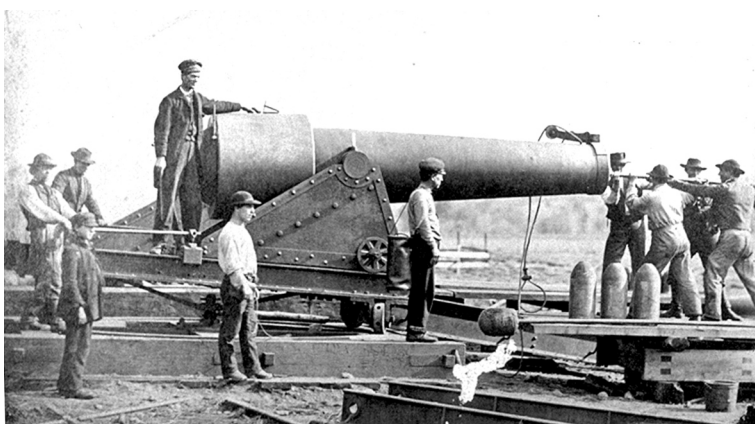




GIS, Geophysics & Photogrammetry in the Discovery and Winter Documentation of R.P. Parrott's Buried Civil War Cannon Proofing Facilities, West Point Foundry, Cold Spring, New York

Joel W. Grossman, Ph.D.

Between 1989 and 1995, Dr. Grossman and his team were selected by the U.S. Environmental Protection Agency and Army Corps of Engineers to plan and direct the first federally-mandated archaeological investigation of a contaminated Superfund site. The clean-up area coincided with the Civil War-era cannon factory of the West Point Foundry, situated on the Hudson River opposite the West Point Academy. Dangerous cancer causing Cadmium deposits from a post-WWII battery factory built over the historic foundry needed to be removed, both on land and from the marshes bordering the river. Clean-up could not begin until the ill-defined historic site had been documented. The superfund effort posed critical health and safety constraints and the need to expedite the fieldwork under often adverse all-weather conditions. It also represented a logistical and scientific test-case over the ability of archaeology, as a discipline, to meet federal preservation laws in contaminated and potentially dangerous contexts.



Fieldwork was completed in deep-winter under heavy custom-built steel-reinforced blast-resistant shelters covered with inflated, forced-air-insulated, plastic skins. Heavy pumps worked around the clock to lower the water table to down to the level of the buried Civil War surface, five feet below. All field and laboratory team members were

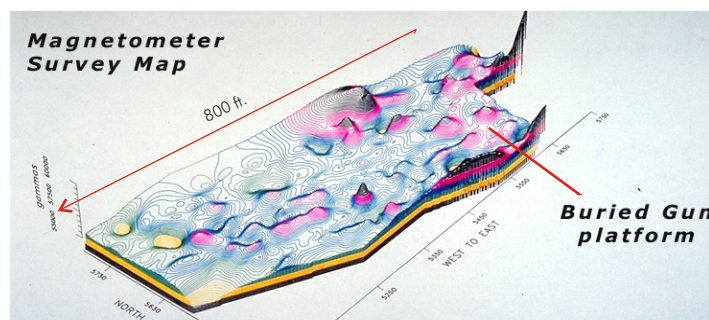
HAZMAT-certified and medically monitored. An on-site laboratory operated concurrently with the excavation and provided decontamination and conservation for the 150,000 excavated artifacts within hours of being recovered.

A range of applied technology solutions were deployed to facilitate the safe and timely investigation and documentation of the site. Traditional "hands-on" manual recording was replaced with remote, or non-contact, high speed 3D recording systems to limit exposure to potentially toxic deposits and artifacts. A new system of single-camera photogrammetry was deployed for the first time in archaeology. The wide angle lens of the camera facilitated high-precision 3D recording of excavated structures within the height limitations of the winter shelters.

In addition, the prospect of exposure to heavy metals, and/ or historic and modern ordinance, underscored the limits of traditional site testing and definition techniques. Instead of the commonly employed archaeological approach of picking excavation areas blindly with "statistically valid" *random sampling*, liability and health concerns mandated a strategic shift to safer, non-random, target-specific geospatial and geophysical technologies. These approaches both reduced uncertainty over where sampling would occur, and served to focus project resources on only undisturbed, high integrity, study areas.

The five year archaeological rescue effort resulted in major discoveries in Civil War military history. The buried Civil War cannon testing facilities were first detected using false-color air-photo image analysis of the vegetation and trees covering the project area. Subtle variations in the reflectivity of different plant types were computer-enhanced and digitally magnified into distinct color patterns which served to fill gaps in the sparse surviving map coverage. Despite Civil War-era photographs which depicted concentrated foundry structures bordering the Hudson, historic map evidence showed only blank areas, and rail lines leading nowhere. A patchwork of irregular, "multi-colored", vegetation indicated subsurface traces of past human disturbance over the otherwise unmapped areas. The false-color remote sensing evidence triggered the intensive terrestrial geophysical survey of a football-field-sized shoreline area targeted for cleanup and land reclamation.

Magnetometer measurements along five foot grid transects identified invisible subsurface magnetic fluctuations from buried historic structures. On-site computerized mapping systems provided real-time underground magnetic maps. Geospatial software was used to scale, overlay and then



subtract modern surveys and maps of 20th century features (cement walls, and surface outcrops of bricks, refuse and metal) from the 3D color plot of magnetic anomalies detected by the magnetometer. Machine-assisted backhoe "ground-truth" cuts across each of the outstanding magnetic anomalies pinpointed the location of R.P. Parrott's 1863 heavy cannon testing facilities under 3 -5 feet of cadmium-laced industrial fill.

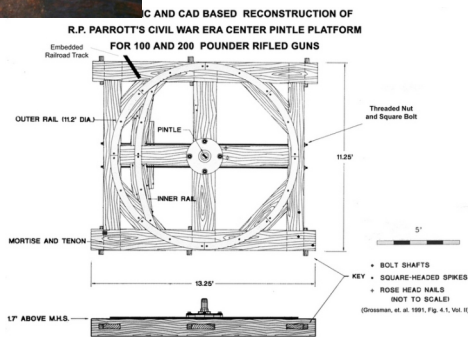


The geophysical survey led the archaeologists to discover and document the preserved wooden and iron gun testing platform of Parrott's 30,000 lb. rifled

cannon, and beside it, the cannon hoist-tower for lifting the new class of heavy rifled ordnance. Two "100 pounder" cast iron rifled shells - one a standard exploding piece, the other an example of Parrott's little-discussed binary incendiary shell which was deployed to burn Charleston in 1863 -- were probed for explosives with Army EOD personnel and then, once declared safe, conserved for exhibition. The cannon platform was recorded with 3D photogrammetry, its metal elements conserved, and then reconstructed for exhibition at the secure Harriman State Park museum complex of the Orange County Historical Society.

The marine portion of the investigation utilized scaled comparisons of historic bathymetric surveys to reconstruct the Civil War era topography of the river channel. Side-scan sonar and marine magnetometer instruments crisscrossed the river in front of the Foundry to identify, avoid and protect any submerged historic ships, barges, and/or historic ordnance dumps prior to dredging. Vertical "Vibra-core" sediment columns were collected, and sampled at 6 inch intervals, to define the depth of the historic river bottom. Spikes in trace-elements of lead and copper, byproducts of initial production of brass canon in the 1830's, showed that the former pre-Civil War channel bottom to be buried under three feet of more recent river sediments.

The team also discovered the undisturbed living floors of a buried prehistoric village site which was found



preserved under the fill of the historic "Haul Road" leading into the foundry. The excavation of a group of the foundry workers' housing covering the prehistoric levels along the historic road yielded thousands of exotic museum-quality Civil War artifacts. The origins and high status nature of the mid-19th century collection indicated that the worker population was more complex, sophisticated and ethnically diverse than had been suggested by secondary historical accounts.

The recovery of elaborate children's toys, officer's medallions, laboratory instruments, a microscope, calipers, an early battery, a condenser (possibly associated with the Civil War-era experimentation with electronic velocity gages) and a variety of imported German and Austrian coins and domestic artifacts suggested the presence of an educated and technically skilled group of workers. These archaeological clues, or material inconsistencies with traditional historical characterizations, precipitated intensive archival investigations at the National Archives which led to the discovery of previously unnoticed military and executive branch documents.



Together, these multiple lines of new archaeological and archival evidence suggested that key elements of Parrott's rifled cannon were actually "re-engineered" from confidential European prototypes, secretly acquired by Lincoln's Executive Branch agents.. These discoveries also..." revealed the existence of a carefully orchestrated and highly effective capability in international military espionage and industrial intelligence on the part of Lincoln's executive branch and the U.S. Army and U.S. Navy ordnance bureaus which had not been addressed in past treatments of Northern Civil War history"(Grossman 1994b, 215).

Finally, as part of the first federally-mandated archaeological investigation of a contaminated Superfund site under HAZMAT procedures, the successful multi-year all-weather data recovery program was completed on time and on budget. It also demonstrated the ability of modern archaeology to adapt a range of applied technology solutions to facilitate the safe and rapid investigation of a logistically challenging site to the highest US Department of Interior standards and guidelines.

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Industrial Archeology

Summer 1994, vol. 7(2)

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■ High-Caliber Discovery

by Joel W. Grossman

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I was here to direct archeological fieldwork in advance of a multi-million-dollar Superfund cleanup sponsored by the Environmental Protection Agency. Under an agreement with EPA, the Army Corps of Engineers was overseeing the project; Malcolm Pirnie, Inc.--who hired my firm--was coordinating the work.

From the 1950s through the 1970s, the Marathon Battery Plant produced nickel cadmium batteries here for the Nike missile program. At a cove just inland from the mouth of a brook, a cleanup facility was to be built to process cadmium-laced sediments. Given the urgency, the issue was could the archeology be done practically, expeditiously, and without undue cost.

EPA believed it could, hammering out the particulars of an agreement to fund and steer the project. It would be the first major attempt to protect the archeological legacy of a Superfund site. The investigation, if successful, would prove the feasibility of meeting preservation mandates on similar sites elsewhere.

The crumbling walls of West Point Foundry, at the foot of a canyon fronting the cove, attested to why the property was on the National Register of Historic Places. Military weapons were developed here from the early 1800s through the Civil War. Of five production centers set up to counter defense deficiencies observed in the War of 1812, the foundry was the only one under "civilian" control (more on this later).

Where I stood--on Civil War-era furnace fill thought to be the brook's flood plain--project engineers expected that little of archeological significance had survived decades of industrial construction and demolition. Besides, military maps from the site's earlier life depicted the area as blank and unoccupied. The vegetation suggested otherwise.

Computer enhancement of aerial photos provided the first clue that something was here. Most of the hill and shore appeared as one color, suggesting a homogenous plant cover, perhaps centuries old. Yet our area was multicolored, suggesting more recent, more diverse plant life. To the trained eye, the enhanced images evidenced multiple episodes of human activity.

Airborne photography was our first adjustment to the demands of the project, phased to comply with the dictates of the National Historic Preservation Act. Each of the phases--identifying, evaluating, and documenting the remains--would require state-of-the-art tools in



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Joel W. Grossman

IN CONTEXT

A Time for Seamless
Cooperation

FEATURE ARTICLES

Written in Rock and Rust

Living on the Boott

Engine of Injustice:
African American Labor
and Technological
Change at the Sloss
Furnaces

High-Caliber
Discovery ►

the hands of a multidisciplinary field crew. A core team came equipped to handle computerized Geographic Information Systems, image analysis, computer transit mapping, concurrent database and data processing, and 3-d photogrammetry, as well as EPA HAZMAT procedures and precautions.

The project's health and safety plan, tailored to the relatively low level of contamination, required that crew members do little more than wear a "level D" Tyvek suit and follow basic procedures of cleanliness precluding the possibility of undue contact with excavation soil. All of the team members were medically monitored before, during, and after fieldwork.

The main challenge, given the impending construction of the cleanup facility, was to get the job done quickly and efficiently. Under heated domes--moveable steel-frame, air-inflated shelters--the team labored below ground in frozen conditions through the cold of two winters.

Environmental control was essential. Artifacts had to be kept at controlled temperatures, and the waterlogged ground maintained in a thawed and dry state. Two 300,000 BTU heaters operated 24 hours a day. Once the excavation got going, up to 50,000 gallons daily were pumped out to de-water the site.

Defining the location and extent of the buried remains--the second phase--called for a range of on-site computer-based processing and mapping systems. A powerful IBM-based system provided immediate hard-copy plots of survey and geophysical data.

First, the crew carefully mapped and removed trees and other plant life, noting their species and size so botanists could reconstruct the environment after the work was completed. Then, at 10-foot intervals over the 400- x 700-foot area, they surveyed the ground with magnetometers--to produce an underground magnetic map of historic remains beneath the fill. The magnetometers were wired to portable data collectors, which facilitated the immediate transfer of information to the mapping computers.

With the evidence of modern debris filtered out, the mapping computers rendered 2- and 3-d views of the subsurface topography. The underground maps showed the location and relative size of anomalies, each of which would require individual subsurface testing. The coordinates of each anomaly were fed into a computer transit system, which--using a near-infrared beam--pinpointed where crew members should probe, using backhoes to slice through the frozen earth.

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Throughout the testing and excavation phases, because of government strictures against removing potentially contaminated materials from a Superfund site, conservation and curation facilities were constructed in the field. Here the crew washed, sorted, x-rayed, decontaminated, electrolytically conserved, and computer-inventoried artifacts as they were excavated (at a rate of up to 5,000 per week). This way, the onsite conservation team was able to ascertain the age and origin of some artifacts within hours of discovery. With walkie-talkies, they immediately fed back this information to the field crew, to help direct their efforts.

The artifacts were exotic, inconsistent with the published historic record. The unanticipated find precipitated an intensive investigation at the National Archives and elsewhere. The platform's significance slowly came to light.

In 1837, following the arrival of new director R.P. Parrott, the foundry both consolidated and expanded its production facilities to enhance its security and self-sufficiency. At its peak, the foundry controlled six mines and 11,000 acres of timberland, employing 700 employees with

a capacity to produce 10,000 tons per year of cast iron for weapons. The foundry was a major research and development center for heavy artillery.

Parrott's public image was one of a lone inventor who created at his own expense, in isolation, with little government support. On the face of it, the foundry appeared to be an example of fledgling capitalism at its best, a private firm rising to meet the needs of the nation's defense. In fact, it was a heavily government-underwritten "proprietary" operation, much like the Flying Tigers in World War II or Air America in Vietnam.

On the eve of the Civil War, the Union was in danger of being outgunned by the superior artillery of the French and British, both potential allies of the South. The "proofing" platform, as it turns out, was being used to test a 30,000-pound rifled cannon capable of bombarding cities from a distance of five miles with almost pinpoint precision. Each shell could carry 300 pounds of a new and deadly chemical dubbed "St. Elmo's Fire." Today we call it napalm.

The consequences of the testing program were profound. The chemical--being developed in a classified project for the eyes of President Lincoln only, directly under his supervision--was to be used for the saturation--shelling of southern cities. Although later accounts suggest otherwise, the long-range gun--in concert with other batteries of rifled cannon--ultimately burned a third of Charleston to the ground.

Parrott took full credit for the cannon's invention. Archival evidence, however, suggests that key elements were derived from confidential European designs acquired through military espionage.

In 1879, Parrott's successor at the foundry wrote that a Captain Schwartz of the Imperial Russian Navy had appeared in January of 1860 with covertly obtained plans for the secret British Armstrong rifled cannon. By March, a mere two months later, Parrott had produced what he called "the first experimental gun on my own system," words he would later retract during closed-door congressional testimony.

The actions of Captain Schwartz were entirely consistent with the Russian policy towards the emergence of the United States as a world power. The Czar viewed a unified United States as a counterweight to Russia's recent enemies in the Crimean War--the English and the French.

As the Civil War progressed, the foundry became part of a spy network that stretched from the Black Sea to the White House. The espionage saved the Union millions of dollars and years of development, time the North did not have at the outbreak of hostilities in 1861. Parrott quickly produced a cannon that could stare down a British ironclad, five to twenty percent more deadly and accurate than weapons being wielded by other nations.

What had taken Great Britain over a decade and more than \$12 million to develop, the foundry accomplished in a matter of months at a fraction of the cost. While the Union was five years behind Europe in heavy weapons technology at the start of the war, by 1863 it had matched, if not surpassed, its European counterparts.

