

RODMAN'S BIG GUN

By Andrew E. Masich

Above: Rodman stands beside the wooden models used to make sand molds for his 20-inch gun and smaller cannons cast at the Fort Pitt Foundry.

Marcus McLeMORE.

Right: Ordnance officer Major Thomas Jackson Rodman.

All images HRC unless noted.



The devastating explosion aboard the USS *Princeton* prompted Rodman to find a solution for casting large-caliber cannons that could withstand the immense pressure of being fired. Library of Congress, LC-USZC2-3201.



The largest cannon of the Civil War was a monstrous 20-inch caliber ship killer designed by Thomas Jackson Rodman—one of America’s most innovative and productive ordnance experts. More than a decade after the war ended, the big gun was still a major attraction for the millions who attended the Centennial International Exposition in Philadelphia. Cast at Pittsburgh’s Fort Pitt Foundry in 1864, Rodman’s Columbiad was a marvel of military engineering that epitomized the prodigious power of Union industry and influenced the cannons that followed.

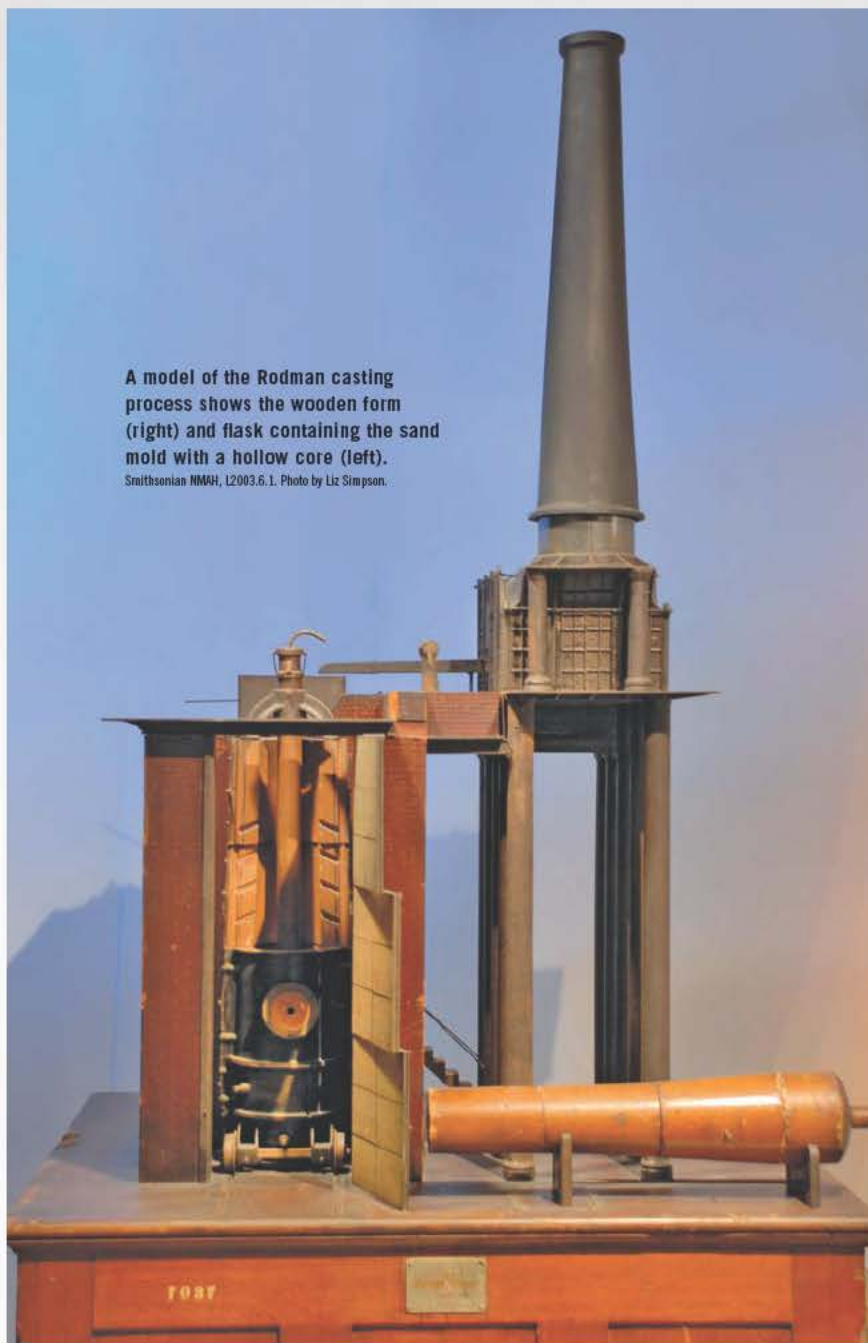
The genesis of Rodman’s big gun and the generation of armament it inspired began well before the Civil War. Appropriately, its story begins with a bang—a tragic explosion that shook the confidence of the Ordnance Department and the nation. On the calm waters of the Potomac River, February 28, 1844, Commodore Robert Stockton hosted a who’s who of Washington society to show off his pet project, the USS *Princeton*, the navy’s most modern warship. Among the dignitaries on board were President John Tyler, Secretary of State Abel Upshur, Navy Secretary Thomas Gilmer, and Senator Thomas Hart Benton.

Even Dolley Madison, the much-admired former first lady, attended with her entourage.

