old New York or New Jersey families who may have been friends of the prominent Stockton.[58] The committee came on board at 11:00 A.M. and departed at 2:30 P.M. to write a glowing report of the ship and its guns.

This report is interesting both for its factual description and for its superlative praise.[59] The guns were "the most formidable ordnance ever mounted," and the "Peacemaker" was "beyond comparison the most extraordinary forged work ever executed." The background of the members of the committee, as well as the tone of their report, suggests that they were intentionally promoting Stockton and Ericsson. Whatever the validity of such a hypothesis, some of them may have had the technical ability to raise penetrating questions concerning the strength

[54] Log of "Princeton," January 12, 15, 16, 1844.

[55] Stockton to Crane, January 16, 1844, in *House Report 479*, p. 4.

[56] Log of "Princeton," January 17, 1844. For those unacquainted with nautical terminology, "liquor (grog) was served to all hands."

[57] *Ibid.* The American Institute of the City of New York was chartered May 2, 1829, "for the purpose of encouraging and promoting domestic industry in this state and the U.S. in agriculture, manufacture and the arts" (Laws of the State of New York, 51st sess., chap. cccxlviii).

[58] The committee included George De Kay, formerly of the Argentine Navy and a humanitarian and shipbuilder; James Renwick, a professor of natural philosophy and experimental chemistry at Columbia who had investigated the feasibility of a canal connecting the Hudson and Delaware Rivers; James J. Mapes, Secretary of the American Institute and author of improvement in steel manufacture, agriculture, etc.; and Thomas S. Cumming, artist and designer. The above is taken from their sketches in the *Dictionary of American Biography*. The remaining five were George F. Barnard, J. S. Drake, Adoniram Chandler, Gurdon J. Leeds, and Ph. Schuyler.

[59] "Ericsson's Petition," p. 17. Factual data from this report have been included in the description of the ship in the opening pages of this paper.

of the "Peacemaker." Criticisms, however, could hardly be expected from a three-and-one-half-hour visit, most certainly including lunch; this is to be regretted, since at this point Stockton and Ericsson did not so much need advocates as objective critics.

The ship then left New York. Ericsson later recalled that he was to have gone to Washington with Stockton and that he went to the foot of Wall Street to meet the "Princeton," "but the vessel . . . steamed by without stopping."[60] From this episode Ericsson's biographers assert that Stockton refused to take Ericsson to Washington because he wanted to claim complete credit for the fruits of Ericsson's genius. There is some evidence to support this.

If Stockton did not claim to have invented the ship and appurtenances, he permitted others to ascribe complete credit to him. John Quincy Adams described the "Princeton" as "the 'gimcrack of sundry other inventions' of Captain Stockton himself."[61] In a glowing report of the ship, which he sent to the secretary of the navy, Stockton did not refer directly to Ericsson's contribution.[62] On the other hand, Stockton, despite a chauvinistic tone, omitted his own role as well as Ericsson's. Furthermore, the Committee of the American Institute carefully distinguished between Ericsson's inventive genius and Stockton's moral daring in adopting many novelties at once.[63]

As for other motives, John Quincy Adams recorded that Stockton exhibited the ship to the leaders of government in order "to fire their souls with a patriotic ardor for a naval war." The names given to the two twelve-inch guns, "Oregon" to the English gun, "Peacemaker" to the American one, seem to support Adams, particularly in view of the dispute with England over the Oregon territory.[64] This, however, appears to be only a partial explanation. Stockton was a strong advocate of a technologically superior navy and argued that each new ship should be of the largest size and adapted to largest guns while existing ships should be converted to steamers.[65] Thus, in addition to war-

[60] Church, p. 141, citing Samuel W. Taylor, Ericsson's confidential secretary. White, pp. 94–95, paints a dramatic picture of Ericsson stranded as the vessel steamed by without stopping and "ran directly to Washington."

[61] Charles Francis Adams (ed.), *Memoirs of John Quincy Adams* (Philadelphia: Lippincott & Co., 1876), XI, 514.

[62] Stockton to Henshaw, February 5, 1844, in "Ericsson's Petition," p. 24.

[63] "Ericsson's Petition," p. 21.

[64] Adams, p. 514. It should be noted that Adams (p. 516) called the guns "Orator" and "Peacemaker." The first known use of the name "Oregon" was in the log of the "Princeton," April 1, 1844.

[65] *Life of Commodore Stockton,* p. 80.

mongering, Stockton, with his strong interest in technology, was undoubtedly attempting to modernize the navy.[66]

Whatever weight should be allocated to these various motives, the "Princeton" did not go directly to Washington but stopped in Philadelphia for two weeks.[67] Thus Ericsson had ample opportunity to renew his effort to accompany her to Washington. He was heavily involved in other activities, however, principally forty-odd commercial ships which had already been fitted with his propeller.[68] He must have been exceedingly busy, jealous of his time, and, perhaps, unwilling to go to Philadelphia. Thus, contemporary evidence on motives is conflicting. It is certain, though, that Ericsson was not present for the triumph that became a tragedy.