The platform excavation filled in the details. The crew used an assortment of tools to expedite excavation and recording as well as limit their exposure to potentially toxic conditions: photo enhancement, computer mapping, computer-based correlations with historic maps, among others. Portable x-ray equipment was employed to identify important metal artifacts below the corrosion layer and--in the hands of U.S. Army explosives experts--examine the cast-iron shells we discovered. One was a standard exploding piece, another an incendiary type much like those used to burn Charleston (as standard operating procedure, gun-testing platforms--which could explode--were sited far from production facilities).

Ultimately, over 5,000 Civil War artifacts were recovered from the platform excavation alone. Through study of what had been the ground surface during the Civil War, the team

reconstructed where the gun crews stood, which was correlated with historic photographs of crews "proofing" Parrott's cannon.

The second part of the investigation focused on excavating a housing complex, located on a ridge overlooking the production facilities in the valley below. Here the road was to be expanded and paved to accommodate 18-wheelers going to and from the cleanup facility. We excavated because the expansion would obliterate the remains of the complex.

In line with Parrott's legend as the lone inventor, the complex was described in the historical record as home to predominantly poor Irish and English laborers. The archeological evidence painted a more complex picture.

The over 145,000 Civil War artifacts we excavated suggested the presence of skilled workers from England, France, Germany, and Austria, countries then developing heavy weapons. Microscopes, gauges, thermometers, calipers, carbon arcs, and many other scientific implements were found. Domestic items, as well, paint a less-than-compelling picture of poor laborers: elegant ceramic goblets and tableware from France, England, and Hungary; gentlemen's smoking pipes from Paris and Glasgow (notably a Tyrolean pipe from the Austrian Alps); an assortment of musical instruments; a broad range of toys including miniature doll house figurines; many late 18th and early 19th century European coins, including several specimens of Spanish Imperial Reales minted in Mexico; and much, much more.

Finally, consistent with the kinds of R&D activities associated with heavy ordnance, each of the house excavations unearthed fuses, primers, and cannon calibration and cleaning tools as well as unidentifiable electronic instruments including batteries and what seemed to be early capacitors. Hardly the repertoire of poor immigrant laborers.

The apparent inconsistency between the material remains and the historical record triggered a re-orientation of the archival research away from a strict focus on the foundry grounds to the influence of foreign technology and foreign workers on Parrott's operation. This fruitful line of inquiry tapped a host of resources from the Civil War era: private correspondence, records of the Navy Ordnance Bureau, and congressional testimony from closed hearings on corruption and faulty workmanship in the North's heavy weapons industry.

There is an important postscript to the investigation. Using the same high-tech tool kit employed elsewhere, the team made yet another discovery beneath the housing complex and 20th century road to the foundry from the hills above: a totally preserved series of prehistoric living floors, dating from 2,000 to 5,000 years old. They too were excavated and recorded, by a crew working under heated domes over a 10-day period.

Thanks to the inconsistencies we uncovered between the archeological and the historic record, Parrott's story was set straight and a new chapter, perhaps, written on the history of the Civil War. In the past, Lincoln's espionage operations have earned little credence among historians. However, based on these archeological discoveries, a story has emerged of international intelligence operations that flourished under the executive sanction of President Lincoln and his inner circle of military advisors. The historical implications suggest a level of technological and geopolitical sophistication that appears not to have been fully recognized in past treatments of Lincoln's Executive Branch structure and operations.

Even beyond that, within the context of this and similar sites, EPA has demonstrated the practicality of doing justice to the archeological legacy under the dictates of the National Historic Preservation Act. What's more, the project's use of technology illustrates that the work can be carried out even in the presence of contaminants, both safely and without delay. I am pleased to note that we will be done well ahead of the schedule projected by EPA.

In a fitting twist, the ramifications of the project rippled back across the Atlantic when I was invited to Russia to speak on archeological methods in contaminated environments. As I told

the story of how Russia secretly assisted the Union during the Civil War, the audience was enthralled. I sensed that there will be many more collaborations to come.

For more information, contact Dr. Joel W. Grossman, 19101 Mystic Pointe Drive, Apt. 2002 Aventura, Florida, 33180 (Tel: 212-920-4648). Questions about federal compliance policies Programs in compliance with the National Historic Preservation Act for this and similar ("Discoveries Under Construction") large-scale infrastructure projects can be referred to Robert Hargrove, Chief, Environmental Impacts Branch, EPA-Region II, Federal Building, New York, NY, (212) 264-1840.

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Last updated: 10/20/2006

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The background image is a sepia-toned photograph of an industrial site. A long, weathered wooden trestle with metal rails runs diagonally from the bottom left towards the upper center. To the left of the trestle, there is a structure made of corrugated metal sheets. In the middle ground, a large, cylindrical metal tank stands upright. The surrounding landscape is arid, with rocky hills in the background and sparse, dry vegetation on the ground.

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ARCHEOLOGY

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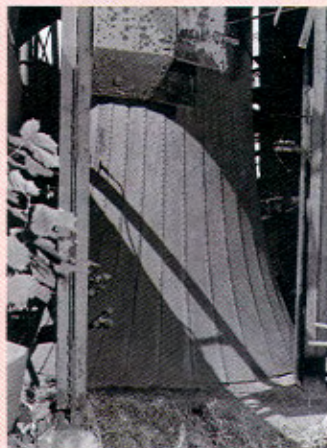
"Living on the Boott"

Beneath the streets, the parking lots, and the backyards of Lowell, Massachusetts, an untold story awaits.

BY STEPHEN A. MROZOWSKI,
GRACE H. ZIESING, AND
MARY C. BEAUDRY



Above: Hurricane Canal, UT; Below: Sloss Furnaces, AL. JACK BOUCHER/HAER



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Engine of Injustice

Hidden inside the labyrinth of Birmingham's historic Sloss Furnaces is a little-known truth about the African Americans who stoked them.

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High-Caliber Discovery

A Civil War-era find at a Superfund site suggests an espionage network that stretched from the Black Sea to the White House.

BY JOEL W. GROSSMAN

HIGH-CALIBER DISCOVERY

The Marathon Battery Superfund Site, on the Hudson River across from the West Point Academy, sits squarely inside a National Register property.

Archeologists expected some evidence of its historic heritage, but not this.

BY JOEL W. GROSSMAN

MY FIRST IMPRESSIONS were not good. What would emerge three years later as a major Civil War-era discovery began as a somewhat somber visit to a heavily overgrown, debris-covered shoreline of the Hudson River. Standing in the cold, numbing rain, I was surrounded by a sea of brick rubble from collapsed 19th century buildings and by the more modern junk of rusting car bodies. It was a challenging place to do archeology. The site was both foreboding as a focus of study and contaminated with cadmium.

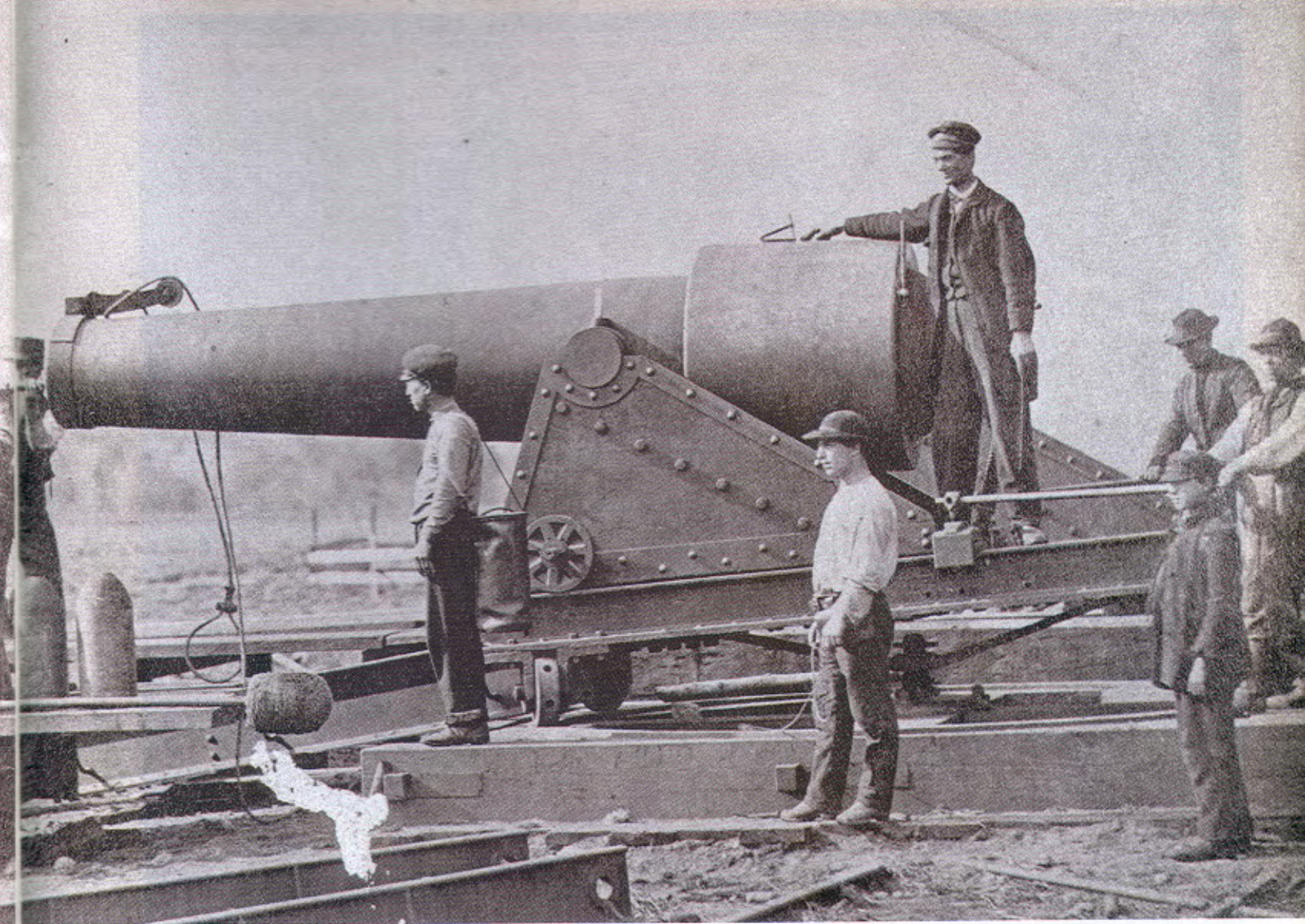
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Civil War-era photo of gun crew testing R.P. Parrott's 30,000-pound rifled cannon. Children were often employed in the highly dangerous work.
PUTNAM COUNTY HISTORICAL SOCIETY, NEW YORK

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 AIRBORNE PHOTOGRAPHY was our first adjustment to the demands of the project, phased to comply with the dictates of the National Historic Preservation Act. Each of the phases—identification, evaluation, and documentation of the remains—would require state-of-the-art tools in the hands of a multidisciplinary field crew. A core team came equipped to handle computerized Geographic Information Systems, image analysis, computer transit mapping, concurrent database and data processing, and 3-d photogrammetry, as well as EPA HAZMAT procedures and precautions.



View of excavated gun-testing platform taken with ultra-high-resolution 3-d photogrammetric camera for plotting on computer mapping system.

GROSSMAN AND ASSOCIATES

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Throughout the testing and excavation phases, because of government strictures against removing potentially contaminated materials from a Superfund site, conservation and curation facilities were constructed in the field. Here the crew washed, sorted, x-rayed, decontaminated, electrolytically conserved, and computer-inventoried artifacts as they were excavated (at a rate of up to 5,000 per week). This way, the onsite conservation team was able to ascertain the age and origin of some artifacts within hours of discovery. With walkie-talkies, they immediately fed back this information to the field crew, to help direct their efforts.

The artifacts were exotic, inconsistent with the published historic record. The unanticipated find precipitated an intensive investigation at the National Archives and elsewhere. Slowly, the significance of the platform came to light.

FOLLOWING THE ARRIVAL of new director R.P. Parrott in 1837, the foundry both consolidated and expanded its production facilities to enhance its security and self-sufficiency. At its peak, the foundry controlled six mines and 11,000 acres of timberland, employing 700 employees with a capacity to produce 10,000 tons per year of cast iron for the weapons produced there. It was a major research and development center for heavy artillery.

Parrott's public image was one of a lone inventor who created at his own expense, in isolation, with little government support. On the face of it, the foundry appeared to be an example of fledgling capitalism at its best, a private firm rising to meet the

needs of the nation's defense. In fact, it was a heavily government-underwritten "proprietary" operation, much like the Flying Tigers in World War II or Air America in Vietnam.

On the eve of the Civil War, the Union was in danger of being outgunned by the superior artillery of the French and British, both potential allies of the South. The "proofing" platform, as it turns out, was being used to test a 30,000-pound rifled cannon capable of bombarding cities from a distance of five miles with almost pinpoint precision. Each shell could carry 300 pounds of a new and deadly chemical dubbed "St. Elmo's Fire." Today we would call it napalm.

The consequences of the testing program were profound. The chemical—being developed in a classified project for the eyes of President Lincoln only, directly under his supervision—was to be used for the saturation-shelling of southern cities. Although later accounts suggest otherwise, the long-range gun—in concert with other batteries of rifled cannon—ultimately burned a third of Charleston to the ground.

Parrott took full credit for the cannon's invention. Archival evidence, however, suggests that key elements were derived from confidential European designs acquired through military espionage.

In 1879, Parrott's successor at the foundry wrote that a Captain Schwartz of the Imperial Russian Navy had appeared in January of 1860 with covertly obtained plans for the production of the secret British Armstrong rifled cannon. By March, a mere two months later, Parrott had produced what he called "the first experimental gun on my own system," words he would later retract during closed-door congressional testimony.

The actions of Captain Schwartz were entirely consistent with the Russian policy towards the emergence of the United States as a world power. The Czar viewed a unified United States as a counterweight to Russia's recent enemies in the Crimean War—the English and the French.

As the Civil War progressed, the foundry became part of a spy network that stretched from the Black Sea to the White House. The espionage evidenced there saved the Union millions of dollars and years of development time, time the North did not have at the outbreak of hostilities in 1861. Parrott quickly produced a cannon that could stare down a British ironclad, five to twenty percent more deadly and accurate than weapons being wielded by other nations.

What had taken Great Britain over a decade and more than \$12 million to develop, the foundry accomplished in a matter of months at a fraction of the cost. While the Union was five years behind Europe in heavy weapons technology at the start of the war, by 1863 it had matched, if not surpassed, its European counterparts.

The platform excavation filled in the details. The crew members used an assortment of tools to expedite excavation and recording as well as limit their exposure to potentially toxic conditions: photo enhancement, computer mapping, computer-



Excavating in the deep cold under heated domes.

GROSSMAN AND ASSOCIATES



Civil War-era photo of the crane and conning tower, found buried under four feet of rubble next to the test platform. PUTNAM COUNTY HISTORICAL SOCIETY

based correlations with historic maps, among others. Portable x-ray equipment was employed to identify important metal artifacts below the corrosion layer and—in the hands of U.S. Army explosives experts—to examine the cast-iron shells we discovered. One was a standard exploding piece, another an incendiary type much like those used to burn Charleston (as standard operating procedure, gun-testing platforms—which could explode—were always sited far away from production facilities).

Ultimately, over 5,000 Civil War artifacts were recovered from the platform excavation alone. Through study of what had been

the ground surface during the Civil War, the team reconstructed where the gun crews stood, which was correlated with historic photographs of crews “proofing” Parrott’s cannon.

THE SECOND PART of the investigation focused on excavating a housing complex, located on a ridge overlooking the production facilities in the valley below. Here the remedial action required that an existing road be expanded and paved to accommodate 18-wheelers going to and from the cleanup facility. The expansion would obliterate the remains of the complex.

In line with Parrott's legend as the lone inventor, the complex was described in the historical record as home to predominantly poor Irish and English laborers. The archeological evidence painted a more complex picture.