The ship had been designed by John Ericsson, a brilliant naval engineer who also designed an innovative 12-inch wrought iron gun for the deck; he added hoops to its breech (back end) for added strength. However, during the three years the boat was being built, relations between Commodore Stockton and engineer Ericsson became strained. Stockton took over much of the project, even creating a second gun for the ship, dubbed the “Peacemaker”; unfortunately, not understanding the design

of the original, Stockton merely thickened the breech, forgoing Ericsson’s hoops.¹

More than 400 guests swarmed the decks enjoying a sumptuous feast and a seemingly endless supply of champagne. The highlight of the pleasure cruise, however, featured the firing of the fleet’s most powerful cannon. The gun was fired twice during the day, sending each shot on a two-mile arc and then glancing across the surface of the water. When it was ready a third time, the crowd broke from dinner and toasts below deck. As the ship passed by George Washington’s Mount Vernon, the gun captain again pulled the



A model of the Rodman casting process shows the wooden form (right) and flask containing the sand mold with a hollow core (left).
 Smithsonian NMNH, L2003.6.1. Photo by Liz Simpson.

lanyard. There was the usual loud blast—in fact, somewhat less than before—but there was much more smoke, and when it cleared, the crowd was flattened from the concussion. Six people were dead and 20 more were wounded, some mortally. Stockton and other dazed and deafened survivors bled from their ears and noses. Uninjured officers and crewmen ran to the breech of the “Peacemaker” to find the gun blown to pieces, along with the closest of the

dignitaries. The beheaded and limbless bodies of Secretary Upshur, Secretary Gilmer, and others were mixed with bloody fragments of the burst gun. Even the father of the president’s fiancée was horribly mangled. Only by chance had President Tyler been out of harm’s way, buttonholed by a constituent and enjoying the music below decks; many had stuck near him too, though his valet, a slave named Armistead, was on deck and died soon after.²

As stunned Americans mourned their loss in the worst peacetime accident ever to befall the nation’s leaders, young Lieutenant Thomas J. Rodman, only three years out of West Point, determined to get to the root of the tragedy and make sure it could never happen again. Before the black crepe was removed from the public buildings across the country, Rodman turned his considerable talents to finding a solution to the problem of catastrophic failure in large caliber guns.

Recognizing that wrought iron and bronze cannon could not be manufactured to withstand the high pressures and consequent stresses demanded of warship cannons and Columbiads (America’s largest class of guns, introduced by Colonel George Bomford in 1811 for seacoast defense), Rodman turned his attention to cast iron. Though iron had been used to manufacture cannons for hundreds of years, the large caliber guns made of this material had a reputation for blowing up and killing their crews. Rodman, however, thought the fault lay not with the iron itself but the casting process. As a newly cast cannon cooled in its mold, it hardened from the outside, one layer at a time, until the molten core finally set up. The cooled gun was then laboriously bored to the desired caliber and finished on the outside. Raised rings known as “reinforces,” where the gun telescoped down from the thickest part of the breech to the narrowest part at the muzzle, were believed to strengthen the gun.

Rodman theorized that air cooling made the guns harder and denser on the outside and left them relatively soft and weak in the center where the greatest strength was really needed. During his tests he found that he could drive a cold chisel its entire length into the cast iron core as easily as if it were wood. He also discovered that the molecules of air-cooled iron aligned themselves under tension rather than compression. Guns cooled in this way were doomed to fail. Rodman determined to reverse the process by cooling the casting from

Rodman thought the fault lay not with the iron itself but the casting process.

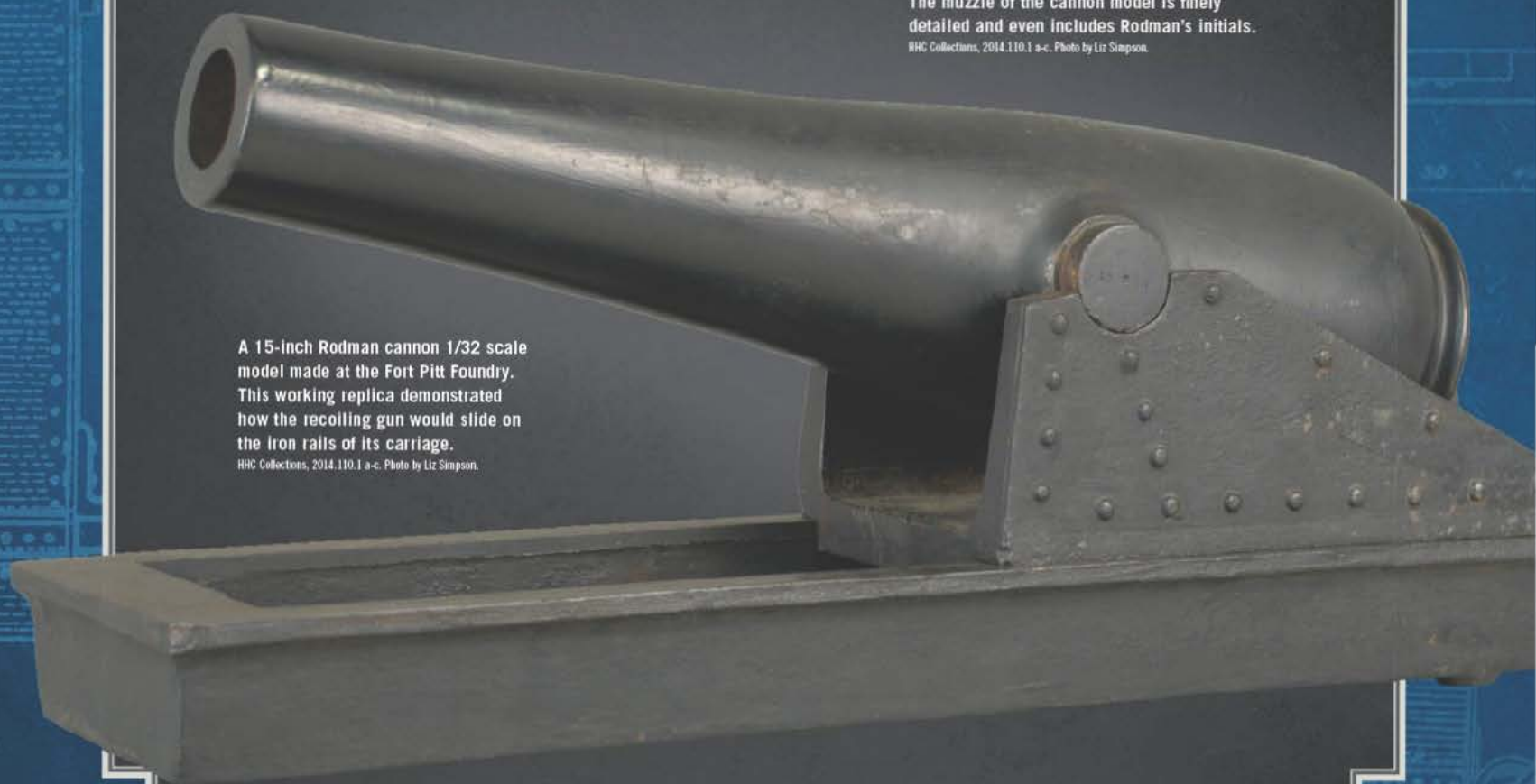


The muzzle of the cannon model is finely detailed and even includes Rodman's initials.