* * *

Upon arriving at Washington, Stockton demonstrated his ship to various government officials, always firing the "Peacemaker." When he took President Tyler on a cruise, he fired the big gun three times.[69] Tyler, much impressed, requested Congress to authorize construction of several ships similar to the "Princeton" but larger and better fitted to carry heavy armament.[70] Stockton, no doubt attempting to override opposition to Tyler's request from the chairman of the House Naval Affairs Committee,[71] held another gay excursion on February 28. President Tyler set the tone by bringing his fiancée, Julia Gardiner. The festive group of 150 ladies and 200 gentlemen included foreign ministers and government officials.[72] Among them were Abel P. Upshur, still secretary of state, and Thomas W. Gilmer, who thirteen days earlier had succeeded Henshaw as secretary of the navy. As part of the merrymaking, and to emphasize the soundness of the new warship, Stockton fired the Peacemaker—twice.

[66] Stockton's plans for naval modernization were not spelled out in detail. Since the "Princeton" was much smaller than the "Raritan," in which he had, in 1840, proposed to instal Ericsson's steam machinery, his most modest goal must have been to equip a steamer of between 1,500 and 2,000 tons with the new armament and machinery.

[67] Log of "Princeton," January 26–February 10, 1844.

[68] Ericsson, pp. 406–10. This contained a table which identified each ship and gave a few characteristics.

[69] Log of "Princeton," February 18, 1844.

[70] Tyler letter, February 23, 1844 (28th Cong., 1st sess. H.R. Doc. 155), p. 2.

[71] Adams, p. 520.

[72] Log of "Princeton," February 29, 1844. Dates in the log were twelve hours in advance of the calendar.