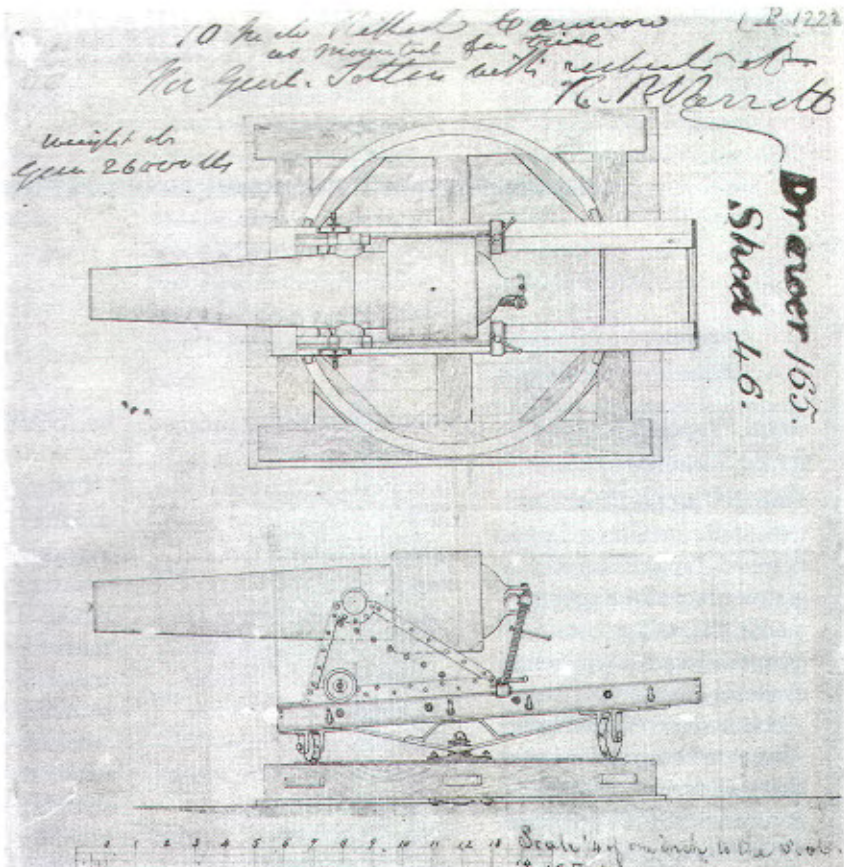
The over 145,000 Civil War artifacts we excavated suggested the presence of skilled workers from England, France, Germany, and Austria, countries then developing heavy weapons. Microscopes, gauges, thermometers, calipers, carbon arcs, and many other scientific implements were found. Domestic items, as well, paint a less-than-compelling picture of poor laborers: elegant ceramic goblets and tableware from France, England, and Hungary; gentlemen's smoking pipes from Paris and Glasgow (notably a Tyrolean pipe from the Austrian Alps); an assortment of musical instruments; a broad range of toys including miniature doll house figurines; many late 18th and early 19th century European coins, including several specimens of Spanish Imperial Reales minted in Mexico; and much, much more.

Finally, consistent with the kinds of R&D activities associated with heavy ordnance, each of the house excavations unearthed fuses, primers, and cannon calibration and cleaning tools as well as unidentifiable electronic instruments including batteries and what seemed to be early capacitors. Hardly the repertoire of poor immigrant laborers.

The apparent inconsistency between the material remains and the historical record triggered a re-orientation of the archival research away from a strict focus on the foundry grounds to the influence of foreign technology and foreign workers on Parrott's operation. This fruitful line of inquiry tapped a host of resources from the Civil War era: private correspondence, records of the Navy Ordnance Bureau, and congressional testimony from closed hearings on corruption and faulty workmanship in the North's heavy weapons industry.

There is an important postscript to the investigation. Using the same high-tech tool kit employed elsewhere, the team made yet another discovery beneath the housing complex and 20th century road to the foundry from the hills above: a totally preserved series of prehistoric living floors, dating from 2,000 to 5,000 years old. They too were excavated and recorded, by a crew working under heated domes over a 10-day period.

THANKS TO THE INCONSISTENCIES we uncovered between the archeological and the historic record, Parrott's story was set straight and a new chapter, perhaps, written on the history of the Civil War. In the past, Lincoln's espionage operations have earned little credence among historians. However, based on these archeological discoveries, a story has emerged of national and international intelligence operations that flourished under the executive sanction of President Lincoln and his inner circle of military advisors. The historical implications suggest a level of technological and geopolitical sophistication that



Drawings of the cannon executed by R.P. Parrott or an assistant. NATIONAL ARCHIVES

appears not to have been fully recognized in past treatments of Lincoln's Executive Branch structure and operations.

Even beyond that, within the context of this and similar sites, EPA has demonstrated the feasibility and practicality of doing justice to significant cultural resources under the section 106 compliance procedures of the National Historic Preservation Act. What's more, the project's successful use of applied technology illustrates that the work can be carried out even in the potential presence of contaminants, both safely and without delay. I am pleased to note that the remedial action at the Marathon Battery Company site will be completed by the end of this year, well ahead of the original schedule projected by EPA.

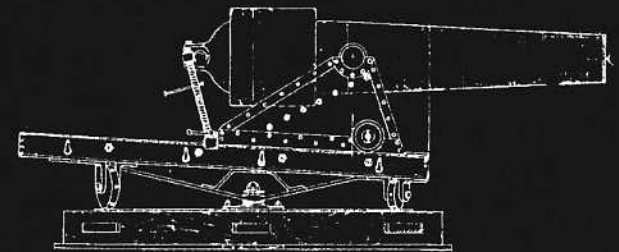
In a fitting twist, the ramifications of the project rippled back across the Atlantic when I was invited to Russia to speak on archeological methods in contaminated environments. As I told the story of how Russia secretly assisted the Union during the Civil War, the audience was enthralled. I sensed that there will be many more collaborations to come.

For more information, contact Dr. Joel W. Grossman, Grossman and Associates, Inc., 201 E. 16th St., New York, NY 10003, (212) 473-2259, fax (212) 473-2595. Questions in regard to federal compliance with the National Historic Preservation Act for this and similar projects can be referred to Mr. Robert Hargrove, Chief, Environmental Impacts Branch, EPA-Region II, Federal Building, New York, NY, (212) 264-1840.

LOOK TO THE EARTH

*Historical Archaeology
and the American
Civil War*

Edited by Clarence R. Geier, Jr. and Susan E. Winter



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Discussion

The high level of site integrity and the existence of detailed background historical data together suggest that these sites hold great research potential. More than 150 separate reminiscences, diaries, or letters, and a total of over 500 sources were located. These sources, along with the more than 125 archaeological features recorded during the mapping project, may guide further research. As domestic sites, Camp Allegheny and Cheat Summit Fort present opportunities to address a broader range of research topics than do pure battle sites. Additionally, these two fortified camps were scenes of battle.

Camp Allegheny and Cheat Summit Fort exist as sites of nearly equal duration, time period, and setting, from opposite sides of the Civil War struggle. They present an opportunity for controlled comparison of Federal and Confederate domestic and military conditions. Discrete areas of Camp Allegheny also are known to have been occupied by regiments from different parts of the Confederacy, providing opportunities for additional controlled comparisons. The same possibly holds true for Cheat Summit Fort. Future research topics likely will focus on military lifeways and material provisioning. These might have been affected by such factors as length of occupation, Confederate versus Union allegiance, temporal placement, military rank, and ethnicity.

The preliminary archaeological test excavations, intensive site mapping, and detailed bibliographical research for Cheat Summit Fort and Camp Allegheny have provided solid baseline data to guide future research at the sites. Additional archaeological research questions may be addressed effectively from the corpus of historic documentation. Site preservation and stabilization issues have also been identified through this work. Interpretive opportunities revealed by the archaeological and historical data have resulted in brochures, signing, and a plan to foster public appreciation for these superbly preserved Civil War sites.

Part IV.

Other Directions

The primary goal of this book is to draw attention to the broad range of topics related to the Civil War, to whose study historical archaeology can contribute significantly. The following four chapters illustrate this diversity of application. Charles Orser offers an exploratory work that looks at broad, regional changes in northern agriculture, specifically that of the Midwest corn belt, during and following the Civil War period. He proposes a strategy for studying this complex subject which encompasses both archaeological field work and extensive research into primary historical documentation. By considering an area of the United States which experienced little military action, Orser illustrates the significant secondary impacts that the war had on the nation as a whole.

Following Orser's focus on the agricultural economy of a region, Clarence Geier illustrates the impact of the war on a specific family. The chapter introduces the family of Thomas Cheatham, who lived between Richmond and Petersburg, Virginia, just prior to the onset of the Civil War. In 1864, their farm came to lie in a "no-man's land" between Confederate fortifications protecting the southern perimeter of Richmond, and the advancing Union Army of the James.

The chapter documents a Union attack on the Richmond defenses on May 6–16, 1864, and considers the impact the military occupation of the Cheatham home had on the farm, its dwellings, and the family.

Joel W. Grossman takes the reader into the realms of espionage and artillery manufacture. His chapter reviews important excavations conducted at the site of the West Point Foundry, in Cold Spring, New York. Not only do the excavations provide important insight into gun testing facilities and the housing of laborers, but also they illustrate how historical interpretation sometimes can create false or misleading perceptions of past reality.

Paul Shackel studies the use of landscapes in establishing and reinforcing dominant ideologies. He uses Harpers Ferry, West Virginia, as a case study to show how northern industrialists used industrial ruins created by the Civil War to reinforce an industrial ideology during the latter half of the nineteenth century.

9

Charles E. Orser, Jr.

CORN-BELT AGRICULTURE DURING THE CIVIL WAR PERIOD, 1850–70

*A Research Prospectus for Historical
Archaeology*

The impact of the American Civil War on the rural South was immediate and significant. Rich, normally productive agricultural fields were burned, huge mansions were ransacked and destroyed, livestock were set free or slaughtered, some four million enslaved African Americans—many of them agricultural laborers—were emancipated, and as many as 62 percent of white farmers served in the Confederate Army (Wiley 1959: 7). In the South's agricultural world, slave plantations gave way to tenant plantations, and small-scale farmers returning from the war—some of whom once owned one or two slaves and some of whom owned none—found themselves competing with a new labor force: the freedman farmer.

Numerous researchers have focused on the social nature of Southern agriculture, both before and after the American Civil War. Historians have explored various aspects of Southern agriculture in both the antebellum and the postbellum periods (see, for example, Fite 1984; Gray 1933; Wayne 1983; Wiener 1978). Rural sociologists have commented on postwar south-

Acknowledgments

The research of certain persons contributed significantly to preparation of this chapter. Martha McCartney provided the archival analysis and background on the Cheatham residence. Further, artifact analyses and interpretations provided by Rita Buchanon (clothing parts), James Cromwell (military and metal artifacts), and Paul Mullins and Susan Andrews (glasswares) were critical to the discussion.

11

Joel W. Grossman

THE ROLE OF ESPIONAGE AND FOREIGN INTELLIGENCE IN THE DEVELOPMENT OF HEAVY ORDNANCE AT THE WEST POINT FOUNDRY, COLD SPRING, NEW YORK

Over a three-year period between 1989 and 1992, the first major federally mandated archaeological investigation of a Superfund site took place at the West Point Foundry in New York. This work led to the discovery of the well-preserved subsurface remains of R. P. Parrott's Civil War era cannon testing facilities and the otherwise unrecorded housing complex of the workers who helped produce and refine a new generation of large-caliber rifled ordnance. In addition to shedding new light on Union military research and development activities in heavy-weapons technology prior to and during the Civil War, these archaeological findings precipitated the archival discovery of a previously unrecognized aspect of Northern military history. This discovery in turn revealed the existence of a carefully orchestrated and highly effective capability in international military espionage and industrial intelligence on the part of Lincoln's executive branch and the U.S. Army and U.S. Navy ordnance bureaus which had not been addressed in past treatments of Northern Civil War history.

At times, the archaeological study of past events is consistent with available documents and published accounts of the past. When this is the case, the archaeological records provided by the surviving material remains can help augment and "flesh out" the perspectives of documented history. However, as this study has shown, the archaeological evidence also can be found to conflict with, and on occasion pointedly to contradict, the written record, in both detail and general implications. This was the case with the archaeological discoveries at West Point Foundry. Taken together, the combined archaeological and archival evidence from this first major archaeological study of Civil War era military facilities north of the Mason-Dixon Line has provided significant and unanticipated insights into the unwritten record of the Civil War and of American military and intelligence history.

This federally mandated compliance and mitigation program was performed under the jurisdiction of the U.S. Environmental Protection Agency and Army Corps of Engineers, and under contract with the lead engineering and design firm of Malcolm Pirnie, Incorporated. This large-scale, multistage site definition and data recovery effort demonstrated the feasibility of undertaking in-depth archaeological investigations within the context of potentially contaminated sites. From an archaeological and methodological standpoint alone, this effort, performed with the assistance of a range of applied-technology solutions to issues of site discovery, definition, and documentation, also clearly established that the discipline of archaeology has the ability to maintain the high standards of current federal compliance guidelines in a feasible and practical manner and time frame which do justice to both the resource and the primary mission of the Superfund environmental cleanup effort.

The West Point Foundry operated in Cold Spring, New York, across the Hudson River from the U.S. Military Academy at West Point. The archaeological remains of this significant Civil War era cannon foundry had lain dormant for the past 130 years under a nineteenth-century industrial landfill capped by modern, potentially toxic waste. This area, identified as the Marathon Battery Superfund Site, had been targeted by the U.S. Environmental Protection Agency for a major environmental cleanup effort. As part of a federally mandated planning and site evaluation conducted between 1989 and 1992, the first large-scale archaeo-

logical investigation and mitigation of a Superfund site resulted in the discovery of R. P. Parrott's Civil War era gun-testing or proofing facilities.

In addition to the exposure and documentation of the Foundry's Civil War era gun-testing facilities, computer-assisted historic map surveys also led to the discovery and excavation of an isolated cluster of unique workers' housing. These houses were located on a bluff above the foundry ruins, apart from the majority of the workers' housing situated within the town of Cold Spring. The large-scale excavation of these household remains yielded over 145,000 Civil War era artifacts, including a range of high status and technologically sophisticated artifacts. As socioeconomic and ethnic indicators, these exotic items simply did not concur with, or support, previously published historical characterizations of the workers who lived there.

The apparent inconsistencies between the material remains and the written record triggered an intensive reorientation in the ongoing archival research effort, away from a focus on the technological history of West Point Foundry proper and toward the role of foreign influences in the history of the military developments which took place there. The research then revealed the existence of a tightly controlled military research and development effort, as well as a Civil War intelligence and espionage operation, that focused on the development of large-caliber rifled cannon. This operation was funded by the Navy Ordnance Bureau and was run by some of the leading military and civilian figures of American science and technology of the time, all with direct lines of communication to President Abraham Lincoln.

Early History of the Foundry Operations

The Kemble Era: 1817-37

West Point Foundry began in 1817 as a private, but government-financed, establishment on the Hudson River, immediately upriver from the protective gun emplacements at West Point (figs. 11.1 and 11.2). It was one of four foundries established after the War of 1812 to produce cannon

for national defense (Kemble 1916: 191–92). Save for the civilian proprietor of West Point Foundry, Gouverneur Kemble, the appointed directors of these four establishments were military officers of high standing. Kemble, however, was well connected politically, economically, and socially within New York and Washington circles. Moreover, he had proven his dedication to his country and his expertise in the area of cannon technology through his participation in “industrial espionage,” first as a commercial and later as a government attaché to the Spanish court (Kemble 1916: 192–201; Raoul 1936: 463).

During his tenure in industrial and military intelligence gathering, Kemble, like many other military attachés similarly posted in foreign missions, participated in a tradition by which former attachés continued to benefit from the fruits of foreign intelligence gathering. They did so especially in the area of heavy cannon technology and manufacture. Kemble was director and proprietor of the West Point Foundry until 1837, at which time he entered the U.S. Congress, a move which induced him to invite Parrott to resign from the U.S. military and take over as director of the foundry (Raoul 1936: 466; Kemble 1916: 199–200).

While the financing, site selection, and initial construction of the foundry appears to have been adequately addressed through a combination of local resources and guarantees of government contracts, the actual technology and expertise required to develop and operate a specialized heavy-gun foundry were not available locally. The lack of skilled labor during the 1820s was both a reflection of the incipient state of industry in America and the result of explicit efforts on the part of the advanced nations of Europe to maintain their strategic technological superiority (Raoul 1936: 464–65; Kemble 1916: 195). In England as well as other European countries, export restrictions were explicitly applied to the products, plans, and technology of artillery manufacture and testing. Further, restraints limited access to workers (founders, molders, mechanics, and ordnance specialists) who were involved in the manufacture and testing of heavy ordnance.

Although the terms may have varied, the skills of iron making in general, and heavy-cannon manufacturing in particular, then were viewed as proprietary areas of national security which were tightly controlled;



Fig. 11.1. Detail of Civil War-era navigation map of the Hudson River, showing West Point Academy and West Point Foundry. Courtesy of Grossman and Associates, Inc.