HHC Collections, 2014.110.1 a-c. Photo by Liz Simpson.

A 15-inch Rodman cannon 1/32 scale model made at the Fort Pitt Foundry. This working replica demonstrated how the recoiling gun would slide on the iron rails of its carriage.

HHC Collections, 2014.110.1 a-c. Photo by Liz Simpson.

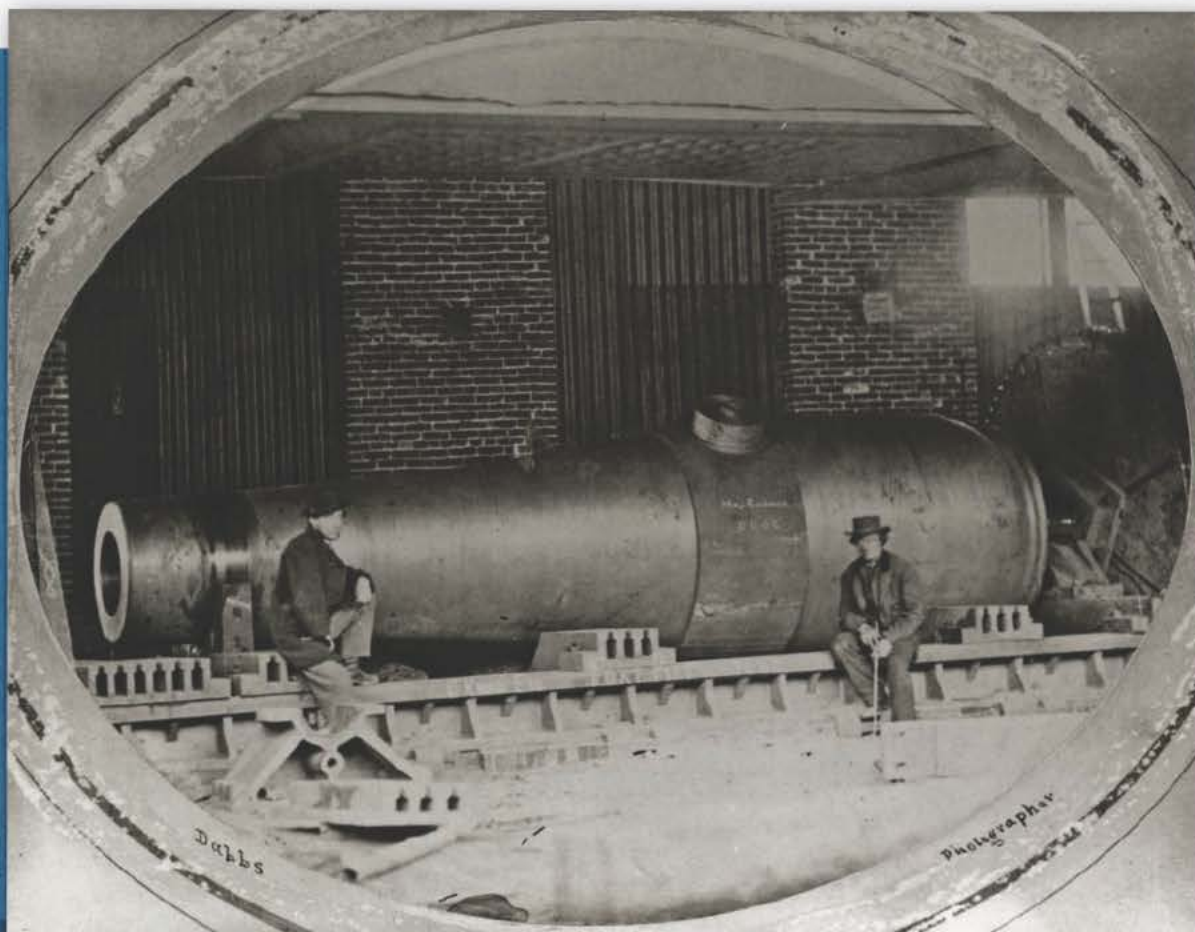
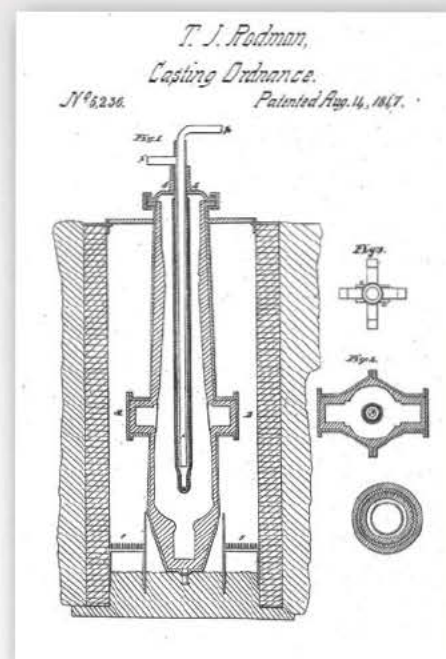


the inside out. To achieve this, he would have to cast the guns hollow by pouring the molten metal into the mold around an iron core. The hollow core was actually an iron pipe through which air and cold water could be pumped in order to cool the casting from the inside out.