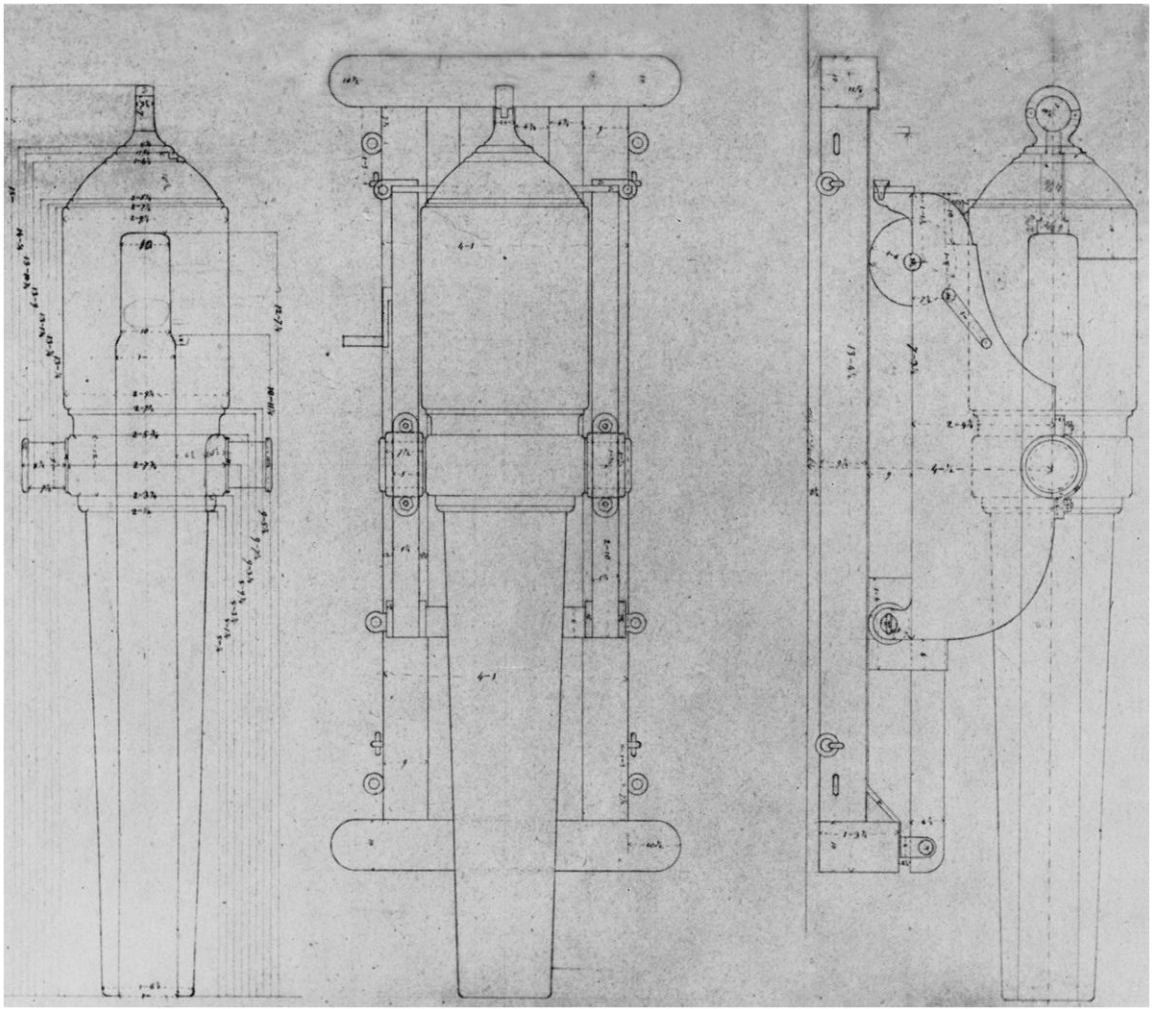

FIG. 1.—Drawing of "Peacemaker" from Lenthall Collection, Franklin Institute. Although the drawing is unsigned, unlabeled, and undated, there is little doubt that it was the "Peacemaker" rather than one of the other large guns. (By permission of the Franklin Institute.)

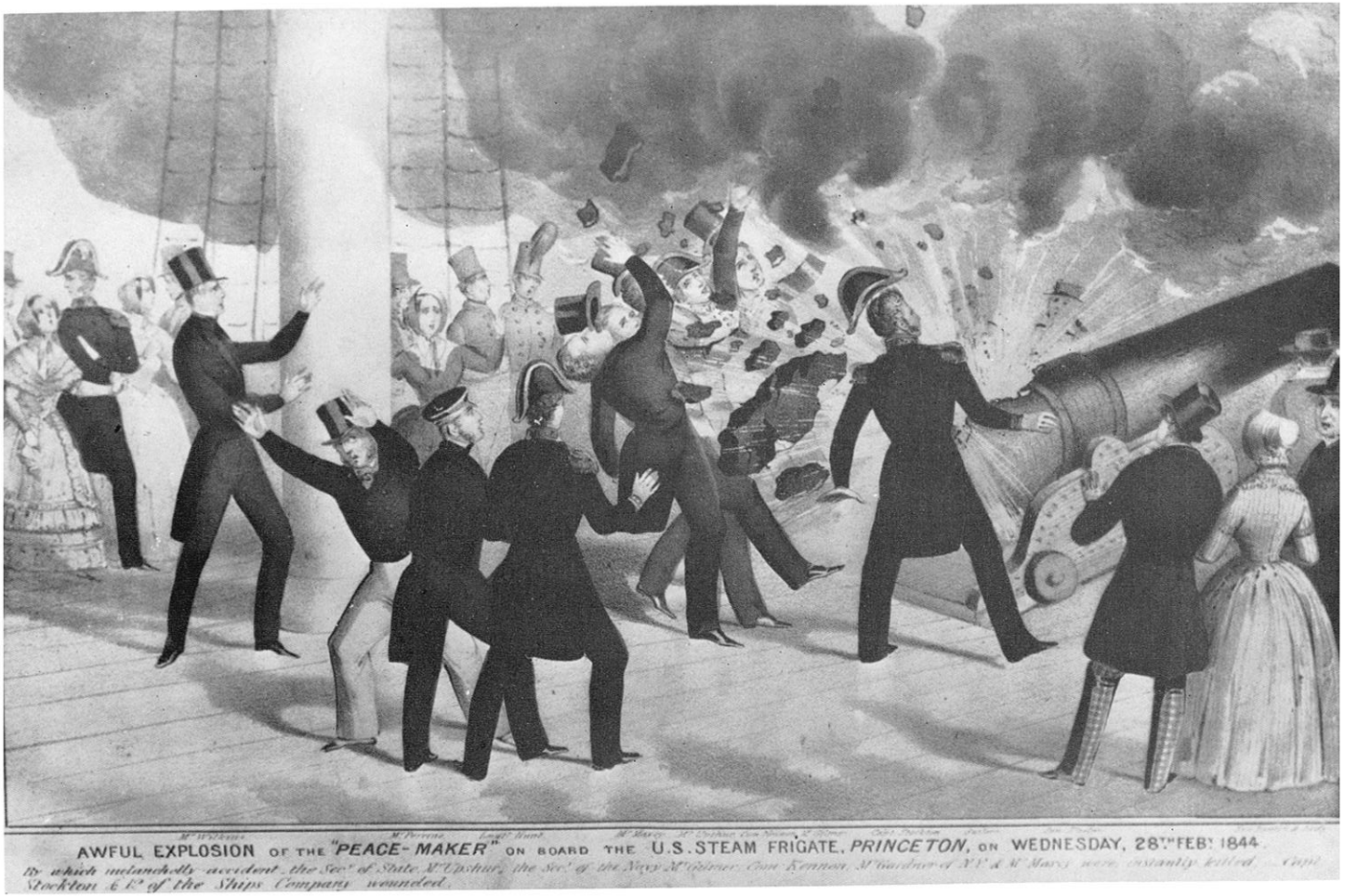

FIG. 2.—Explosion on board the U.S. steam frigate "Princeton," February 28, 1844. (Official U.S. Navy photograph from a lithograph by N. Currier in the collection of President Franklin D. Roosevelt.)