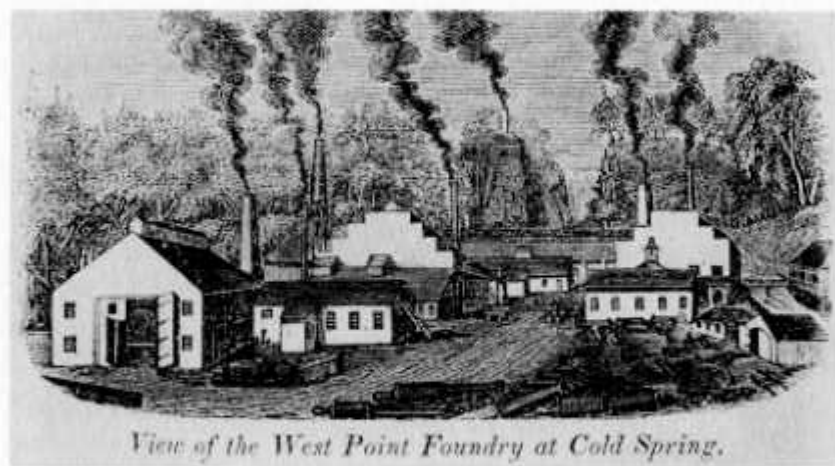


Fig. 11.2. Pre-Civil War Currier and Ives lithograph of the West Point Foundry, showing area immediately to the north of the Superfund Remediation Zone (Area 1). The inclusion of the elevated iron furnace at the rear suggests a pre-1837 date for the illustration. Courtesy of the Putnam County Historical Society.

transgressors were subject to severe punishment. Thus, in violating these laws, either an Englishman or a foreigner knowingly embarked on what was defined and clearly understood as a crime against England. Such a transgression was something not to be undertaken lightly as a private commercial venture.

Against this backdrop, what Kemble and his foundry partners subsequently undertook reads as a carefully coordinated subterfuge, with all the flair of a modern spy novel. Kemble, apparently with the assistance of the U.S. military, addressed the problem of an insufficient number of foundry workers and ordnance technicians with a simple but dangerous tactic. Despite the legal and diplomatic barriers, he stole them away from England, and possibly other European countries, with a carefully formulated series of international operations, undertaken with subterfuge and with naval logistical support. According to Kemble's later account, transatlantic trips to secure British and Irish iron founders, molders, and craftsmen occurred on at least two occasions. This pattern of "borrowing" men and technology from Europe, and from England in particular, appears to have been a long-standing tradition in the technological development of both the West Point Foundry and the American military throughout the nineteenth century (Raoul 1936: 465–66).

The first such documented voyage took place between 1818 and 1825 and the second, on or about 1825. On the first trip, a Captain Graham of New York docked at Liverpool and announced that he was sailing with a work force of unskilled laborers. After setting sail, he then docked at Queenstown and, with the help of Mr. Young (a skilled ironmaster and brother of an Irish foundry owner who served under Kemble as the first superintendent at the West Point Foundry), replaced the laborers with a group of passengers who turned out to be skilled mechanics, most probably including iron founders and molders. The British got wind of the subterfuge and sent a warship in pursuit, but Captain Graham escaped, and a half-dozen men arrived in New York (Raoul 1936: 466).

The second trip, in 1825, involved an even more elaborate example of international subterfuge. Captain Graham and Mr. Young returned to the British Isles, presumably on normal business. However, upon sailing from Liverpool, they reportedly experienced a mutiny which forced them to dock at a small Irish port to unload the rebellious crew. When they returned to New York, the new crew members were found to consist of foundry specialists and "first class molders" (Kemble 1916: 195–96; Raoul 1936: 465–66). Aside from this documentary footnote to history, these special immigrants, brought to Cold Spring as part of a surreptitious quasimilitary operation, essentially disappeared from the historical record. Their existence, and the significance of their role in the development of armaments for the American Civil War, came to light only in 1990, as a result of the West Point Foundry archaeological investigations.

The Parrott Era: 1837–67

Robert Parrott, an ordnance officer at West Point Academy, became director of the West Point Foundry in 1837. With his arrival, the establishment both consolidated and expanded its production facilities to enhance its regional security and self-sufficiency. At its peak, the West Point Foundry employed seven hundred workers and had the capacity to produce ten thousand tons of cast iron per year. The production of cast iron in turn required support facilities, which included six mines and eleven thousand acres of timberland. The latter utilized fifteen hundred workers, who

produced ten thousand cords of wood for fuel per annum (Naylor 1961: 14–15; Parrott 1921; Raoul 1936: 469; Tyrell 1962; M. Wilson 1886).

Under Parrott's tenure, the foundry was a major research and development center. In addition, as a regional center of heavy cannon production, and as the sole source supplier of the Parrott rifled cannon, the West Point Foundry played a central role in establishing the military superiority of the Union land and naval forces during the Civil War. By the second and third year of the war, Parrott's facility had developed several sizes of large reinforced cast-iron rifled cannon, capable of repeatedly hitting targets at a distance of five miles or more and with an armor-piercing velocity of 1,200 feet per second (Bruce 1989: 230; Holley 1865: 487). This combined accuracy, range, and throw weight not only rendered traditional masonry fortifications and wooden ships obsolete, but also brought a new element of large-scale warfare to urban centers by providing reliable mechanisms for accurate long-distance explosive and incendiary bombardment (Bruce 1989). By the end of the war, Parrott's foundry had produced nearly two thousand cannon of various calibers, and in excess of three million shells (U.S. 40th Congress, 2d Session, 1868, volume 99: 915; Naylor 1961: 14–15).

Traditional accounts of the foundry's history have highlighted Parrott's singular role in developing his version of the rifled cannon. The picture presented by these accounts suggests that Parrott developed his version of the rifled cannon in relative technical and intellectual isolation. They also imply that he received little financial support or involvement from the government in general, or from the army and navy ordnance bureaus in particular (Kemble 1916: 199; Raoul 1936: 467; Parrott 1865; Tyrell 1962: 6). Archaeological discoveries at the West Point Foundry, however, combined with the detailed archival investigation that followed, suggest otherwise. In fact, the independent lines of archaeological and documentary evidence come together to create a very different characterization of the history of the foundry, the course of heavy-cannon development there, and Parrott's status as the "inventor" of the "Parrott" cannon. Furthermore, this evidence suggests that the Union military's role in weapons development before and during the Civil War was heavily influenced by foreign intelligence sources and was tightly con-

trolled as an aspect of federal military policy. Finally, the combined research reveals that the military, particularly the U.S. Navy Ordnance Bureau in Washington, D.C., heavily financed and monitored Parrott's research and development activities throughout the war.

In contrast to previous portrayals, this investigation strongly indicated that the origin and development of Parrott's cast-iron rifled cannon were heavily influenced by, if not the direct result of, an elaborate government-sponsored program of foreign intelligence gathering and military and industrial espionage, both before and during the Civil War. Furthermore, archival records and congressional testimony suggested a high probability that key elements of Parrott's rifled gun actually were derived from confidential European designs and prototypes, which the American ordnance officers knew about long before Parrott's announced "invention" in 1860–61.

The Archaeological Discovery of Parrott's Gun-Testing Facility and Workers' Housing

Beginning in 1989, the archaeological investigation of the West Point Foundry National Register District evolved over a three-year period, as a multistage identification, definition, and documentation effort performed in compliance with the National Historic Preservation Act, as amended. A combined approach of historic map analysis, subsurface testing, and remote sensing was applied to document the presence and extent of buried historic remains within the project impact areas that could not be avoided through construction redesign (Grossman et al. 1991). Based on the discovery of deeply stratified and otherwise undocumented nineteenth-century remains, the U.S. Environmental Protection Agency mandated a concentrated data recovery program aimed at the exposure and scientific documentation of the buried Civil War era remains located within the Superfund cleanup area.

The level of potential heavy-metal contamination within the historic shoreline landfill, as well as deep-winter conditions at the site, dictated that the field team work in protective gear, under inflated and heated domes, with all essential laboratory activities incorporated into on-site

facilities outfitted with the appropriate decontamination equipment. Heavy dewatering pumps operated on a twenty-four-hour basis to maintain the excavation site in a dry, workable condition. All field personnel worked in sealed protective suits which were decontaminated and disposed of daily. All crew members were trained and certified for Hazardous Waste Material Handling (HAZMAT), and all were medically monitored before, during, and after the field effort.

The site testing and data recovery program used an assortment of applied technology procedures to expedite the excavation and recording process, and to limit the field crew's exposure to potentially toxic conditions. These tools included computer-integrated, total-station survey and mapping equipment which facilitated rapid, computer-based historic map correlations and site survey. In addition to the installation of on-site processing, inventory, decontamination, and conservation procedures, portable X-ray equipment was used to expedite the evaluation and selection of often heavily corroded metallic diagnostic artifacts. Once exposed through controlled natural stratigraphic excavation, the Civil War era gun-testing facilities also were rapidly recorded using the recently developed Rolleiometric photogrammetric three-dimensional camera system, which reduced the time and labor of the documentation effort of the exposed features and profiles by a factor as much as ten to one.

The field program was conducted in three stages between 1989 and 1992, covering three distinct areas of the site complex (fig. 11.3). The first stage consisted of a Phase I-II site identification and evaluation study of the historic foundry "Rail Spur," which ran out of the foundry along East Foundry Cove. These initial tests were important because they revealed a deep stratigraphic sequence of nineteenth-century fill layers which suggested the potential presence of deeply buried Civil War era deposits elsewhere on the site.

The second phase, and the main focus of the 1989-90 investigation, took place within what was referred to as the Area 1 remediation zone. This work consisted of a broader site definition, evaluation, and data recovery program within the former marsh and shoreline area forming the core of the Superfund cleanup zone. The deep-winter excavation utilized computer-scaled historic map projections and area-wide remote sensing survey procedures to identify and delimit the location and ex-

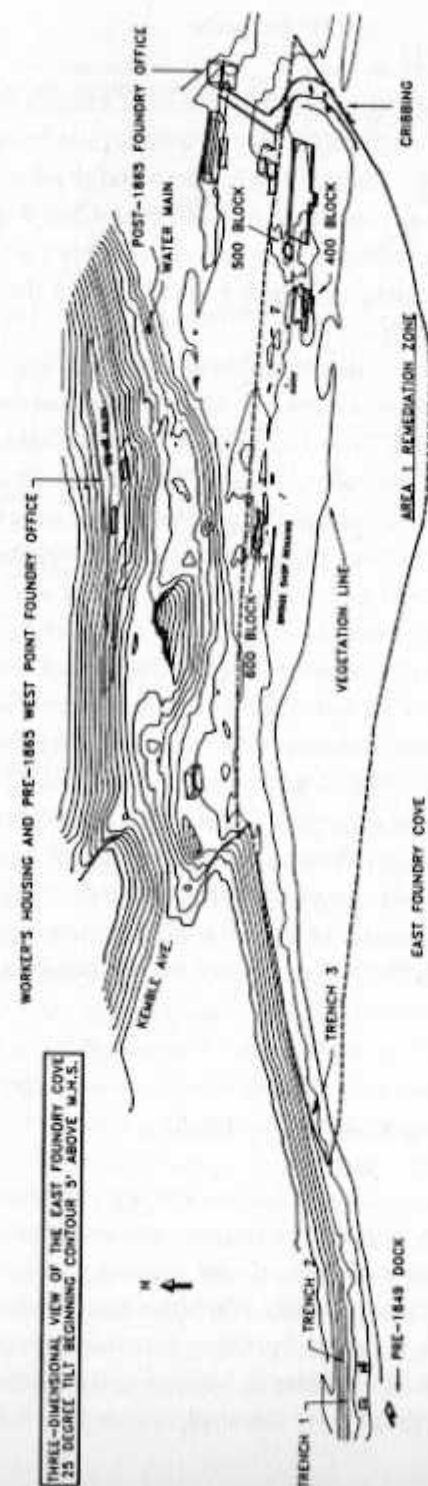


Fig. 11.3. Three-dimensional perspective of the historic West Point Foundry shoreline, showing the project limits of the Area 1 Superfund Remediation Zone and locus of 189-92 archaeological investigations. This bird's-eye view also depicts the historic rail spur bordering East Foundry Cove, the area of the gun platform and tower excavation (block 400), and the historic workers' housing on the bluff overlooking the foundry. Courtesy of Grossman and Associates, Inc.

tent of the buried and preserved remains of R. P. Parrot's Civil War-era gun-testing facilities. These facilities lay sealed five feet below the modern surface, and three feet below the modern water table, sandwiched within a ten-foot-deep sequence of pre- and post-Civil War historic fill deposits of foundry slag and ash which had been dumped along the shore of the former marsh beginning at least a decade before the onset of the Civil War (Grossman et al. 1991).

Finally, the third phase of the investigation began with the initial identification in 1990 of historic masonry foundation depressions adjacent to a modern dirt utility road, "The Haul Road," which overlooked and led down to the foundry in the valley below. Upon closer examination, these depressions were found to contain the well-preserved structural remains of the Civil War era complex of foundry workers' housing (fig. 11.3). This housing complex formed a group of six duplex structures which were separate and apart from the majority of the workers' housing located outside the foundry proper in Cold Spring. Initial testing revealed evidence of a buried stone foundation two to four feet thick, associated with undisturbed interior and exterior living floors, together with well-preserved hearths, artifact-filled refuse pits, and cisterns. The excavation of the naturally stratified occupation and destruction layers yielded in excess of 140,000 historic artifacts, with large proportions of diagnostic, high-status, imported, and domestic specimens. Below the historic deposits, the excavation also documented the well-preserved living surfaces, hearths, and pits of prehistoric occupants of the site (Grossman et al. 1991).

The Shoreline Civil War Gun-Testing Facilities

The discovery of the gun-testing facilities was accomplished through the combined use of computer-assisted historic map correlation studies and grid-based magnetometer remote sensing across a rectangular shoreline area (designated Area 1), two hundred feet by seven hundred feet, where heavy disturbance was to occur from construction associated with the Superfund remediation effort. Prior to beginning the field investigations, the historic map analysis involved the compilation and digitized transfer

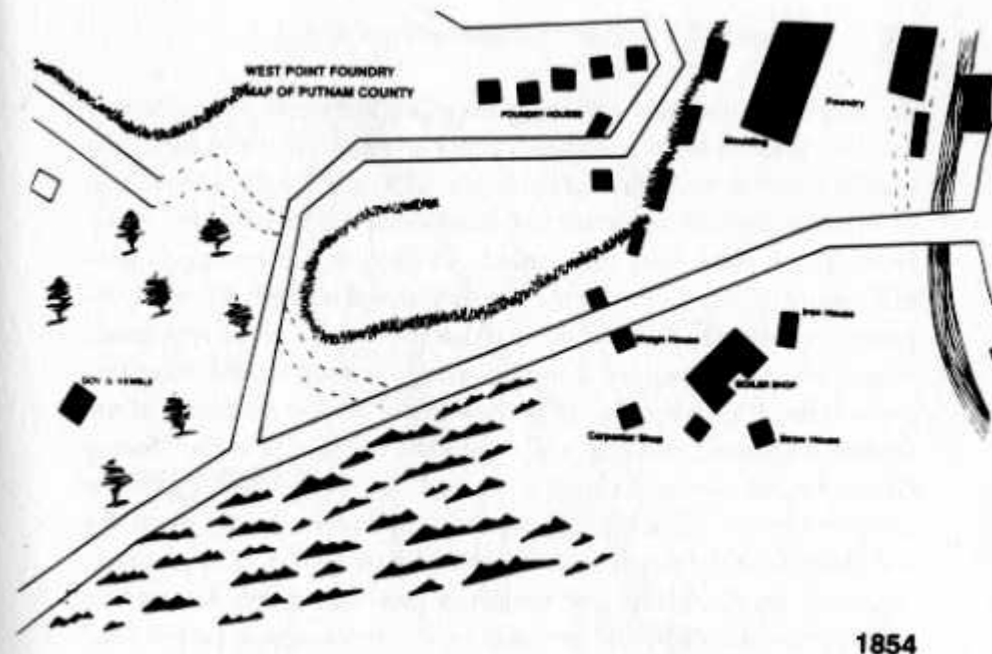


Fig. 11.4. Detail of 1854 Bevan Map of Putnam County, showing West Point Foundry prior to development of the shoreline gun-testing facilities. Courtesy of Grossman and Associates, Inc.

of all pertinent historic maps as scaled overlays onto the most current engineering site plans. Using these scaled historic map overlays, an attempt was made to locate specific structures and activity areas, as a basis for selecting zones for focused archaeological testing. Three mid-nineteenth-century maps were utilized, dating from 1854, 1867, and 1876, which showed sufficient detail to project the approximate location, relative to modern features, of earlier structures and foundry-related activity areas. The earliest of these, the 1854 Bevan map, showed six pre-Civil War structures in the shoreline impact zone of East Foundry Cove (fig. 11.4). Though detailed in its depictions, the 1854 map proved impossible to enlarge and scale accurately relative to any current topographic or structural remains. Nevertheless, despite these problems of scale and correlation, this prewar map was significant because it provided evidence that the shoreline area facing the cove (west of the core of the foundry complex further inland) was being used for secondary storage structures at least as early as 1854, and, by implication, that this former cove area had been partially landfilled by this date.