Excited by the possibilities of this new system, Lieutenant Rodman shared his idea with others at Pittsburgh's Allegheny Arsenal, where he was then stationed, and on up the chain of command to Chief of Ordnance Colonel Bomford and his superior General George Talcott. The higher-ups brushed off the young officer's carefully drawn plans and told him that the army was not interested but that he was free to pursue his novel ideas on his own—if he had the inclination and funds to pursue a patent. On a lieutenant's

pay of \$53 a month, Rodman had little extra to spend on ordnance development and legal fees, but he did possess an abundance of ambition and energy.³

On August 14, 1847, Rodman was awarded Patent No. 5,236. Pittsburgh had already gained a reputation as the "Iron City" and by 1849 he worked out a partnership with receptive iron founders Charles Knapp and William Totten. Rodman assigned his patent to the Fort Pitt Foundry owners, and in exchange they funded the research and development and agreed to pay him 1/2 cent per pound for every finished cannon cast using his system. The Fort Pitt Foundry, located just two miles from the Allegheny Arsenal, soon cast a prototype 8-inch Columbiad on Rodman's principle. Additional experiments followed with 10-inch



Top:
Patent drawing showing the
core barrel used to cool the
casting from the inside out.
U.S. Patent and Trademarks Office.

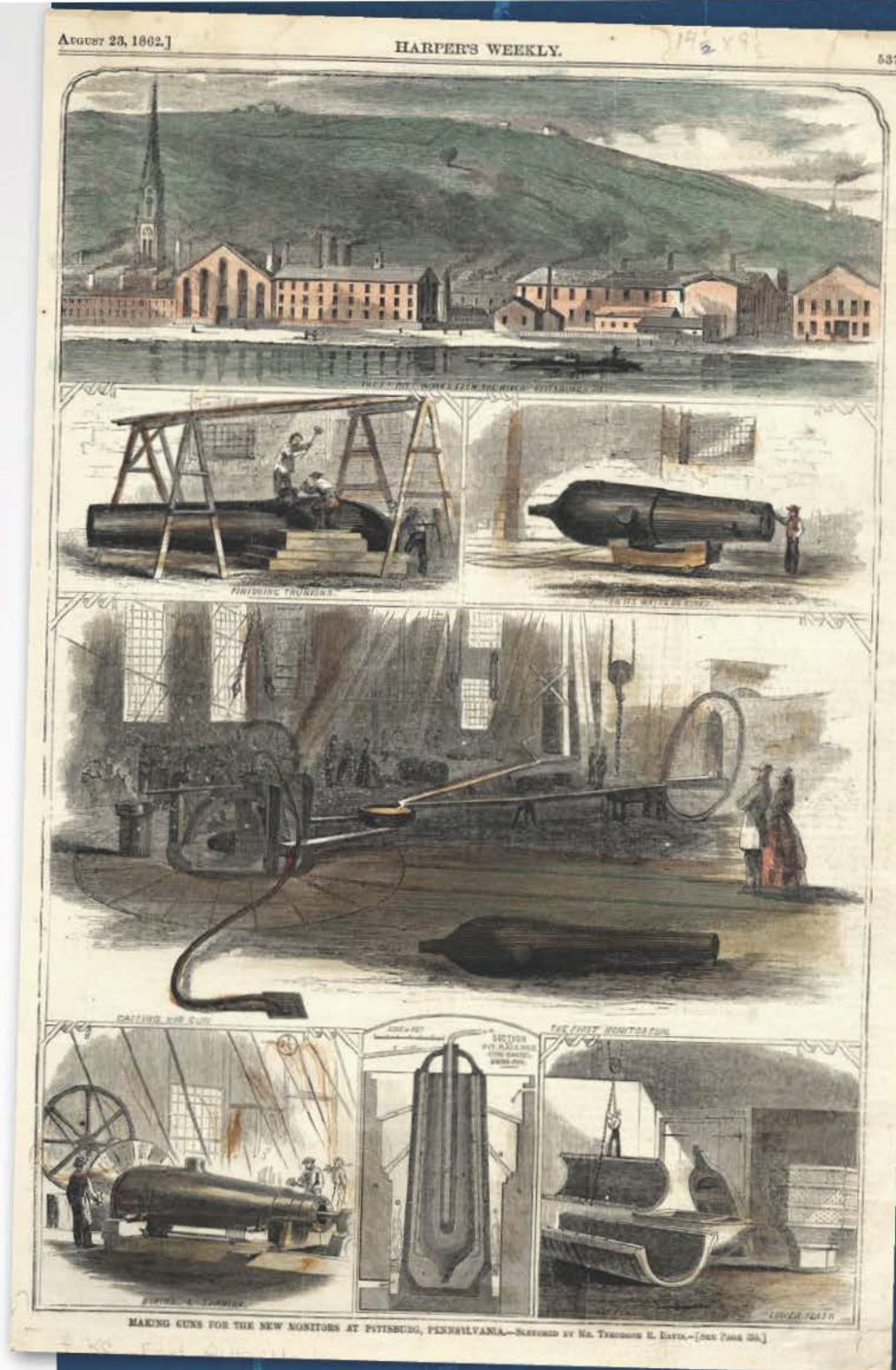
Left:
The big gun sits on a lathe
at Fort Pitt Foundry; on the
right is Superintendent
Joseph Kaye.
Carnegie Library.

Harper's Weekly featured the skilled ironworkers of the Fort Pitt Foundry (right) in 1862. The Rodman gun is being bored and turned at lower left.