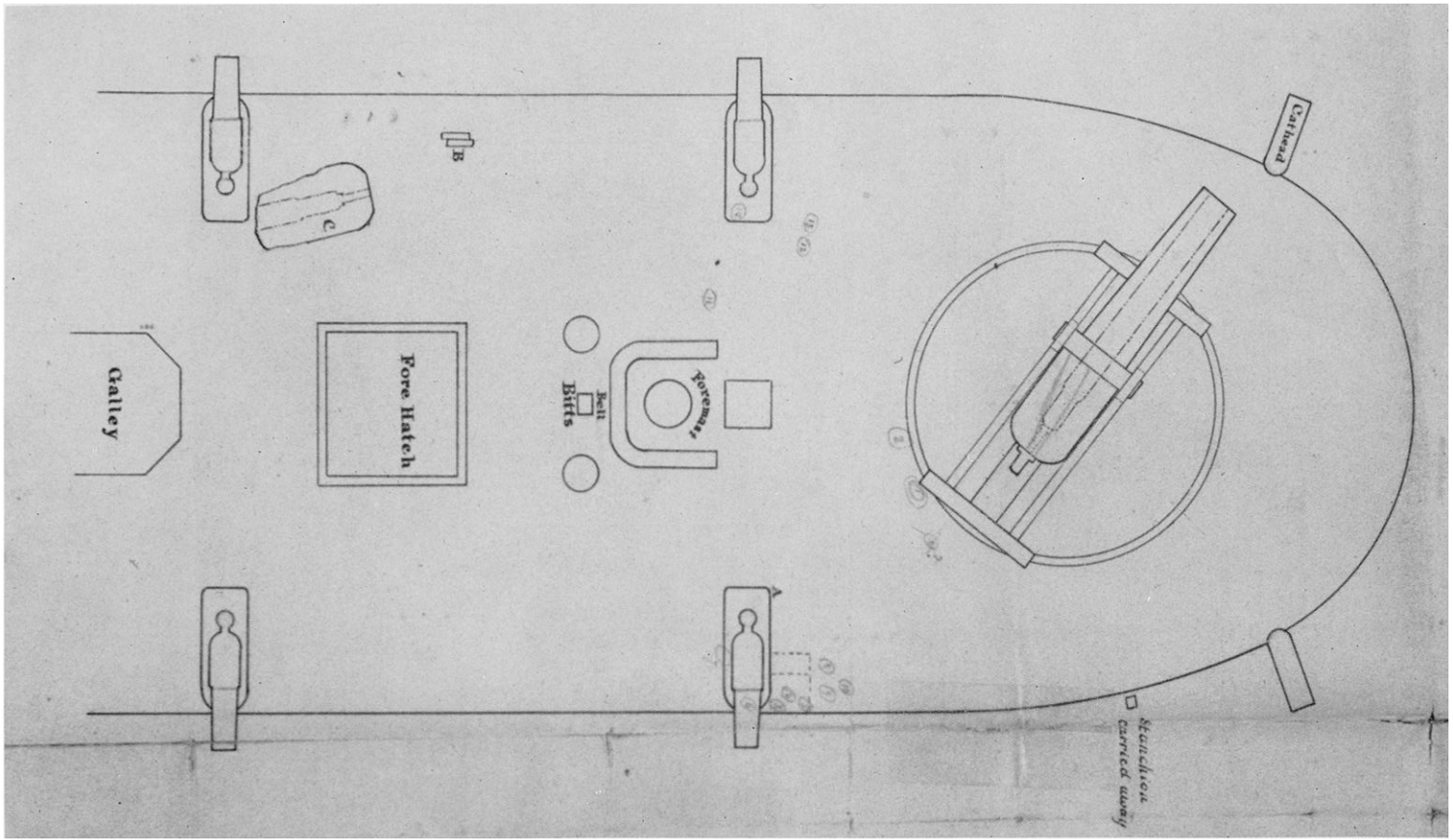

FIG. 3.—Foredeck of "Princeton." The small circles, barely discernible in the above illustration, show the location of various people at the time of the explosion. Sketch made by the Committee on Science and the Arts, Franklin Institute. (By permission of the Franklin Institute.)