In contrast to the ambiguities of the 1854 Bevan map, two maps from

the decade immediately following the Civil War proved considerably more accurate in scale and detail. When overlaid on the modern site map, the 1867 Beers, Ellis, and Soule (fig. 11.5) and the 1876 Reed (fig. 11.6) maps provided important new clues about the Civil War era activities that took place along the marsh. In addition to documenting a general pattern of expansion for the foundry complex itself, the maps depicted the removal of previously recorded structures, and the appearance of new structures along the shoreline zone of historic landfill. Most important, the 1867 map (fig. 11.5) showed the earliest rendering of the location, alignment, and extent of what had been labeled as the "Testing Guns" area, which was depicted at the end of a rail line used to roll out and test-fire new cannon being produced by Parrott. Jointly, given the wide latitude in the precision and consistency of the historic map coverage, these studies placed the projected gun-testing area somewhere within a corridor 80 to 100 feet wide by 200 feet long and perpendicular to the modern shoreline of East Foundry Cove.

The level of definition provided by the map data was refined through the use of a grid-based magnetometer survey of the entire 700-foot-long shoreline Superfund Remediation Zone. The actual magnetic survey of the historic industrial landfill area was conducted using two EG&G 860 magnetometers linked to portable data collectors, one to survey the site and the other as a control station to measure diurnal variations in the earth's magnetic field. A total of 4,884 data points were sampled at ten-foot intervals across the site. At the completion of the magnetic survey, the entire data set was electronically transferred into a desktop system equipped with two- and three-dimensional surface modeling programs that scaled the averaged, and coordinate-based, magnetic values relative to the site grid, to create contour or "terrain" maps. These maps illustrated the relative highs and lows in the recorded magnetic readings as color-coded peaks and valleys, each color representing a specific range of magnetic values. A total of thirty-five magnetic anomalies, or significant "dipolar" highs and lows, were rendered by the color-coded magnetic contour and mesh-surface maps (fig. 11.7). The buried Civil War era facilities were located as two major areas of extreme dipolar magnetic variation in the southeast corner of the site, and both fell



Fig. 11.5. Detail of 1867 Beers, Ellis, & Soule Map showing the "testing guns" rail line leading out of the gun casting and turning shops of the foundry and down to the shoreline area of the cannon-testing facility. Courtesy of Grossman and Associates, Inc.

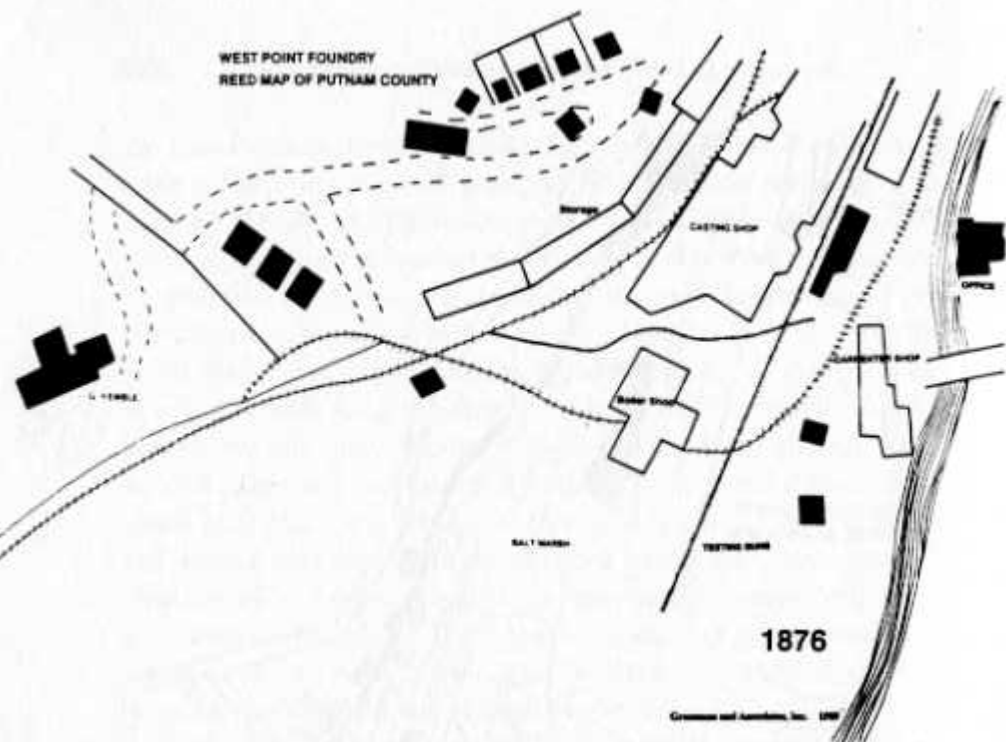


Fig. 11.6. Detail of 1876 Reed Map of Putnam County, showing continued presence of the "testing guns" area a decade after the Civil War. Courtesy of Grossman and Associates, Inc.

PERSPECTIVE VIEW OF THE MAGNETOMETER SURVEY DATA FROM THE
ARCHAEOLOGICAL STUDY ZONE BORDERING EAST FOUNDRY COVE

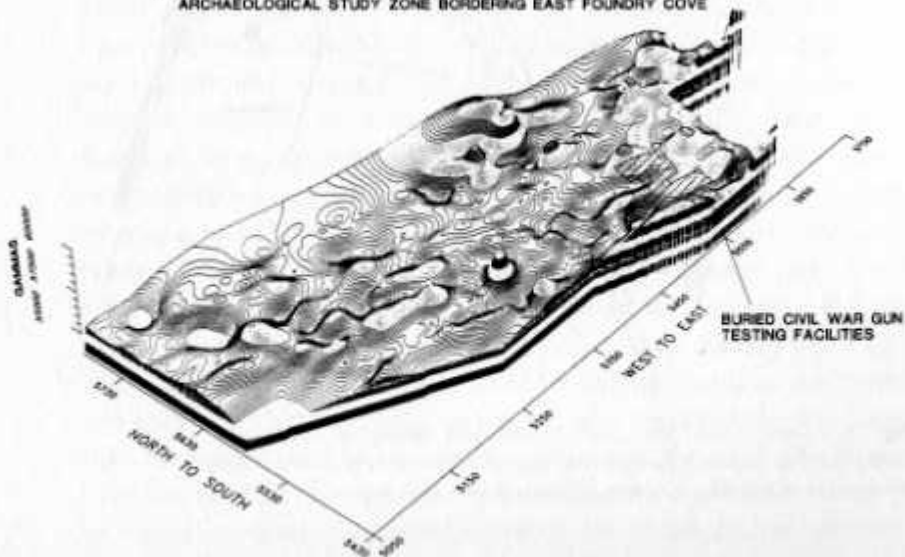


Fig. 11.7. Three-dimensional perspective of topographic map showing the location and magnetic range (gammas) of all identified magnetometer anomalies. The creation of this map led to dis-

BLOCK 400 AND EXT. - COMPOSITE EAST WALL PROFILE

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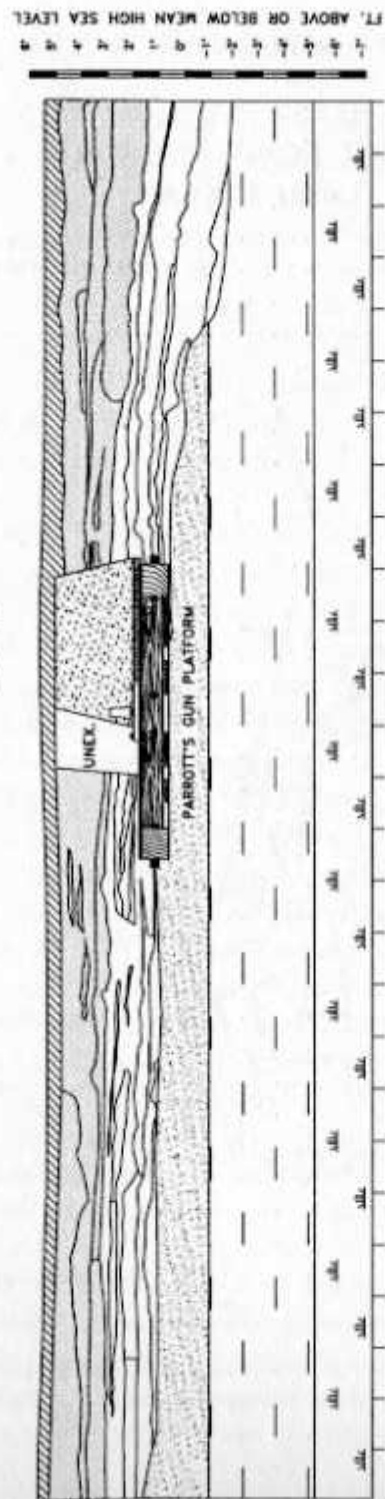


Fig. 11.8. Stratigraphic profile of the R. P. Parrott gun platform and collapsed hoist tower under nineteenth-century fill deposits. Courtesy of Grossman and Associates, Inc.

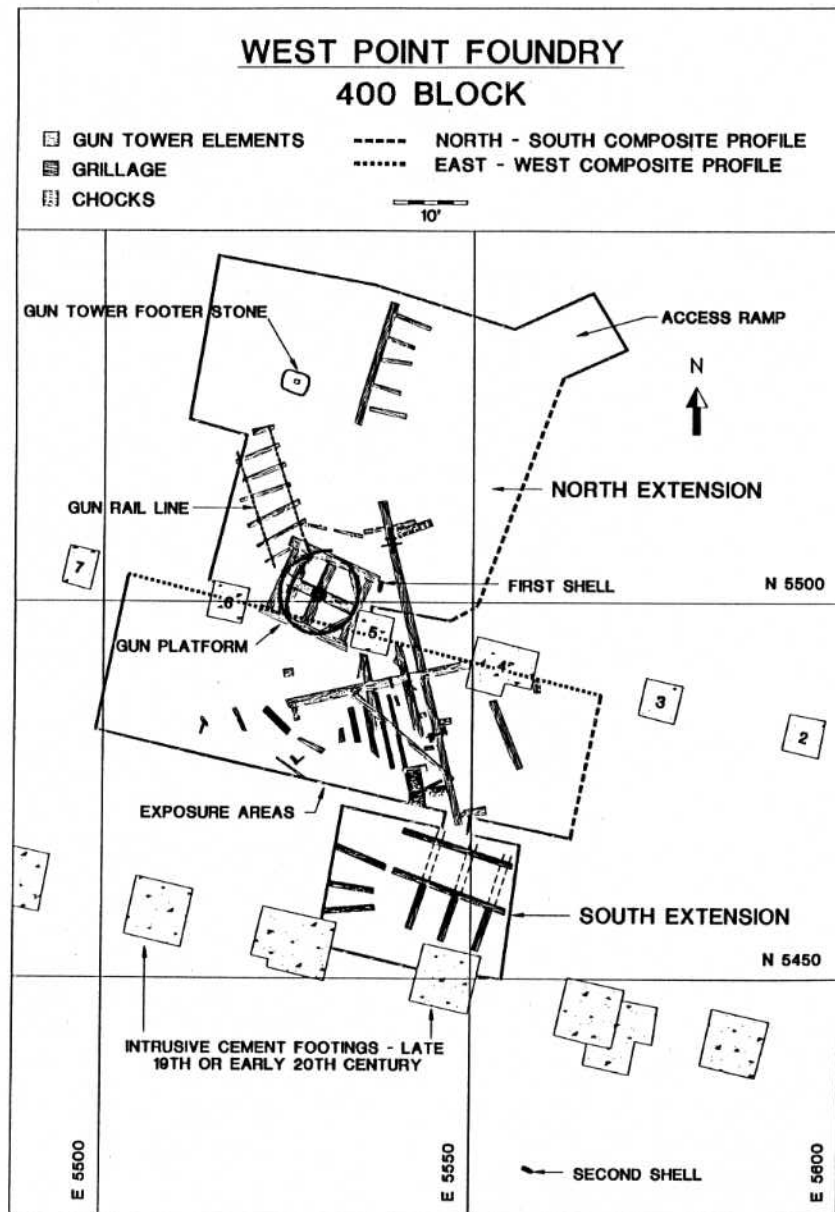


Fig. 11.9. Plan of excavated Civil War gun-testing platform, tower hoist, rail line, and underlying grillage elements (Block 400). Courtesy of Grossman and Associates, Inc.

within the sensitivity corridor defined by the computer-based historic map projections.

Parrott's Civil War era gun-testing facilities were found buried five feet below modern grade. Dated historic artifacts from the lowest level of fill below the buried Civil War surface indicated that the fill process had begun in this portion of the site at least a decade prior to the Civil War. The actual Civil War surface appears to have been laid down as an artificial layer sometime after 1857 and used throughout the war and possibly as late as the 1870s. The overlying fill consisted primarily of a four-foot accumulation of postwar ash and debris deposited between about 1880 and 1903.

In winter 1989–90, research teams identified, exposed, and recorded the well-preserved wartime cannon-testing facilities. These features included the wooden structural remains of R. P. Parrott's gun-testing platform, a rail delivery line used to move the cannon from the foundry, and the base and structural elements of a large cannon-hoisting crane topped by an observation tower. This cannon hoist tower had been used to lift the new class of heavy rifled cannons to the platform for testing, or "proofing" (Grossman et al. 1991: 58; figs. 11.8, 11.9, 11.10).

The wooden gun platform, about twelve feet square, with a cast-iron center pintle to hold the heavy cannon in place, was used in proofing the durability, accuracy, range, and shell velocity of Parrott's larger, eight- and ten-inch rifled cannon and projectiles. The identification and function of the gun-testing platform were confirmed by the archival discovery (after the excavation had been completed) of two original hand-colored plans and profiles rendered by Parrott of his ten-inch, 300-pounder, rifled cannon (fig. 11.11). This same platform was shown in a wartime photograph of the foundry's civilian gun "proofing" crew standing beside a 300-pounder rifled cannon and chassis (figs. 11.12). Another photograph from this era depicted the cannon hoist tower (fig. 11.13).

Once the buried Civil War surface had been defined, it was exposed horizontally with an area-wide control system of five-foot grid excavation units (fig. 11.10). This controlled excavation resulted in the recovery of 4,184 historical artifacts, of which 70.2 percent were stratigraphically associated with the surface supporting the gun-testing platform. Of these, 897, or nearly 25 percent, were associated with military activities.



Fig. 11.10. Excavated gun platform and stone base of hoist tower, looking north. Courtesy of Grossman and Associates, Inc.

They consisted of friction primer pins, tubes, safeties, iron pintle shear pins, vent picks, reamers for loading the shells, lead ammunition seals, and a variety of shells and exploded shell parts. The shells included two 100-pounders. One of these was a standard exploding piece, while the other appears to have been an example of Parrott's little-discussed binary incendiary shell, deployed in 1863, on the orders of President Lincoln, to burn Charleston, South Carolina (Bruce 1989).

The generation of computer-based density plots of each artifact class across this buried Civil War surface permitted the reconstruction of the former location and distribution of gun-crew positions. These plots, particularly the large numbers of friction primers found to the side and rear of the platform, could be correlated with historic Civil War era photographs of the gun crews at work testing and "proofing" a rifled cannon (fig. 11.14).