Columbiads. Rodman modified his design to eliminate any reinforces or other abrupt changes in the gun's exterior contours. He had discovered that cracks and failure usually occurred at these places, and his cannons now took on the smooth "soda bottle" shape that became their most distinguishing characteristic.⁴

Double-charged and double-shotted proof testing, followed by repeated firing with service loads, demonstrated the efficacy of Rodman's system. A solid core gun cast from the same batch of iron burst after only 74 test rounds while the "water core" gun showed no discernable wear to the bore, chamber, or vent after 1,300 rounds. The new process was an unqualified success, and by 1860 the Ordnance Department fully appreciated the value of Captain Rodman's innovation (he'd been promoted in 1855) and ordered 8- and 10-inch Columbiads as well as an experimental 15-inch gun. This latter piece had a 16-foot-long barrel that weighed in at nearly 50,000 pounds—the largest gun cast in America up to that time. It was proudly named the "Union Gun" and sent to Fort Monroe, Virginia, for further testing in March 1860.⁵

As the Southern states seceded from the Union in 1861, the War Department scrambled to order Rodman guns in 8-inch, 10-inch, and 15-inch calibers. On April 15, just days after Confederate guns surrounding Charleston harbor blasted Fort Sumter into submission, Rodman notified his superiors that he could cast an even bigger gun—one weighing over 100,000 pounds and capable of



By 1860 the Ordnance Department fully appreciated the value of Captain Rodman's innovation.



hurling a 20-inch, half-ton iron ball up to five miles and destroying a ship with a single shot. As much as Abraham Lincoln may have wanted a Rodman super gun to deter European powers from steaming into New York harbor (as was indeed contemplated by France, Russia, and Britain), the necessity of manufacturing Rodman's smaller caliber guns to fortify cities—including Washington—and seacoast defenses took precedence over his massive gun proposal, which remained unrealized on Rodman's drawing board.

By late 1863, Rodman's hollow casting technique was standard for Model 1860 Columbiads of his design and for other cannons as well, including Admiral John A. Dahlgren's big 9-inch, 11-inch, and 13-inch

naval shell guns.⁵ Though Fort Pitt Foundry was still producing the majority of the big guns, the West Point Foundry in New York, Cyrus Alger Works in Boston, and Seyfert, McManus & Co. in Reading, Pa., also manufactured siege guns, mortars, naval guns, and Columbiads using Rodman's process. The conservative Ordnance Department now wholeheartedly endorsed the idea of hollow casting and, with the fulfillment of cannon orders by the various foundries, the chief of ordnance saw fit to give Rodman the go-ahead on the 20-inch gun.⁶

Charles Knapp and his new partner H.F. Rudd oversaw the activities of 280 workers at the Fort Pitt Foundry as they excavated more than 40 feet of earth for a casting pit that was so deep it had to be shored up and lined

to prevent the Allegheny River water table from rushing in and filling it up. The pit was engineered to accommodate a multi-piece iron flask containing a sand mold that had been formed on an oversized wooden model (it measured six feet at its widest point by 25 feet long). Five furnaces burned at full blast for five hours to melt the 105 tons of Juniata pig iron (from central Pennsylvania, and considered the best) that would be needed for the continuous pour. Two of the smaller furnaces stood by as backups while the three primary furnaces were connected by troughs that would pool their molten streams in a clay-lined collector before the molten metal funneled into the mold.⁷

On a cold February 11, 1864, Rodman, ordnance officers from the army and navy,



As the Southern states seceded from the Union, the War Department scrambled to order Rodman guns in 8-inch, 10-inch, and 15-inch calibers.

A 15-inch Columbiad at Fort Monroe, Virginia. A seven-man crew could load and fire it in one minute and ten seconds, however, it took two minutes and 20 seconds to traverse the gun.
LoC 8817-7419.

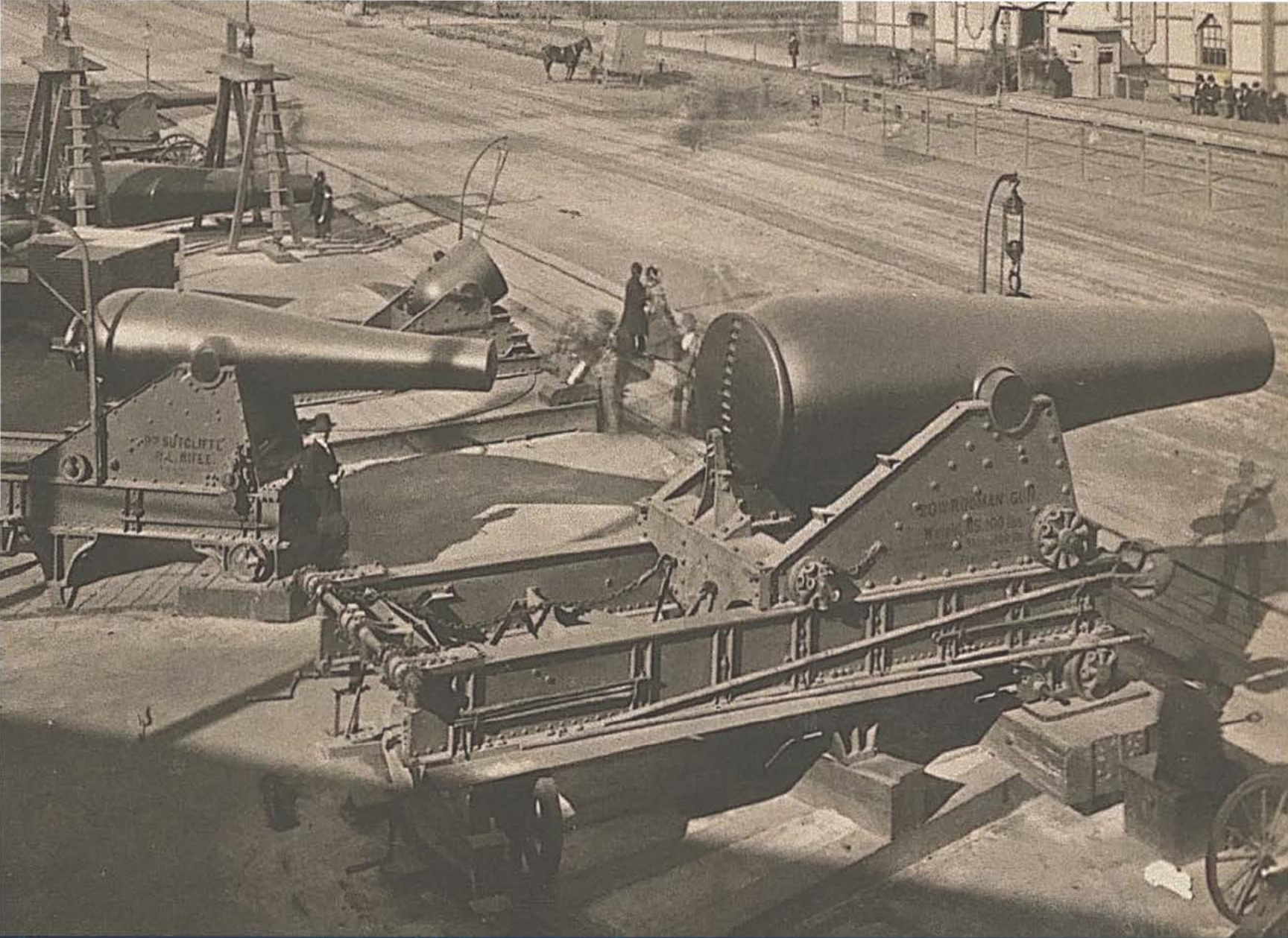
and observers from as far away as Great Britain and Italy huddled in their greatcoats and looked on expectantly as the red-hot metal began to flow. The foundry men pumped water at the rate of 60 gallons a minute down through the core, then captured the heated water as it returned to the top through flutes scored into the fire clay coating that surrounded the core barrel. After two days the water was shut off and cold air was forced through the core. Four days after the initial pour, the casting was determined to be entirely cooled. Steam cranes hoisted the casting from the pit and, with the help of men and several dozen oxen, moved the rough cannon to the boring machine. Here the bore was enlarged from 17 to 20 inches.