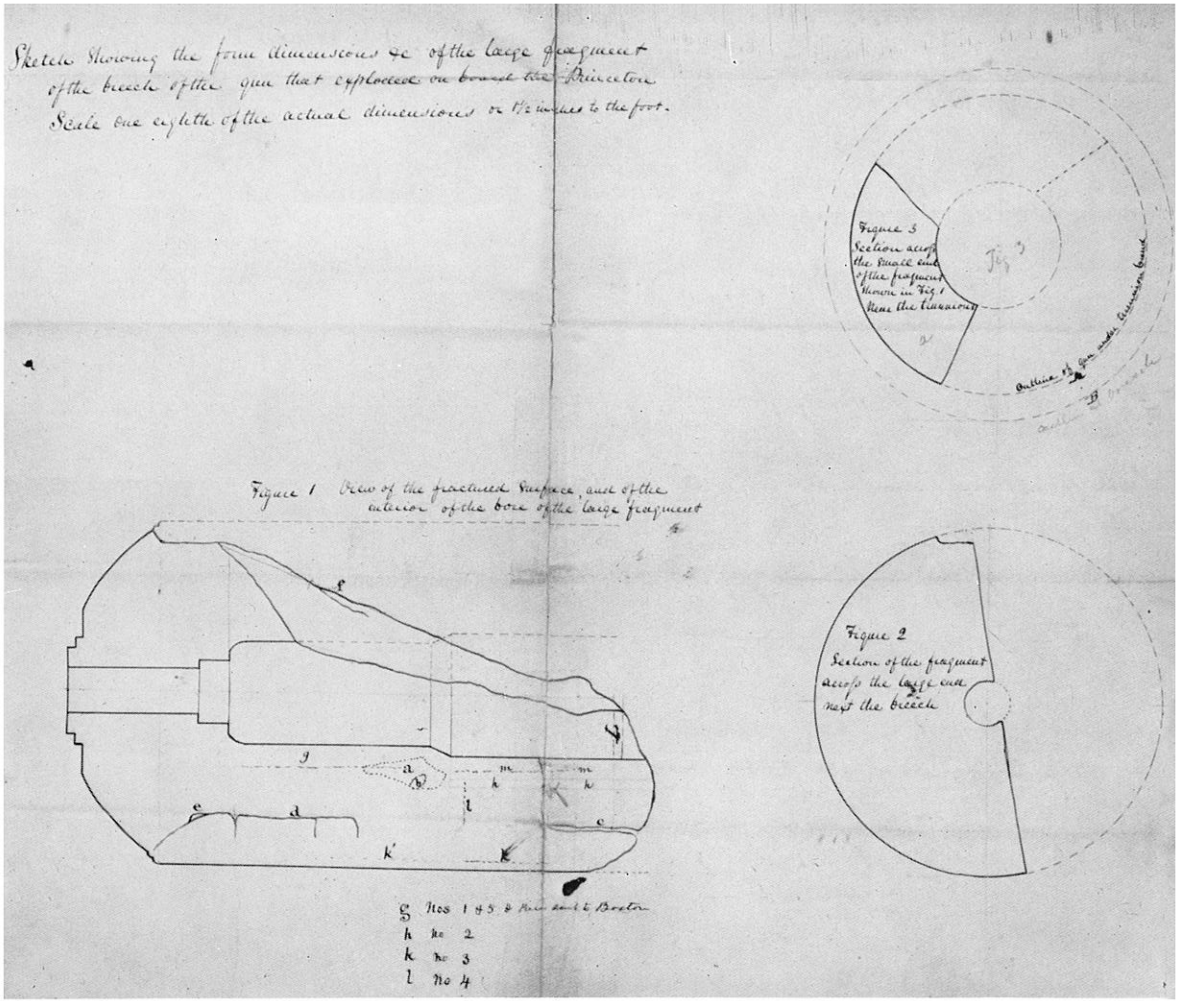

FIG. 4.—Large fragment of "Peacemaker." Sketch made by the Committee on Science and the Arts, Franklin Institute. (By permission of the Franklin Institute.)

The third time, it burst.[73] Fragments struck and killed Gilmer; Upshur; Beverly Kennon, Chief of the Bureau of Construction, Equipment and Repair; Virgil Maxcy of Maryland; Colonel David Gardiner, father of the President's fiancée; and a servant of the President. A celebrated Currier and Ives lithograph later depicted the scene (Fig. 2), and the Franklin Institute also prepared a sketch of the ship's foredeck showing the location of various individuals at the time of the explosion (Fig. 3).

As an eyewitness, Mrs. P. Y. Pember, later recalled, the report was moderate: "A strange stillness followed in the vicinity of the explosion, but on the quarter deck the company could be heard laughing amid the buzz of many voices. Suddenly overmastering all sounds Lieut. Johnson's trumpet rang out sharply: 'Lower a boat, a woman overboard—send all aft, stretch a rope across the deck.' Some minutes after Capt. Stockton was led below by two sailors . . . his full black wig . . . blown away, and his head bound up in cloths saturated with blood."[74]

Lieutenant R. E. Thompson reported in the ship's log that the gun broke off at the trunnion band and the breech and split in two.[75] One piece of the breech passed overboard while the second fell "in the Larboard gangway." His matter-of-fact entry identified the dead and wounded, reported the departures of the guests, the later departure of the President, and the removal of injured seamen. He concluded his report of the tragic day with an ironic: "From 8:30 to midnight light breezes from the N'd and W'd and clear pleasant weather."