The artificial floor on which the cannon platform and hoist tower rested was built over a waterlogged historic landfill of ash and slag. The gun-testing or proofing surface was composed of a crisscrossed grillage of oak beams, which in turn was packed with a matrix of brown and green clay. When these structural details were compared with surviving

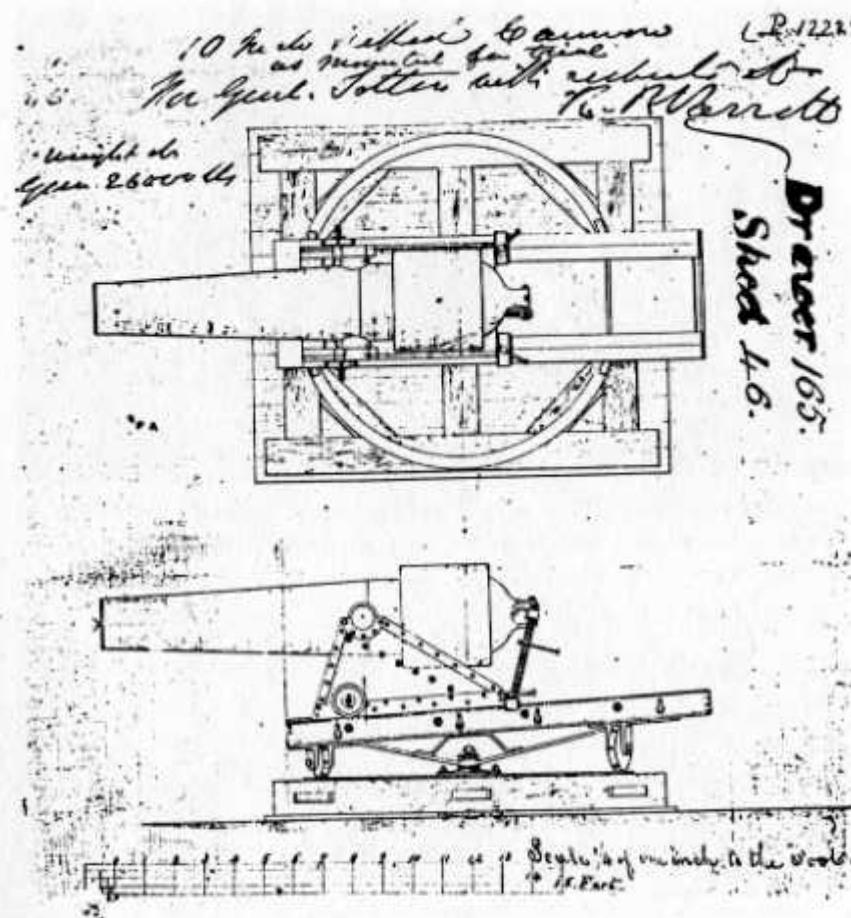


Fig. 11.11. Sketch plan and profile of platform support system for R. P. Parrott's rifled 300-pounder, sent by Parrott to General Totten at the Washington Arsenal. Courtesy of the National Archives.

military engineering reports on the construction of batteries from the Battle of Charleston, South Carolina, it became apparent that this West Point Foundry structure was similar to the famous Marsh Angel gun battery, built far out into the tidal flats of Charleston Harbor. The field records and engineering plans from this battle illustrate the use of a horizontal wooden platform supported by deep vertical pylons. These reports also documented that Alfred Mordecai, the engineer in charge of

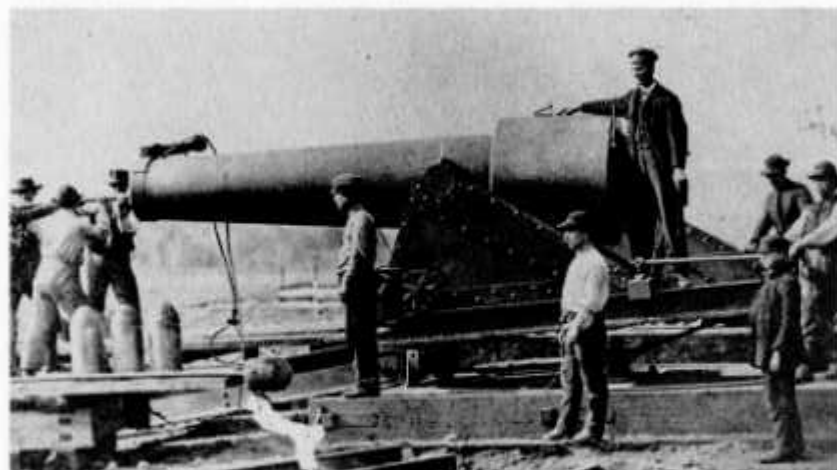


Fig. 11.12. Post-1863 Civil War era photograph of gun-testing crew around a Parrott 300-pounder rifled cannon at the West Point Foundry gun-testing site. Courtesy of the Putnam County Historical Society, Cold Spring.

constructing the Union gun batteries on Morris Island in Charleston Harbor, also had been stationed as an ordnance officer at West Point Foundry before and during the war. The parallels in construction and the presence of the same officer in both posts suggest that this engineering capability for the support of long-distance, heavy-cannon emplacements in bog or marsh environments may have been developed first at West Point Foundry.

The Foundry Workers' Housing Complex

Following the excavation and photogrammetric recording of the gun proofing area, the field investigation shifted to the evaluation of the proposed haul road alignment along the flank of the bluff. Archaeological evidence uncovered here indicated that the composition of the workers' community was more economically complex, technically sophisticated, and ethnically distinct than had been suggested by traditional historical accounts. Previously the workers had been described as predominantly poor Irish and English laborers. However, analysis of the Civil War era artifacts from the workers' homes suggested instead the presence of



Fig. 11.13. Enlarged half of a Civil War era stereograph of the West Point Foundry cannon hoist tower, observation cupola, and gun hoist crane. Courtesy of the Putnam County Historical Society, Cold Spring.

skilled and materially well-off workers from England, France, Germany, and Austria—countries that then were actively involved with the research and development of heavy rifled ordnance (Grossman et al. 1990: 6–7; Grossman et al. 1993; Raoul 1936: 464–65; Kemble 1916: 195).

Analysis of the archaeological data from the large-scale excavation of the structures at the Haul Road revealed the presence of a large assortment of imported high-status technical and scientific tools, many of them associated with military technology. These artifacts did not fit the established characterization of supposedly poor laborers. In addition, a

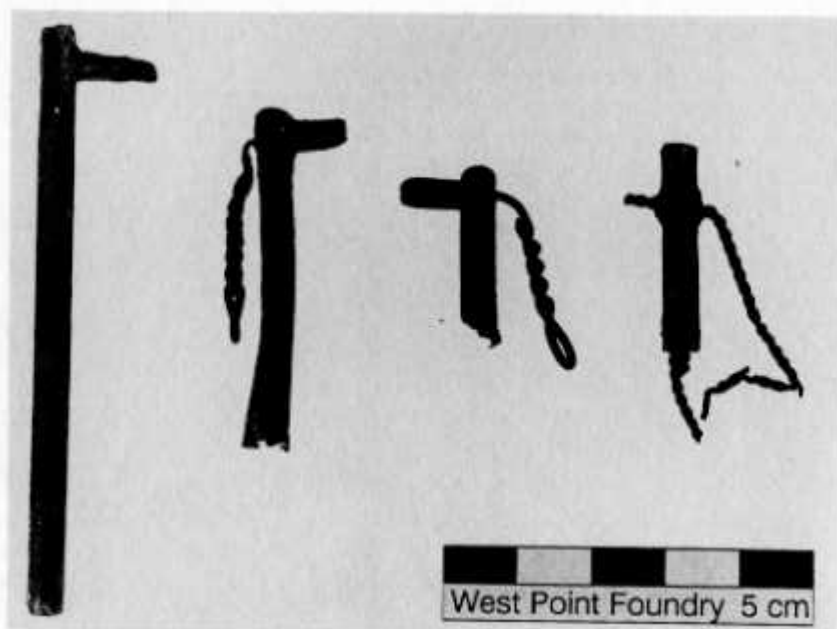


Fig. 11.14. Friction primer tubes, with attached primer wires, which were found concentrated in an oval area about ten feet at its widest point, located southwest of the gun platform. Courtesy of Grossman and Associates, Inc.

variety of children's toys, "collector's" china figurines, miniature dollhouse furnishings, utensils, and jewelry (a cufflink stud, a watch chain, and several crosses: one gold and one with a Celtic motif) were recovered, many of these are luxury items by any standard. Identified ceramics included exotic imported types from China and Europe (including specimens from England, France, and Austria), many of which can be viewed only as high-status items, both today and during the Civil War period. This diversity in ceramic origins was paralleled by the presence of identifiable coins and tokens from France, England, and Venezuela, as well as several specimens of Spanish imperial *reales* minted in Mexico. Furthermore, the excavation revealed a diverse assortment of gentlemen's smoking pipes from England, France (Paris), Ireland, Scotland (Glasgow), Austria, and Germany, and glass artifacts from France, England, Hungary, and Bohemia (Grossman et al. 1993).

Military items specifically associated with the testing and manufacture of large-caliber guns and shells were recovered from the interior floors and features associated with the houses. These military-related items included friction primers, fuses, fuse strikers, fuse adapters, fuse caps, gun sight pendulums, and examples of shot from large-caliber shells, many of which were identical to examples from the previously excavated gun-testing facilities in the marsh. This archaeological evidence strongly suggests that at least some of the Civil War era inhabitants were involved specifically in the testing of 100- to 300-pounder rifled cannon, instead of simply doing general work at the foundry.

Finally, in addition to imported domestic household items of ceramic, glass, and metal, the artifact analysis revealed a number of unique scientific tools and instruments, including microscopes, gauges, a thermometer, calipers, battery jars, electrical contacts, carbon arcs, and timing devices. These artifacts in turn suggest that this group of residents very possibly was involved not only in the testing, but also in research and laboratory activities associated with testing the materials which went into the manufacture of the rifled guns.

Foreign Influences and Antecedents

Based on the archaeological discoveries outlined above, the archival research was expanded and redirected to include sources relating to foreign gun technology, foreign workers, and foreign influences on Parrott's operations. This change in direction yielded unanticipated results. The research (primarily in the National Archives in Washington, D.C.) indicated that the origin and development of Parrott's cast-iron rifled cannon was heavily influenced by, if it was not the result of, an elaborate government-sponsored program of foreign military and industrial espionage before and during the Civil War. This interpretation, supported by private correspondence, records of the Navy Ordnance Bureau, and Civil War era congressional testimony, suggests the probability that key elements of Parrott's rifled gun actually were derived from confidential European designs and antecedents.

In fact, the 1862 date of Parrott's first patent was preceded by an 1860

visit from a Russian officer, or agent, who supplied Parrott with covertly obtained copies of the secret, and tightly guarded, plans for the production of the banded reinforced British Armstrong rifled cannon (Paulding 1879: 265–66). In 1879, Parrott's successor wrote that, in January 1860, twenty-two months before the date of Parrott's first patent, a Captain Schwartz of the Imperial Russian Navy had appeared at West Point Foundry and asked Parrott to make him a British Armstrong cannon. When Parrott said he was unable to because the designs were secret, Schwartz responded by providing detailed plans and specifications of the British gun. The Russian's gun was completed in March 1860, and a few weeks later Parrott produced what was described as "the first experimental gun on his own system" (Paulding 1879: 265–66).

What stands out from the archival research is that the visit of the Russian agent to Parrott's facility was not an isolated event, nor one inconsistent with broader policy and actions by the Russians toward the beleaguered Union cause. In contrast to the pro-Confederate and often pro-interventionist attitudes and actions of Britain and France during the Civil War, the special assistance provided by Captain Schwartz to Parrott was entirely consistent with Russian foreign policy in the mid-nineteenth century. This policy subsequently was manifested openly by the 1863 supportive appearance of the Russian fleet at Northern ports, in a show of force.

The Russian Czar wanted friendly relations with the U.S. for a variety of reasons. At the most mundane level, both countries consisted of large, isolated land masses; both were ethnic melting pots; both had, almost at the same time, emancipated large blocks of minorities, the slaves in America and the serfs in Russia; and, significantly, as the Czar stated in 1866, "The two peoples have no injuries to remember" (Bailey 1958: 363). Another, more immediately pressing, reason existed for a Russian officer to breach British security to help the American defense efforts. As T.A. Bailey pointed out in his *Diplomatic History of the American People*, "The overwhelming sea power of Britain had proved highly offensive to both nations. From an early date the Czar's government had deliberately undertaken to cultivate the U.S. in the hope of building up a New World rival that would curb England's power and pride" (Bailey 1958: 364).

In addition to the Czar's favorable attitude towards Lincoln's domes-

tic policies, the Russian emperor viewed a strong, unified U.S. as a much-needed political, economic, and military counterweight to Russia's recent enemies in the Crimean War. During that war, England and France had thrown their combined military might behind the Turks against Russia (Adamov 1930; Tyrner-Tyrnauer 1962; Woldman 1952).

In actuality, "Russia's pro-Union sentiment prevented participation in any policy alien to the Lincoln administration's wishes" (Howard Jones 1992: 229). Against this larger Russian policy, Captain Schwartz's contribution can be seen as simply representing a clandestine military manifestation of a larger pattern of Russian diplomatic largesse to the North. In addition, this initial input provided by the Russian officer appears to have represented only the smallest tip of what apparently was a much larger pattern of information flow on the state of British and European cannon technology and metallurgy that continued even after the Civil War ended (Wise to Parrott, Dec. 12, 1865, National Archives RG74 E4; Mission 1865; Martin n.d.).

It is also highly probable, judging from official Ordnance Department records and reports, that both the Union military establishment and Parrott, as a former ordnance officer, had detailed knowledge of the status of European research and development efforts concerning heavy rifled cannon in particular, not only prior to the onset of the Civil War, but as much as three years before the visit of the Russian officer in 1860. One early key source was provided in an official report by Major Alfred Mordecai of the Ordnance Department on the field observations of the U.S. Military Commission to Europe during the Crimean War between 1855 and 1856, a report written in 1856 and published in 1861. In addition to detailed field observations on the efficiency of various heavy cannon, including the early British Lancaster rifled cannon (which initially was deployed in the battles of Sebastopol), Mordecai's report included detailed accounts on the layout, workings, and production procedures of armories and foundries in Russia, Prussia, Austria, France, England, and Belgium. Among the primary engineering reports and drawings collected by the commission, Mordecai highlighted the acquisition, from Colonel Frederix of the Belgian foundry works at Liège, of drawings and plans of cannon produced for thirteen foreign countries under contract by that facility.

Of greatest relevance to the issue of early influences on Parrott's work, the study included a special section (part 5) dedicated specifically to the treatment of rifled cannon and shell technology. In addition to describing early trials of the British (Lancaster), Swedish, and Italian rifled canon and shells of various designs, Mordeccai's report included a summary of Colonel Cavalli's research monograph "Memoire sur Sivers Perfectionnemens Militaires," which had been translated from Italian in 1856 and included the 1854 test results on the accuracy and range of Cavalli's experimental rifled guns and shells. The translation documented that the Italians had developed a heavy rifled cannon capable of firing an 81-pound shell over a distance of between 3,140 and 5,627 yards, or nearly three miles, with an accuracy of fifteen to thirty feet (Mordeccai 1861: 110).

In general outline, the overall report summarized past European accomplishments and failures and weaknesses in the design and manufacture of cast-iron rifled cannon, and of cast- and wrought-iron rifled shells, with special attention to those used for the British Lancaster and Whitworth rifled prototypes (Mordeccai 1861: 111). Finally, Mordeccai's intelligence document also included what appears to represent the first American technical description of the design details and initial failures of Krupp's early cast-steel cannon and rifled shells. The Prussian rifled gun, originally manufactured under contract for the British, fired a 259-pound shell, twenty inches long, which was made to spin in the rifled gun barrel through the application of a wrought-iron expansion ring, or sabot, which was later paralleled in design by the first Parrott shells over the same period (Mordeccai 1861: 115).

The Role of the Navy Ordnance Bureau

It is now apparent that the Russian officer's input was not a unique or isolated event; nor was the flow of information across the Atlantic confined to Russian sources. Reports and correspondence by ordnance bureau officers document that, throughout the war, many technical decisions involving the production of Parrott's cannon were made with the approval and oversight of the Navy Ordnance Bureau stationed both in

Washington, D.C., and at West Point Foundry (Brandt 1862). It is also clear that the ordnance officers in Washington, D.C., and at the West Point Foundry had a keen understanding and detailed technical knowledge of the state of British and European arms technology in general, and of the secret British Lancaster, Whitworth, and Armstrong rifled cannon technology in particular (Wise 1866a-c; Padgett 1945: 38-109).

Work at West Point Foundry not only was under the control of officers of the Navy Ordnance Bureau, but also was under the direct and immediate control of its chief, Commodore Henry A. Wise. Wise, in turn, was in intimate contact with special assistants to President Lincoln, and he appears to have served on various occasions as an expediter, trouble shooter, and high-level intelligence officer for the U.S. government. As chief of the Navy Ordnance Bureau, Henry Wise often dined with John Hay, Lincoln's personal secretary. As noted in Hay's diaries, the topic of their after-dinner conversations often pertained to intelligence matters and the potential for war with England (Hay in Dennett 1939: 88, 110; Anonymous, *National Cyclopaedia of American Biography* 1921: 425; Bruce 1989: 16; Grossman 1991: 148).