A mammoth lathe then turned and smoothed the 80-ton casting to the pleasing shape of a finished gun, more than 20 feet long and weighing 116,497 pounds—the largest iron cannon barrel ever cast, anywhere.⁸

The big gun was drawn from the mold nearly 20 years to the day after the explosion of the *Princeton*'s "Peacemaker"—the infamous accident that originally set Rodman on his course. The British, Germans, Russians, and Italians all expressed wonder at the feat. Rebel reaction to the news of the successful casting of the 20-inch gun was not recorded, but in Richmond Chief of Ordnance Josiah Gorgas, who had worked with Rodman on ordnance projects before the war, must have admired the effort as he struggled to produce his own

crude, and often unsafe, Columbiads for the under-resourced Confederacy.

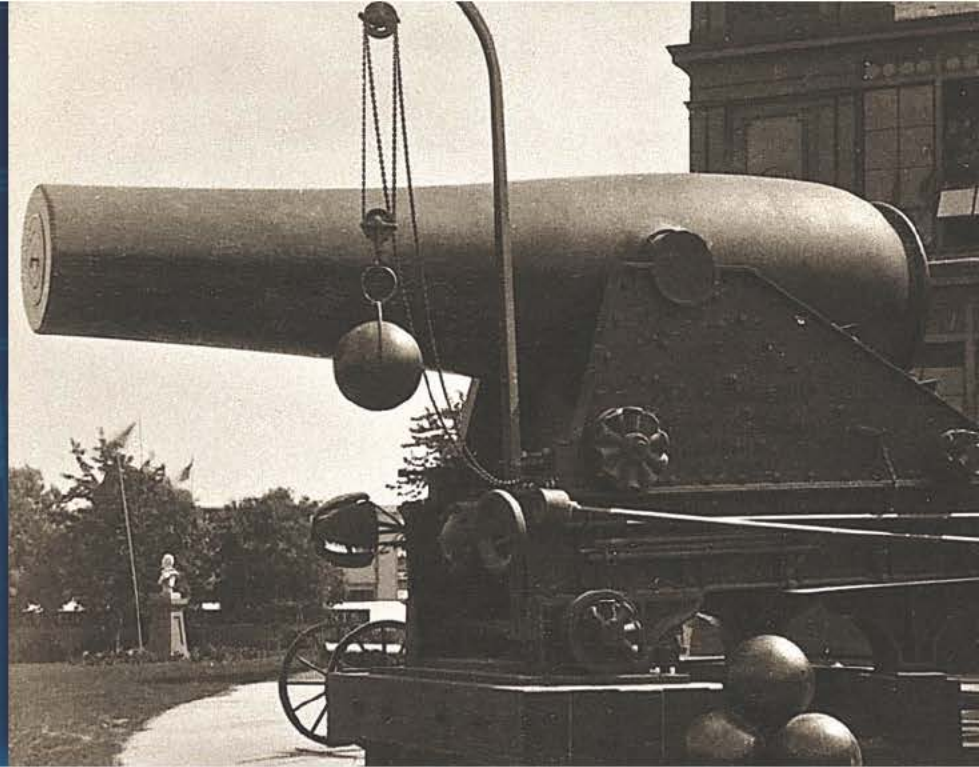
The 20-inch Rodman gun required special handling to get it to Brooklyn's Fort Hamilton at the Narrows that separated New York's upper and lower bay. Twenty-four big horses and a small army of foundry workers hauled, levered, and wheeled the massive barrel to a railroad spur where two specially fitted flatcars with double trucks (iron wheels) waited. While the special cars would help distribute the gun's tremendous weight, Pennsylvania Railroad officials carefully inspected rails and ballast between Pittsburgh and New York and shored up or otherwise strengthened the trestles and bridges along the route to ensure that they could accommodate



The ball hurtled through the air for
a full 24 seconds, sounding like a
freight train in flight.

Left:
The 20-inch Rodman gun was a featured attraction at the 1876 Centennial International Exposition in Philadelphia, Pa.