The next morning President Tyler sent a report of the tragedy to Congress giving his opinion that it was "one of those tragedies which, . . . are invariably incident to the temporal affairs of mankind." Seeking to save Stockton's reputation and his recommended naval construction program, Tyler added that it in no means detracted "from the value of the improvements contemplated in the construction of the "Princeton," or from the merits of her brave and distinguished commander and projector."[76] Despite the President's urging, the House Naval Affairs Committee promptly disapproved constructing more ships similar to the "Princeton," wryly noting that "the success thus far of our war steam-

[73] The sworn claim that the third firing was at the order of Secretary Gilmer appears irrelevant.

[74] Mrs. P. Y. Pember, "The USS Princeton," *Independent,* LVII (1904), 560, quoted by Hornsby, *American Neptune* (July, 1946), p. 218.

[75] The Franklin Institute later reported that the breech split in three pieces, two of which went overboard.

[76] Tyler letter, February 28, 1844 (28th Cong., 1st sess. H.R. Doc. 158).

ers has not been so perfectly complete as to call for immediate action."[77]

With the naval construction lost, Stockton's career may also have been in jeopardy. He requested President Tyler to institute a judicial inquiry; on the same day that the Naval Affairs Committee made its negative report, Lewis Warrington, as ad interim secretary of the navy, directed that a court of inquiry be convened.[78] The precept stated that the question was the conduct of Captain Stockton "and officers in relation to the experiments and proofs which preceded the construction, and the proof and subsequent explosion." Warrington indicated the nature of the findings that were to be made by adding that the President entertained "the most perfect confidence that no censure can, with any show of justice, be imputed to either of the parties."

Stockton later notified the court that he was unable to attend because of wounds, and his attorney, John R. Thompson, would represent him.[79] Thompson had already invited Ericsson to present evidence. Ericsson declined in a letter that foreshadowed future difficulties with Stockton and bore marks of bitterness because Stockton had not shared favorable publicity with him. "How differently should I have regarded an invitation from Captain Stockton a week ago! I might then have had it in my power to render good service and valuable counsel. Now I can be of no use."[80]

The delicacy of the situation was not overlooked by the younger and more liberal naval officers. Lieutenant J. H. Ward, who at this time was preparing a book of instructions on naval ordnance, in a private letter commented upon the membership of the court and the inadequacy of its procedures and concluded, "You are likely to get no light from this investigation."[81]

As Ward predicted, the court found that every precaution skill could devise had been taken.[82] President Tyler then insured Stockton's future by ordering another gun of "the size and dimensions" of that recently destroyed to be wrought under the direction of Captain Stockton.[83] Although the House Naval Affairs Committee questioned the wisdom

[77] *House Report 259* (28th Cong., 1st sess., March 6, 1844).

[78] *House Report 479*, p. 14.

[79] Stockton letter, March 8, 1844, *House Report 479*, p. 15.

[80] Ericsson to Thompson, March 1, 1844 in Church, p. 141.

[81] Ward to Goldsborough, March 11, 1844.

[82] Report of Court Inquiry, in *House Report 479*, p. 14.

[83] Tyler to Warrington, March 14, 1844; Warrington to Crane, March 15, 1844; Crane to Stockton, March 16, 1844; all in *House Report 479*, p. 43.

and propriety of this, the new gun was constructed by the Mersey Works. After delivery, it was loaded with forty-five pounds of powder, a double shot, and fired, but only once. It was never mounted for service.[84] When this gun was being ordered, Stockton requested instructions on its proof from Crane. Crane said that he was unacquainted with its design and refused to give such instructions.[85]

* * *

At the instigation of Stockton, the Committee on Science and Arts of the Franklin Institute investigated the explosion. This committee limited its inquiry to material and workmanship.[86] By avoiding legal complications and staying clear of motivation, it did not exacerbate any arguments. At the same time, it gathered facts regarding the gun's fabrication and competently analyzed the large fragment (Fig. 4).

The forging had been made by laying up a fagot from thirty iron bars, each of which was four inches square and about eight and one-half feet long. These were welded together and rounded into a shaft of twenty to twenty-one inches in diameter, using a seven-and-one-half-ton hammer.[87] As Talcott had predicted, the welding had indeed been inadequate, for the form of the original bars could still be detected in the fragment, while scales of iron oxide nearly penetrated the body.