Wise appears to have begun his career in espionage during the Mexican-American War, with additional experience gained in Southeast Asia and Japan. He made at least one secret mission to Germany to investigate and report on Krupp's new forged-steel cannon technology (Anonymous, *National Cyclopaedia of American Biography* 1921: 425). His access to foreign military secrets was illustrated by the fact that his testimony before Congress often included submission of confidential military documents from other countries, including England. Wise's involvement with issues of foreign intelligence appears to have continued throughout his dealings with the West Point Foundry. He explicitly described them to Congress in his testimony before the Joint Committee Hearings on the Conduct of the War in 1865 (Wise Testimony in U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War: 22-32).

Military correspondence and official reports to and from the Navy Ordnance Bureau revealed multiple references to the status of European capabilities and technology of the period, and allusions to plans and specifications for the products of various British and European muni-

tions centers (Mordecai 1861; Wise Testimony in U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War: 22–32; Grossman 1991; Grossman et al. 1993). Additionally, explicit references to the “giving” or “exchange” of details of American technology to foreign diplomats, with the hint of reciprocal benefits, cast in a very different light the developments documented as having taken place at Parrott’s West Point Foundry. Instead of Parrott’s working in isolation, the testimony by ordnance bureau officers stationed there (most with extensive overseas field experience) documented the availability of a wealth of confidential information concerning the status of foreign research and development in rifled cannon technology (Testimonies of Wise, Mordecai, Benét, and Benton in U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War).

As documented in Senate testimony at the time, the American officers knew, press accounts to the contrary notwithstanding, that the carefully engineered and finely tooled British Armstrong cannon was unreliable and was being withdrawn from service. They knew that the European bronze guns were too soft to withstand the pressures of rifled shells, and that the heavily promoted Prussian forged-steel Krupp cannons were unreliable and tended to explode with grenade-like force (Benton Testimony in U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War: 62). By 1863, after the bombardment of Charleston, these officers knew that the British banded Whitworth guns (one of which was experimentally deployed at a Union battery), the successor to the Armstrong, proved too delicate in combat conditions, and was 20 percent less accurate than the cast-iron Parrott cannon (Parker in Gilmore 1865: 310). In fact, the Americans were in control of information regarding the strengths and weaknesses of almost every competing rifled cannon system, at the same time that they were testing and evaluating Parrott’s reinforced cast-iron cannons (Parker in Gilmore 1865: 310; Barry and Benét Testimony in U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War: 47, 62).

As an example, American and foreign officials had detailed knowledge of Krupp’s Prussian experiments with cast-steel rifled cannon. Although many early histories of Parrott and the West Point Foundry have alluded repeatedly to Parrott’s initial awareness of Krupp’s 1849 experi-

ments in Prussia as the impetus for his own research and development efforts in rifled cannon, the weight of surviving archival evidence suggests that this description of his inspiration is inaccurate. Both the British and the Americans, while impressed with the cast-steel technology as a concept, were aware of a pattern of mortal failures of Krupp’s steel guns. In addition, as General John G. Barnard, chief engineer for the defense of Washington, D.C., revealed in his Senate testimony, the Americans had developed their own opinion of the Krupp guns through hands-on experimentation, and were not overly impressed:

In Prussia, Krupp has made rifled guns of 9-inch caliber (about 200 pounds) of cast-steel, which is probably the strongest of all materials, the steel being cast upon a core and later forged. The Russian government have [*sic*] given him extensive orders, and I have recommended the Governor of Massachusetts to import a few of them. It is a very expensive material, and the process of forging large masses seems yet to be uncertain. I have since observed that one of them recently burst at St. Petersburg. (Barnard Testimony in U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War: 173–82)

In addition to well-informed naval ordnance officers, Commodore Wise’s network of informants during the Civil War included a number of special civilian agents who had sufficient standing in Europe to gain access to otherwise restricted installations. Two such special agents who played key roles in the acquisition of detailed technical information on the manufacture, performance, and reliability of British and German rifled cannon and shell prototypes were Abram S. Hewitt and Henry S. Sanford, who at the time were publicly perceived as, respectively, an industrialist and a diplomat.

As Lincoln’s diplomat-at-large in Europe, Sanford is credited with playing an important role in undermining Confederate maneuvers in France and England (Wriston 1929: 779). Sanford’s diplomatic career began with his appointment as attaché to the Russian court in Saint Petersburg, followed by a posting in Paris, and then, with the inauguration of President Lincoln, as minister to Belgium. Sanford has been recognized for his skill in undertaking delicate missions. Of immediate relevance to the Union’s weapons development program, he single-

handedly supplied the North with otherwise unavailable stores of saltpeter, the key ingredient of gunpowder, and also played a key role in conducting back-channel negotiations with the British over the Trent Affair (Anonymous, *National Cyclopaedia of American Biography* 1921: 140; Axelrod 1992: 194).

Sanford reported directly to Commodore Wise when his activities involved the acquisition of information and hardware relevant to the bureau's weapons development program. His clandestine activities also included acquisition of difficult-to-obtain examples of production prototypes of European ordnance. Unpublished letters from Sanford to Wise in 1863 also document in detail his role in acquiring and sending an example of Krupp's cast-steel cannon to the U.S. for testing. In this instance he was beseeching Wise to help direct the piece to suitable authorities so that it could be tested properly and "given to our Yankee inventors to look at and endeavor to imitate its metal." He went on to say that "Gen. Chazal, the Minister of War here [Belgium], told me that he had tested one by 10,000 discharges in every conceivable form . . . and he considers it indestructible" (Sanford to Wise, Aug. 7, 1863, Wise Papers, LB 5, No. 6.5, New York Historical Society, New York).

In contrast to Henry Sanford, Abram Hewitt's wartime exploits and ties to Wise have not been recognized previously. His firm, Cooper and Hewitt, was the first to produce iron girders and supports to be used in fireproof buildings and bridges in New York. Utilizing the reputation (and access to facilities which may have been closed to others) gained by his innovations in cast-iron structures and molded facades, in 1862 Hewitt "visited England in order to learn the process of making gun-barrel iron, and was enabled to supply the gun-barrel material needed by the U.S. government during the continuance of the civil war" (Anonymous, *National Cyclopaedia of American Biography* 1921: 295). This fact, as well as his critical involvement in the production of Union mortars, also under the direction of Wise, became public record after the war (Nevins 1935; Bruce 1989: 159).

What was not known, however, is that, when Abram Hewitt reported back to unnamed members of the U.S. government, he reported directly to Commodore Wise of the Navy Ordnance Bureau, a relationship documented in a series of unpublished letters from Hewitt to Wise. Of

immediate pertinence to Parrott's work with rifled cannon development is one particular letter which details the technological history and production techniques of the British precursor to the Armstrong cannon. The description is revealing because it highlights the technical parallels between the British methods of production and those ultimately adopted by Parrott for making the reinforced element around the breach of his cast-iron rifled cannon. Hewitt wrote:

Capt Blakeley commenced with a wrought iron tube, with wrought iron jackets in rings. His next step was to abandon the rings and substitute a continuous jacket. This was shrunk on hot, while the inner ring was kept cool with a stream of water [the very procedure that Parrott characterized as being a key element of his "invention"]. . . . His next step was to make the initial tube of cast iron, and to shrink on it a jacket of wrought iron. (Hewitt to Wise, Apr. 22, 1862, Wise Papers, LB1, No. 9, New York Historical Society, New York)

This unpublished source suggests that, given his ties to the Ordnance Bureau in general and to men under the command of Wise in particular, it is highly probable that Parrott was well aware of the essential details of ongoing European research.

Lincoln and Executive Branch Involvement

Several newly discovered primary sources document that President Abraham Lincoln was intimately involved with rifled cannon technology early in its developmental history. Perhaps the most overt example of industrial espionage by the Federal defense establishment involved the purchase and trans-shipment of a battery of British Whitworth cannon for testing and combat deployment through private sources during the Civil War. The details of this acquisition and the resulting evaluation of the gun's worthiness were first brought to light in an unpublished letter to Lincoln from his first secretary of war, Simon Cameron, dated July 1, 1861; and in detail later, in 1864, during hearings held by the U.S. Joint Committee on the Conduct of the War.

This unpublished letter documents that President Lincoln knew of

the ongoing efforts by the War Department to acquire heavy gun technology and details of rifled shell technology by as early as July 1861, several months after the war had begun. On July 1, 1861, Secretary of War Simon Cameron reported that efforts were being made to acquire and test current models of European heavy ordnance from England and on the continent, including France and Austria:

Some patriotic American citizens resident in Europe, fearing that the country might not have a sufficient supply, purchased on their own responsibility, through co-operation with the United States Ministers to England and France, a number of improved cannon and muskets, and at your [Lincoln's] insistence, this department accepted the drafts drawn to defray the outlay thus assumed.

A perfect battery of the six Whitworth 12 pounder rifled cannon, with three thousand rounds of ammunition, the magnificent donation of sympathizing friends in Europe, has also been received from England (Cameron to Lincoln, July 1, 1861, National Archives RG107 E5).

The wording and date of this report to the president are important for three reasons. First, the report documents that, early in 1861, Lincoln was aware of the U.S. efforts to acquire and benefit from European research and development accomplishments in large-caliber rifled cannon. Second, this document shows that the U.S. was keenly aware of the superior fire power, accuracy, distance, and penetration capabilities of rifled ordnance as early as 1861, and already was converting its existing 32- and 42-pounder smooth-bore cannon into rifled versions. Third, this report documents that, prior to July 1861, during the first months after the outbreak of the Civil War, Lincoln had sanctioned and paid for the importation and testing not only of British Whitworth rifled cannon, but also of other new systems from England and France.

Access by the Navy Ordnance Bureau and the executive branch to many of the most carefully guarded secrets of the European arsenals was forcefully illustrated by the discovery in the National Archives of a previously unknown numerical table found folded with an 1863 personal note to President Lincoln from Admiral Dahlgren. This handwritten listing was titled "Tables of Comparative Power of American and European Heavy Rifled Ordnance" (Dahlgren to Lincoln, Jan. 24, 1863, National

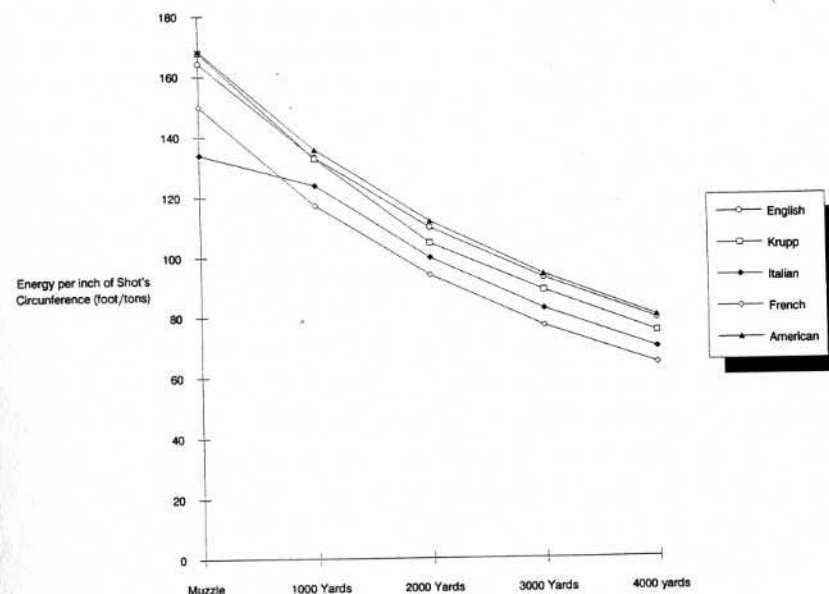


Fig. 11.15. Line graph derived from classified Civil War memo and data table presented to President Lincoln by Admiral Dahlgren. It compares the energy per inch of shot circumference (potential penetration in foot/tons), between American and European ten-inch rifled cannon. Despite public misconceptions to the contrary, this confidential briefing document illustrated the superiority of American rifled cannon relative to European heavy ordnance. Derived from Navy Ordnance Department Records, National Archives.

Archives RG156 E200). The comparative table was a detailed technical report, of the most confidential nature, on the relative shell velocity of American versus English, German, Italian, and French rifled shells of various calibers (fig. 11.15).

This data comparing domestic and foreign shell velocity showed Lincoln that the inexpensive American rifled guns produced by Parrott at West Point Foundry were, in fact, 5 to 20 percent superior in velocity and fire power, depending on the caliber and country in question. What the data indicated to the president was that, by 1863, Parrott's rifled cannon and shells, at close range, could outgun a British or French ironclad. This would have been critical information for a commander-in-chief faced with the possibility of a sea-based conflict with foreign ships. The discovery of this document was important because it clearly indicated that both the Union War Department and President Lincoln con-

trolled, and had timely access to, tactically specific hard data on the strengths and weaknesses of European weapons systems of the time. Given the volume of foreign, predominantly British, weapons that were being shipped to and used by the Confederacy, this document indicates that Lincoln and his inner cabinet of military advisors were making war-time decisions based upon intimate knowledge of the tactical and technological capabilities and weaknesses of their adversaries (Hay in Dennett 1939: 76; Anonymous, *National Cyclopedia of American Biography* 1921: 425; Grossman 1991: 147).

While no explicit mandate for the development of a foreign intelligence gathering program was found in any of the surviving archival sources, the existence of such a program was alluded to in an official 1864 report for the U.S. Navy (initially presented before Congress in 1864 but not published until after the War), concerning the status of heavy ordnance. In the report Wise stated, "The bureau has sought in vain among the systems of European nations and the improvements of our own country for a better gun, taken as a whole, than the Parrott rifle" (U.S. Congress 1869: 156–57).

This oblique yet explicit reference and other comments by high-ranking officers and staff of the Navy Ordnance Bureau, speaking before U.S. Senate investigators during and after the war, clearly document that this stream of confidential information flowed through the offices of the Navy Ordnance Bureau, both to the executive branch of President Lincoln and to U.S. producers of heavy ordnance.

Parrott's Accomplishments in Retrospect

Given the fact that Parrott's work during the Civil War was supervised and predominantly funded through contracts with the Ordnance Department, it now appears highly probable that Parrott actively utilized data on the most promising experimental systems and techniques of manufacture coming from Europe. Only when this broader international context of fluid transatlantic information exchange and access to foreign sources is taken into account can we accurately evaluate the details of

Parrott's foundry operations, production procedures, and accomplishments in the area of heavy rifled ordnance.

Parrott's public image was that of a lone inventor who developed his new cannon at his own expense and in isolation, with little government support. He helped to cultivate this impression. In 1862 Parrott wrote, "I was led to the construction of my gun wholly by my own experiments and conclusions." The originality of Parrott's design and patent was officially questioned, however, in 1864 and 1865, during confidential Senate investigations following the repeated occurrence of premature explosions of his shells and cannon in both land and sea combat (Grossman 1991: 222–23; Turner in Gilmore 1865: 151). In 1865, while testifying under oath before the U.S. Joint Committee on the Conduct of the War, Parrott initially reiterated his claim to invention by stating: "In 1860, I made the first of these guns. I made it from my own ideas upon the subject of what would make a gun of moderate cost and of good strength." Chairman Wade pushed the point and asked, "You were the inventor of these guns, were you?" Parrott responded in the affirmative, but with a little more caution: "Yes, sir. I do not pretend to be the inventor of the idea of putting a band on the gun because that thing has been tried before; but I believe my gun is the first banded gun that was ever actually introduced into the service of any country as part of its armament" (Parrott Testimony in U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War: 139). With these words Parrott essentially negated his earlier claims for invention of the gun, and instead emphasized only the production and incorporation of this technology into the American arsenal.

Thus, the idea of a banded or "hooped" rifled cannon was not new, either in Europe or the U.S. It was the details of design and methods of production for the Armstrong cannon that provided the critical technological elements for Parrott at Cold Spring. The proprietary aspect of the Armstrong cannon involved the use of a heavy, steam-powered trip hammer to weld a wrought-iron coil, or band element, and the use of heat and controlled cooling to evenly shrink the band onto the barrel of the gun. If the Russian officer indeed provided Captain Parrott with the details of the British system of making rifled cannon with wrought-iron

hoops as reinforcement around the breach, then he had the essential elements to make a highly accurate, high-velocity, long-distance cast-iron gun which would not break apart when fired with a heavy charge and sluggish rifled shell. By adopting this one element of a coiled wrought iron band over the breach of the gun, Parrott would have been able to develop an inexpensive and easily produced rifled cannon, at one-half to one-quarter the cost of contemporary British guns (Grossman 1991). Thus, from an engineering perspective alone, the development of Parrott's rifled ordnance appears to have reflected awareness of, access to, and familiarity with the latest military developments in weapons technology in Europe at the time.