Right:
The loading crane holds a 1,080-pound solid shot for the cannon. A 12-pounder mountain howitzer, the smallest cannon in U.S. service, was displayed next to the big Rodman for comparison.



the unusual load. Even with these precautions the journey took nearly a month as railroad officials limited the speed to a crawl in order to avoid excessive friction on the rails.⁹

At Watertown Arsenal, Rodman designed and fabricated an 18-ton, front pintle, iron barbette carriage that was set in place at Fort Hamilton's lower battery alongside the 15-inch Rodmans overlooking the mouth of the Hudson River. The upper portion of the riveted iron carriage that cradled the gun was designed to slide on rails pitched at a 15-degree angle, but the immense weight of the barrel was expected to absorb most of the recoil. So confident was Rodman that even the enormous powder charges contemplated would not budge the barrel from its balance point, that the oversized pivoting trunnions (the supports on each side of the cannon) were not even capped. The big gun would be fired only six times during the war, with charges of mammoth gunpowder (each grain measured nearly an inch across) varying from 50 to 150 pounds. Regular cannon powder was too fine grained and would burn too rapidly creating dangerously high pressures, even for Rodman's guns, so the captain designed the slower-burning large grains. To make the powder

burn more thoroughly and predictably, he formed cylindrical and hexagonal cakes of compressed powder, which he pierced through with wires. This perforated cake powder would burn uniformly and progressively to ensure that internal pressures would remain within the safe range while imparting maximum propellant force to the projectile.¹⁰

Secretary of War Edwin Stanton joined Rodman and a crowd of onlookers for the test firing, and hopes ran high as the specially trained, nine-man crew loaded the gun with a 100-pound blank charge. But the first shot was a disappointing misfire because the standard friction primer was not strong enough to send a flame down the 24-inch length of the vent hole drilled through the cannon's thick iron breech known to ordnance men as the "preponderance." Once the charge was pulled and the vent cleared by a volunteer, who crawled 20 feet down the bore and confirmed that the primer flash was inadequate, the gun was reloaded, the vent filled with fine-grained powder, and the lanyard yanked again. This time, even with the reduced charges, the gun's roar was deafening. Brooklyn residents claimed that the shock wave broke windows. The 1,080-pound solid shot left the muzzle

at over 1,700 feet per second—nearly twice the velocity of a Minié ball fired from a rifle musket. The barrel remained in the iron cheeks, but the entire upper carriage recoiled almost seven feet, sliding back along the iron rails just as planned. The crew then levered the gun back into position and fired a round at an elevation of 25 degrees. The ball hurtled through the air for a full 24 seconds, sounding like a freight train in flight, and splashed into the water three and a half miles away after skipping like a stone and sending enormous plumes of spray skyward with each bound.¹¹

It seems, however, that once Rodman had demonstrated that the gigantic gun was a practical reality, the country lost interest. The very fact of its menacing existence seemed to be enough to satisfy the president and the Ordnance Department. Further testing was not carried out until 1867. When loaded with 200 pounds of Rodman's improved cake powder, the half-ton ball flew nearly five miles. One well-aimed shot obliterated a target ship anchored in the channel. Ordnance officers and awestruck spectators could only wonder at the destructive capacity of the Rodman gun, causing Rodman to design new devices to more accurately measure projectile



The Rodman at the Centennial Exposition sat across from the Women's Pavilion.
Library Company of Philadelphia.

velocities (an unprecedented 1,735 feet per second) as well as the internal and external forces exerted by his weapons. Though the 20-inch gun was never deployed against an enemy and the government only authorized the casting of two of the giant guns, their deterrent effect was great. The Rodman guns became a symbol of the North's industrial might and its determination to go to any extreme to defend the Union.¹²

More than a decade after the Civil War, the 20-inch Rodman gun was still considered a super weapon and an unequalled example of American power. In 1876, the nation celebrated its centennial with a year-long exposition in Philadelphia. One of every type of Rodman gun, from mortars to Columbiads, was exhibited—including one of the 20-inch guns, which had been placed in the battery at Fort Monroe to guard strategic Norfolk and Hampton Roads, Virginia. The problem was getting the monster gun to Philadelphia. The 100-ton ship nearly capsized when the steam crane operator failed to center the big gun on the deck. By the time the ship reached Philadelphia, alarmed exposition officials and reporters noted that the load sank the vessel to within a foot of its gunnels.

Rodman's big gun was the hit of the Centennial Exposition. Millions gaped at the

huge weapon that the army whimsically chose to exhibit next to a Model 1841 12-pounder mountain howitzer—the smallest cannon in the U.S. service. Alongside the big gun were the 20-foot-long rammers and the hook-shaped winch the crew needed to hoist the ball and load the gun—a procedure that could be accomplished in under two minutes. Also on display were a variety of 20-inch rounds: explosive shells (each capable of holding a 25-pound bursting charge), solid shot (weighing 1,080 pounds each), and “cored shot” (with a small hollow cavity to reduce weight and thereby extend the gun's range). No one who saw the exhibit doubted that the muzzle-loading cannon had reached its zenith and that only American ingenuity and industry were capable of such an achievement.¹³

Though the ever-conservative Ordnance Board attempted to upgrade the big smoothbores by reducing the bore diameter with inserted rifled sleeves, inventing elongated projectiles, and designing more easily traversed gun carriages, by the 1880s most experts realized that built-up guns fabricated from steel (which became readily available thanks to advances in metallurgy and new blast furnace technology in the post-war years) were the future of heavy artillery.

They never fired a shot in anger and did little to change the outcome of the Civil War. Still, the 20-inch Rodman guns were spared the scrap drives of subsequent wars and can be seen even today, guarding New York at Fort Hamilton and across the Narrows at Sandy Hook, New Jersey. They remain symbols of American military might and the largest iron cannons ever cast in the history of warfare.

Andrew Masich, PhD, is president and CEO of the Heinz History Center, and chairman of the Pennsylvania Historical and Museum Commission.