Other deficiencies were more serious than poor welding in the forging proper. As Ogden had testified, bands were welded on the American gun, whereas those on the English gun had been shrunk on.[88] In terms of modern metallurgical practice, this use of welded bands was a gross error in design. Shrunk-on bands would have served as crack arrestors, whereas welded bands permitted any cracks to enlarge.[89]

Other weaknesses resulted from the method of fabrication. Iron segments, usually large enough to reach one-third of the way around, were welded on the forging in two strata, and the breech was thus built

[84] Holley, pp. 86, 88.

[85] Crane to Stockton, May, 9, 1844 (National Archives, R. G. 74).

[86] "Report on the Explosion," pp. 206 ff. The draft copy of the report in the files of the Franklin Institute, Committee on Science and the Arts, was signed by Joseph Henry, John C. Cresson, John H. Towne, G. W. Roberts, John Agnew, John F. Frazer, R. M. Patterson, and P. V. Merrick. W. Wade, of Boston, carried out some of the physical tests of the gun fragments. The inclusion of Merrick and Towne, the engine-builders, is indicative of the small circle surrounding the entire sequence.

[87] L. B. Ward to Hamilton, April 16, 1844 (Franklin Institute, Committee on Science and the Arts).

[88] *House Report 479*, p. 5. Also Ericsson, p. 403.

[89] Information from Mr. Thomas J. Dawson, metallurgist with Bureau of Ships.

up to about thirty-six inches in diameter. Making the forging from iron bars and welding on the strengthening band required forty-five "turns," or a day's work, during which the gun was held at welding temperatures.[90]

The reader will keep in mind that wrought iron is permeated with minute slag particles, is by nature fibrous, and if properly worked has fine grains. If wrought iron is heated to near the melting point for a long time, its grains increase in size, and impurities tend to collect in the grain boundaries, which thus become serious planes of weakness. This can be overcome by working the heated metal with a heavy hammer.[91]

Ward and Company readily admitted that their hammer was not heavy enough to work such a mass as they had forged and added, "No hammer at present known could affect it much."[92] The committee found that the iron had lost nearly half its strength; that is, drawing fragments of the metal down with a hammer increased their strength from thirty-four thousand to sixty thousand pounds per square inch. Moreover, the crystalline structure at the fracture varied from fine grains to coarse crystals, one of which was three-quarters of an inch long and one-half inch wide.[93]

Even before the Franklin Institute had completed its analysis, the ordnance officers in Washington were conjecturing that prolonged heating had weakened the iron. Talcott, in a report on wrought-iron guns that he prepared following the tragedy, included a generalized statement to this effect.[94] Ward, in his private correspondence, was more definite but stopped short of certainty.[95] The Franklin Institute was positive and recommended that no more guns of this design should be obtained.[96] In all fairness, however, it must be pointed out that even twenty years later there was some disagreement as to whether prolonged heating and inadequate working did in fact weaken wrought iron.[97]

[90] "Report on the Explosion," pp. 206 ff.

[91] Information from Mr. Thomas J. Dawson.

[92] "Report on the Explosion," pp. 206 ff. [93] *Ibid.*

[94] Talcott to William Wilkins (Secretary of War), April 5, 1844, in *House Report 479*, p. 18.

[95] Ward to Goldsborough, March 11, 1844.

[96] "Report on the Explosion," pp. 215–16.

[97] Holley, p. 350, citing Longridge's "Construction of Artillery" (Institute of Civil Engineering, 1860) and Kirkaldy's "Experiments on Wrought Iron and Steel (1862). Ogden testified that nothing in his knowledge showed that the nature of

In the face of uncertainty, the approach should have been cautious. On this basis, Stockton, Ericsson, Ogden, and any members of the Committee of the American Institute who were conversant with the metallurgy of wrought iron were rash in ignoring Talcott's comments upon welding and in not becoming concerned about the effect of prolonged heating.

Ericsson and Stockton had come to a parting of the ways. Ericsson had already received $1,150 from Stockton for his part in designing the "Princeton" and her equipment. Stockton refused to honor his request for an additional $15,000, maintaining that Ericsson's services had not been needed and that he had been permitted to assist as a particular act of kindness in order that some of his ideas could be tested. Ericsson took the issue to the Court of Claims and obtained a favorable verdict, but Congress failed to pass the necessary appropriation; hence Ericsson received no more money.[98] During the Civil War he once more attempted, without success, to fabricate wrought-iron guns, which he strengthened with a number of thin washers, accurately positioned with a hydraulic press.[99]

For some time Stockton continued his interest in ordnance. Not only did he arrange for Franklin Institute to examine the "Peacemaker," but he obtained permission from the President to construct several small brass guns for use in studying the pressure of gunpowder and related problems.[100] With misguided enthusiasm, he apparently considered the "Peacemaker's" weakness to be ballistic rather than metallurgic in nature. He spent several months at Sandy Hook on these experiments, but by early 1845 had abandoned them and gone to Galveston as the President's emissary. He later achieved further military and political triumphs.

Crane, although peripheral to the entire affair, was a principal loser. As we have seen, he had no control over the design or use of the gun. When the investigations of the tragedy were under way, one of his subordinates, Ward, irreverently remarked that Crane was so anxious to keep clear from responsibility that he would not even have a frag-

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wrought iron changed when welded together in masses (*House Report 479*, p. 5). L. B. Ward, of Ward & Co., expressed a contradictory view (Ward to Hamilton, May 2, 1844 [Franklin Institute, Committee on Science and the Arts]).

98 National Archives, Court of Claims docket 115.

99 Holley, p. 98; Report of Board to Investigate Bursting of Parrott Rifles, June 4, 1865, in Secretary of the Navy, *Annual Report, 1865*, p. 186.

100 Stockton to Crane, April 30, 1844, and Crane to Stockton, May 9, 1844 (both in National Archives, R.G. 74).

ment of the gun in his office.[101] In this Crane succeeded, as the House Naval Affairs Committee reported that the guns were not ordered with the advice of the Bureau of Ordnance, "as would seem the proper course—that being the branch of the service instituted by law for the regulation of naval armament." Despite that, Crane committed suicide in 1846, and his family believed that this resulted from brooding over the episode.[102]

* * *

Until this time, the bursting of guns aboard ship appears to have been accepted as a normal risk. Stockton, while a midshipman, had encountered such an attitude among his superior officers.[103] The explosion of the "Peacemaker" would have served to emphasize the magnitude of the risk involved and to increase efforts to minimize it. Thus Rodman and Parrott, ordnance innovators of the Civil War era, both testified that they had become interested in gun design as a result of the explosion.[104] The American army and navy continued experiments for some time with wrought-iron and wrought-steel guns,[105] an assertion to the contrary by Ericsson notwithstanding.[106] The technique of banding or hooping guns may have gained in popularity because of Ericsson's successful application of strengthening bands to the "Oregon." Finally, at a time when new metallurgical techniques and processes were being devised, the Franklin Institute's analysis provided a point of departure for applying this knowledge to ordnance while the explosion provided dramatic reiteration of the need for increased reliability.

A number of conclusions, some of them pertinent to contemporary naval research and development procedures, emerge from the study of the "Peacemaker" episode:

1. Most obvious, the proof-testing of the "Peacemaker" was inadequate to determine the gun's life and strength, even though the evidence given at the Court of Inquiry indicated that its proving, despite irregularities, was in keeping with existing navy practice.

[101] Ward to Goldsborough, March 11, 1844.

[102] *Dictionary of American Biography.*

[103] C. O. Paullin, *Commodore John Rodgers, A Biography* (Cleveland, Ohio, 1910), p. 252.

[104] Church, p. 130, citing *Report of the Joint Committee on the Conduct of the War* (38th Cong., 2d sess.), II, 99, 136.

[105] E.g., Wadsworth to Crane, December 23, 1844 (National Archives, R.G. 74), described tests of the Treadwell Gun,

[106] Ericsson, p. 403,

2. Only slightly less apparent, the tragedy might have been avoided if Stockton had been able to examine objectively the product of his labors and had exercised normal prudence in exposing his guests.

3. Stockton's consultants and associates were equally enthusiastic and uncritical in their support of his endeavors. Thus a wide consensus was built up in favor of the endeavor, enabling him to ignore such sound criticism as was made, notably that of Talcott.

4. Stockton's ability to proceed with his demonstrations, despite doubts of the ordnance officers, stemmed from his political support. His efforts to strengthen this support transformed an accident into a national tragedy.

5. At the same time, this tragedy militated against the acceptance of sound technical innovation. There is no way of knowing whether the explosion retarded the acceptance of propeller-driven ships, but it upset Stockton's and Tyler's plans to modernize the navy.

6. The above five points all revolve around an aspect of governmental administration which is now recognized as crucial. Critical scientific and technological issues often have to be decided by political authority. In the event of conflicts in professional opinion or of uncertainty as to who is qualified to render sound professional advice, decisions may be made without adequate consideration of technological factors. The background to the tragedy aboard the "Princeton" points up the fact that this problem, although perhaps only recently recognized, has been of long duration. It suggests the need for continuing study of the institutions and procedures whereby political authorities have decided issues involving scientific and technological judgments.

7. The historian of technology should find it of great significance that readily available files have provided information concerning an often-told episode which alters greatly the role of the principals, Ericsson and Stockton, from that usually assigned to them. Since any sound understanding of the history of technology and its advances must begin with an accurate understanding of what took place, there appears to be need for additional research in most areas in which accounts of developments are usually taken for granted. Not only is there a continuing need to collect primary records pertaining to various developments, but perhaps even more important is the need for investigating central collection of records where such information may already be found.