¹ For detail of the tragedy, see St. George L. Sioussat, ed., “The Accident on Board the U.S.S. *Princeton*, February 28, 1844: A Contemporary Newsletter,” *Pennsylvania History* 4, no. 3, (July 1937), available at <http://journals.psu.edu/phj/article/view/21070/20839>. The Swedish-born Ericsson was recruited by Stockton to come to America after his innovative screw propulsion designs were rejected by the British Admiralty; he would later design the ironclad USS *Monitor*.

² President Tyler married Julia Gardiner, daughter of New York Senator David Gardiner whose arms and legs were blown off in the blast; she fainted into President Tyler's arms when she learned of her father's fate. The 57-year-old president had previously asked the 23-year-old woman to marry him, but her parents demurred. The traumatized couple was married a few months after the tragedy.

³ Charles Knap testimony, Feb. 4, 1864, “Heavy Ordnance,” *Thirty-eighth United States Congress, second session, Report of the Joint Committee on the Conduct of the War*, Benjamin Franklin Wade, Daniel Wheelwright Gooch (Washington: GPO, 1865), 85-90.

⁴ Brig. Gen. George Ramsay Testimony, Jan. 27, 1864, "Heavy Ordnance," 8-11; T.J. Rodman testimony, Feb. 6, 1864, *ibid.*, 99-100.

⁵ Henry A. Wise testimony, Jan. 28, 1865, "Heavy Ordnance," 27. Cast in 1860, the 15-inch gun was originally named the "Floyd Gun" after War Department Secretary John Floyd, who soon after announced his secessionist loyalties and was commissioned a Confederate general. "War Excitement in Pennsylvania," *New York Times*, June 23, 1861.

⁶ Admiral Dahlgren became a bitter rival of Rodman, contending that the strength of his shell guns was due primarily to their exterior form rather than the hollow core cooling process. Dahlgren testified to the Joint Committee on the Conduct of the War that Rodman actually borrowed the admiral's own design for smooth exterior lines that resulted in stronger castings. Fort Pitt Foundry cast three "water core" XX (20-inch) Dahlgren shell guns—one in 1864 and two more in 1866. See B.F. Wade's report and testimony of Charles Knap, Feb. 4, 1864 in "Heavy Ordnance," 2, 87, 119; Gideon Welles to J.A. Dahlgren, letter, July 9, 1863, *ibid.*, 129; *New York Times*, July 23, 1865.

⁷ George T. Fleming, *History of Pittsburgh and Environs* (New York: American Historical Society, 1922), 99, 113-15.

⁸ *Harper's Weekly*, August 23, 1862; *Scientific American*, May 18, 1861, and March 19, 1864.

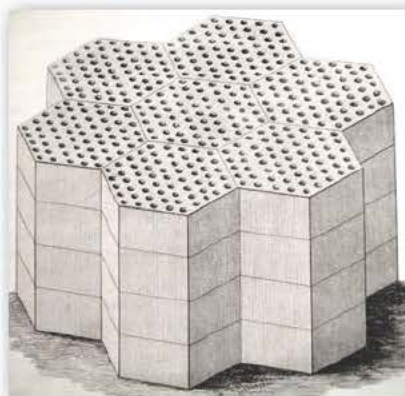
⁹ As officials wrestled with the problems of transporting the "big gun," Pittsburgh residents amused themselves by "crawling into the bore on their hands and knees." A reporter speculated that, "A good sized family, including pa and ma, could find shelter in the gun—and it would be a capital place to hide in case of a bombardment." *Pittsburgh Gazette*, July 23, 1864. The special train's progress was limited to only 30 miles a day. *Pittsburgh Post*, Sept. 3, 1864.

¹⁰ S.V. Benet testimony, Jan. 28, 1865, "Heavy Ordnance," 44; T.J. Rodman testimony, *ibid.*, 108.

¹¹ *Pittsburgh Evening Chronicle*, Oct. 28, 1864; *Harper's Weekly*, Nov. 19, 1864.

¹² Though authorized during the Civil War, a second 20-inch Rodman Columbiad was not completed by the Fort Pitt Foundry until 1869. Two 20-inch Dahlgren-style shell guns were also cast using the Rodman "water core" system but these were sold as surplus to Peru after the war.

¹³ S.V. Benet testimony, Jan. 27, 1883, Report of the Select Committee on Heavy Ordnance, 86-87, 95.



Rodman's perforated cake powder.

THOMAS JACKSON RODMAN

Thomas Jackson Rodman was born in 1816 on a farm near Salem, Indiana, the son of James Rodman and his wife, Elizabeth Burton. In 1837, Rodman entered the United States Military Academy in West Point, graduating seventh of 52 cadets, and in 1841 was appointed a brevet second lieutenant in the U.S. Army Ordnance Department. At Allegheny Arsenal in Pittsburgh, he built the first bullet machine capable of making Minié balls and other bullets by compression rather than casting molten lead. A great innovator, he held patents for hollow casting large cannons as well for improvements in cartridges for breech-loading small arms. His revolutionary idea of progressive-burning perforated cake gun powder for heavy seacoast and naval artillery is still in use today.

He spent most of the war commanding the Watertown Arsenal in Massachusetts, and his inspector's initials may be seen stamped on the muzzles of U.S. ordnance ranging in size from the diminutive 12-pounder mountain howitzer to the largest Rodman Columbiads. By the end of the Civil War, he was still an "unconfirmed major" according to his own testimony before Senator Ben Wade's Joint Congressional Committee on the Conduct of the War, which investigated charges of war profiteering and disloyalty. This suspicion likely resulted from jealousy within the army over royalties (1/2 cent per pound) he supposedly received for the large guns cast for the government using the Rodman hollow casting method. Some of his political enemies and competitors questioned his loyalty when he failed to fire salutes at the end of the war, but his mother having been born in Virginia also may have raised concerns. Though energetic and admired by his superiors for all of his work in the Ordnance Department, Rodman spent much of his postwar time defending his conduct. He ended his career as commander of the Rock Island Arsenal in Illinois, where he died in 1871 at the age of 54.