Discussion

The discovery of historically inconsistent high-status and "high-technology" Civil War era artifacts in the isolated complex of "workers housing" above the foundry precipitated the focused archival investigation of formerly confidential primary sources. These sources cast a different light on the status of American heavy weapons technology relative to contemporary developments in England, France, Germany, Belgium, and Russia. They provide new evidence that Parrott was not working in isolation and that the foundry which he administered rather was, from its inception, controlled, supervised, and financially supported by the ordnance bureaus of the military. The developments which took place there were not isolated phenomena, but instead formed part of a concerted effort involving the assimilation of the most current developments in the European arms industry, through extensive borrowing and outright espionage.

Taken together, these data now suggest that the Union was actively and covertly working to gain access to, and to apply, the results of costly European research efforts in heavy rifled cannon development, which had been under way since the 1850s. This policy of industrial and military espionage, and its manifestation in the products of the West Point Foundry, in effect saved the Union millions of dollars and years of development time—time that, at the onset of hostilities in April 1861, the

North did not have. What took the British over a decade and over \$12 million dollars to develop, with questionable success, was accomplished at Parrott's facility in a matter of months and at a fraction of the cost (Holley 1865: 80). While the North was five years behind Europe in heavy ordnance technology at the beginning of the war, by 1863 it had matched if not surpassed its European counterparts in what was, in fact, a transatlantic arms race.

This archaeological and archival investigation also highlighted the existence of an effective foreign intelligence gathering capability which operated out of the Navy Ordnance Bureau, with direct lines of communication to both the president and Parrott. This information network appears to have operated under the direct control of Commodore Henry A. Wise, who served first as assistant to Adm. John A. Dahlgren, chief of the Navy Ordnance Bureau, and then, as of 1863, as Dahlgren's successor in the position (Hay in Dennett 1939: 108–10). As the archaeological and archival investigations have documented, Wise directed the flow of ongoing research and testing work for the development of heavy weapons systems for the Navy, at the West Point Foundry and other munitions centers. He did so based on an extensive knowledge of the status of research and development efforts in heavy rifled cannon systems throughout mid-nineteenth-century Europe (U.S. Congress 1865, Joint Committee Hearings on the Conduct of the War: 22–32).

Thus, during the war, the Navy Ordnance Bureau was not limited to merely administering and tracking government purchases and acquisitions. Instead, it also was intimately involved with larger issues surrounding foreign technological advances and ongoing government efforts aimed at benefiting from access to, and utilization of, these European accomplishments in rifled cannon and shell technology. It was in this context, and in direct response to acquired insights into the status of European weapons technology, that the Union military establishment managed its domestic cannon and shell development program in heavy ordnance. Against this backdrop, as chief of the bureau, Wise, and his officers stationed at West Point Foundry, appear to have controlled information on almost every aspect and detail of Parrott's foundry operation, including access to, and flow of, foreign technological and military secrets to the foundry and to Parrott.

In addition, Commodore Wise worked in intimate contact with Lincoln, as well as with members of the president's "kitchen cabinet" which met with little or no public visibility and worked with Lincoln throughout the war (Hay in Dennett 1939: 76; Bruce 1989: 159). Because of the president's 1862 visit to the foundry, his constant association with Wise, and his direct involvement in the first field experiments with rifled incendiary shells, Lincoln was aware of the capabilities and tactical implications of heavy rifled cannon technology for both domestic and transatlantic conflicts at least as early as summer 1862, if not before (Benét in Bruce 1989: 97; Grossman et al 1991). Cameron's letter to the president in 1861 suggests that Lincoln's personal involvement with heavy rifled cannon may have been established by 1861.

Furthermore, American developments in heavy ordnance took place with a dual focus—on preparing for potential threats to the Union not only from the South but from the transatlantic naval powers of England and France. Much of the concern for developing an effective rifled cannon centered on countering, and preparing for conflict with, one of these latter two maritime powers, most urgently during the first half of the war, between 1861 and 1863, when the threat was greatest. It was during this time that Parrott's efforts to develop and produce his 200- and 300-pounder rifled cannon were at their peak.

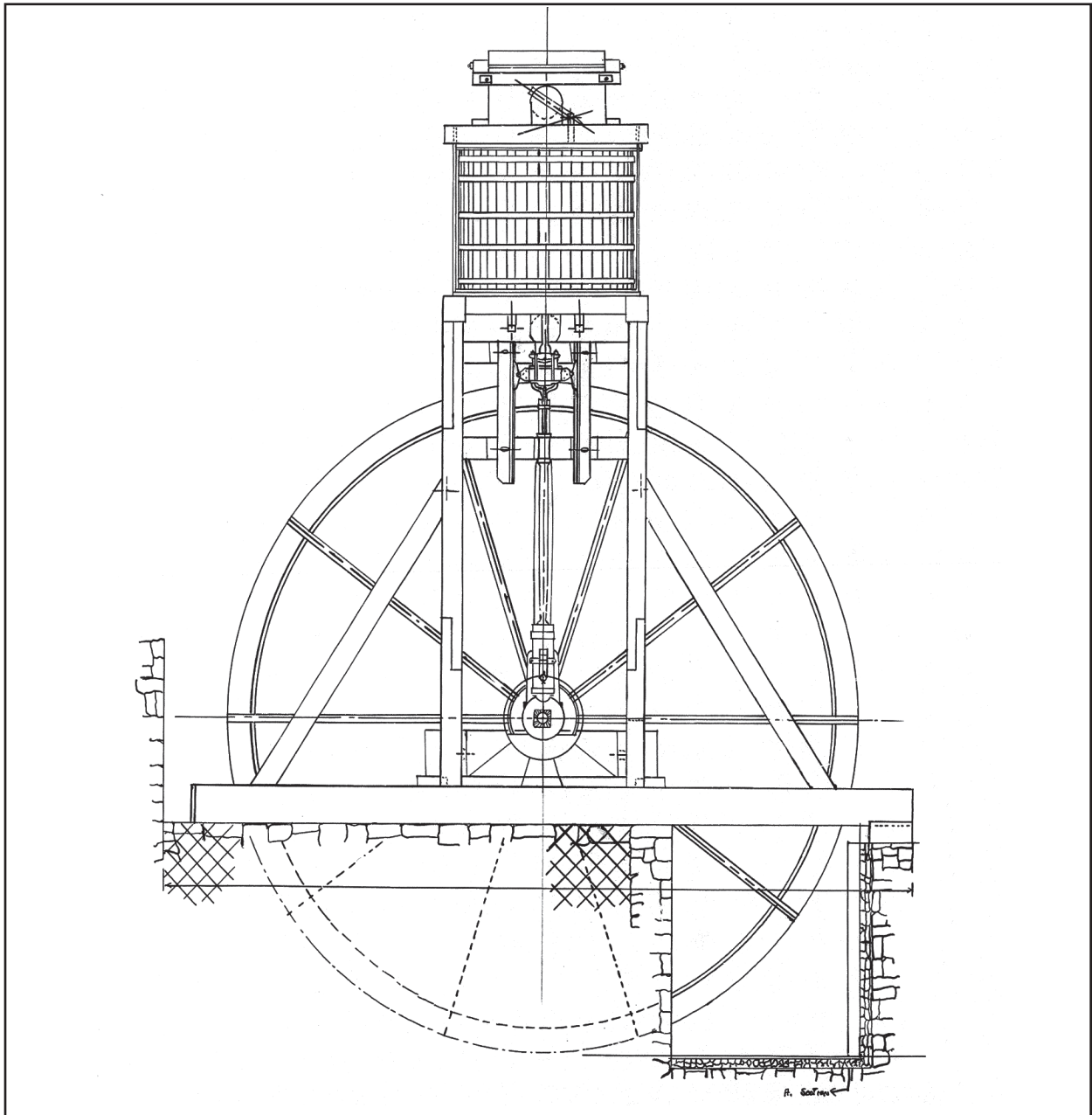
These insights from the West Point Foundry investigation are presented not to derogate Parrott or detract from his accomplishments, but instead to place the role of Parrott, the West Point Foundry, and the Union military establishment in a new perspective. The archaeological and archival evidence strongly suggests that Parrott, rather than being an example of "Yankee ingenuity" in a regionally and technologically isolated context, was a player in a sophisticated international and national program of military intelligence and espionage. The foundry itself, rather than being an example of fledgling capitalism at its best, rising to meet the technical demands of the government in times of need, in fact functioned as a "proprietary" operation, heavily underwritten by the government, much like the "Flying Tigers" in China during World War II or "Air America" during the Vietnam War era.

This data recovery program, mandated by the U.S. Environmental Protection Agency, has resulted in the discovery of what appears to rep-

resent the unique remains of Civil War era military technology not otherwise preserved at any known mid-nineteenth-century site or institutional repository. In terms of its contribution to Civil War history, the physical and archival discoveries which emerged from the West Point Foundry investigation shed new light on the history of Parrott's invention in particular, and on the development of American military technology in general. The documentary investigation of Civil War foreign intelligence efforts triggered by the archaeological discoveries has written a new chapter in Civil War history. What has emerged is a story of nationally- and internationally-based intelligence operations which flourished under the sanction of President Lincoln and his inner circle of military advisors. The historical implications are complimentary to Lincoln's administration and suggest a level of technological and geopolitical sophistication which appears not to have been recognized in past treatments of Lincoln's executive branch structure and operations.

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Trace Element Time Markers as Proxies for the Calibration of Civil War-Era Sediment Accumulations at the West Point Foundry

Joel W. Grossman, Robert J. Taylor, and Eri Weinstein

Abstract

Between 1989 and 1995, Joel Grossman and his team were selected by the Environmental Protection Agency and Army Corps of Engineers to conduct the first major archaeological excavation of the contaminated Superfund and National Register site of the West Point Foundry in Cold Spring, New York. The project included both a terrestrial and a marine aspect. The team needed to determine the depth of the buried and submerged Civil War-era surface within the shoreline coves that were to be dredged to remove cadmium deposits deposited by a twentieth-century nickel-cadmium battery plant. The trace elements of copper (Cu), lead (Pb), and cadmium (Cd) were used to calibrate the depth of historic and modern marine sediments as part of the remediation process. We selected copper and lead because both metals represent industrial byproducts of military smelting. Six cores were successfully recovered from submerged Hudson River and marsh sediments. We used the depth of recorded increases in the levels of both metals to demarcate the onset of foundry operations in 1817. Increases in mid-level readings of Pb and Cu suggested a major increase in effluents during the Civil War. Twentieth-century fluctuations are tied to the advent and elimination of leaded gas.

Dating archaeological deposits can be difficult. The dating of submerged cultural, or anthropogenic, sediments can be even more so. This report will summarize the use of lead, copper, and cadmium (Pb, Cu, and Cd) concentration in core profiles to establish the depth of datable historic sediments in an important but contaminated archaeological site complex composed of riverine and terrestrial components. This dating method also proved useful in determining the relative depth of proposed dredging operations. In the early 1990s, metal concentrations served as chronological proxies to augment the 1950-era nuclear benchmarks from the first atomic bomb tests which were, until that time, one of the few sources for dating of twentieth-century sections from vertical core samples. These archaeological benchmarks augment the inventory of available time markers in the Hudson River sediments and provide archaeological proxies for three critical events in the local history: 1) the opening of West Point Foundry operations in 1817, 2) the peak of foundry production during the Civil War years (1858–1865),¹ and 3) the onset of discharge of cadmium into East Foundry Cove from the Marathon Battery Company in 1953.²

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The U.S. Environmental Protection Agency and Army Corps of Engineers selected Grossman and his team to plan and direct the first federally mandated archaeological investigation of a contaminated Superfund site. This investigation took place between 1989 and 1995 in the context of a large-scale, multi-year archaeological sensitivity study and mitigation program required by Section 106 of the National Historic Preservation Act ahead of critical remediation work to remove cadmium from the shore and cove areas around Cold Spring, New York (figure 1).

The clean-up area encompassed the Civil War-era iron manufacturing complex of the West Point Foundry, which specialized in cannon for the military, steam engines, and sugar production machinery, as well as general commercial iron products.³ Cadmium deposits from a post-WWII battery factory built over the historic foundry needed to be removed, both on land and from the marshes bordering the river. Clean-up could not begin until the poorly defined historic site had been documented. The Superfund effort posed critical health and safety constraints, and there was a need to expedite the fieldwork under often adverse weather conditions. It also represented a logistical and scientific test case of the ability of archaeology, as a discipline, to meet federal preservation laws in contaminated and potentially dangerous contexts.⁴

Fieldwork along the shoreline of the foundry complex was completed in deep winter under heavy, custom-built steel-reinforced shelters covered with inflated, forced-air-insulated, plastic skins. Heavy pumps worked around the clock to lower the water table down to the level of the buried Civil War surface, five ft. below the 1990 grade. Large industrial heaters ducted hot air to

the shelters to keep the artifacts and archaeologists thawed. All field and laboratory team members were HAZMAT-certified and medically monitored. A range of applied technology solutions was deployed to facilitate the safe and timely investigation and documentation of the site. Instead of using “statistically valid” random sampling, liability and health concerns necessitated a strategic shift to safer, non-random, target-specific geospatial and geophysical technologies to locate buried and submerged resources. Traditional “hands-on” manual recording was improved with remote, or non-contact, high-speed 3D laser transit and photogrammetric recording systems to limit exposure to potentially toxic deposits and artifacts. On-site concurrent computer and conservation systems provided real-time feedback and planning capabilities, reducing uncertainty over where sampling should occur and focusing project resources on only undisturbed, high integrity study areas.

The five-year archaeological rescue effort resulted in major discoveries in Civil War military history. Intensive terrestrial geophysical surveying of a football-field-sized shoreline area targeted for cleanup and land reclamation resulted in the discovery and documentation of the preserved wooden and iron gun testing platform of Parrott’s 30,000 lb. rifled cannon (figure 2). Recovered beside it were the remains of the cannon hoist tower for lifting this new class of heavy rifled ordnance. These archaeological materials were covered by a deposit of 3–5 ft. of cadmium-laced industrial fill. While these terrestrial discoveries have been extensively described, the riverine elements of the overall study have not.⁵ This summary presents the use of trace elements as markers or proxies to document historic riverine and marsh sediment depths.

The marsh and riverine portions of the investigation combined scaled comparisons of historic bathymetric surveys, geophysical (magnetometer) marine surveys and side-band sonar scans with historic trace element analysis to reconstruct the Civil War-era bathymetry, sediment depths and archaeological sensitivity of East and West Foundry Coves. Historic bathymetric maps were digitized, scaled, and georeferenced using early CAD software and then compared with the geophysical data to indicate the relative depths of sediments within West Foundry Cove (figure 3). Comparisons between 1857, 1905, and 1933 maps showed considerable differences in channel, cove, and marsh sediment depths between the mid-nineteenth and early twentieth centuries.⁶

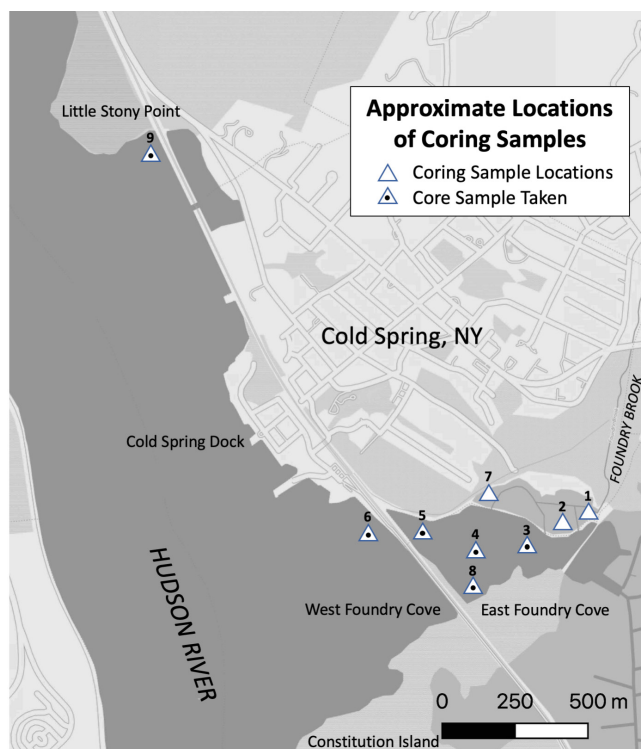


Figure 1. General location map of core samples from East and West Foundry Coves, Cold Spring, New York. Map by Steven A. Walton.

Figure 2. Photo of a 30,000-lb. Civil War cannon taken at Cold Spring, NY, 1863. Courtesy of the Putnam County Historical Society, Cold Spring, NY.

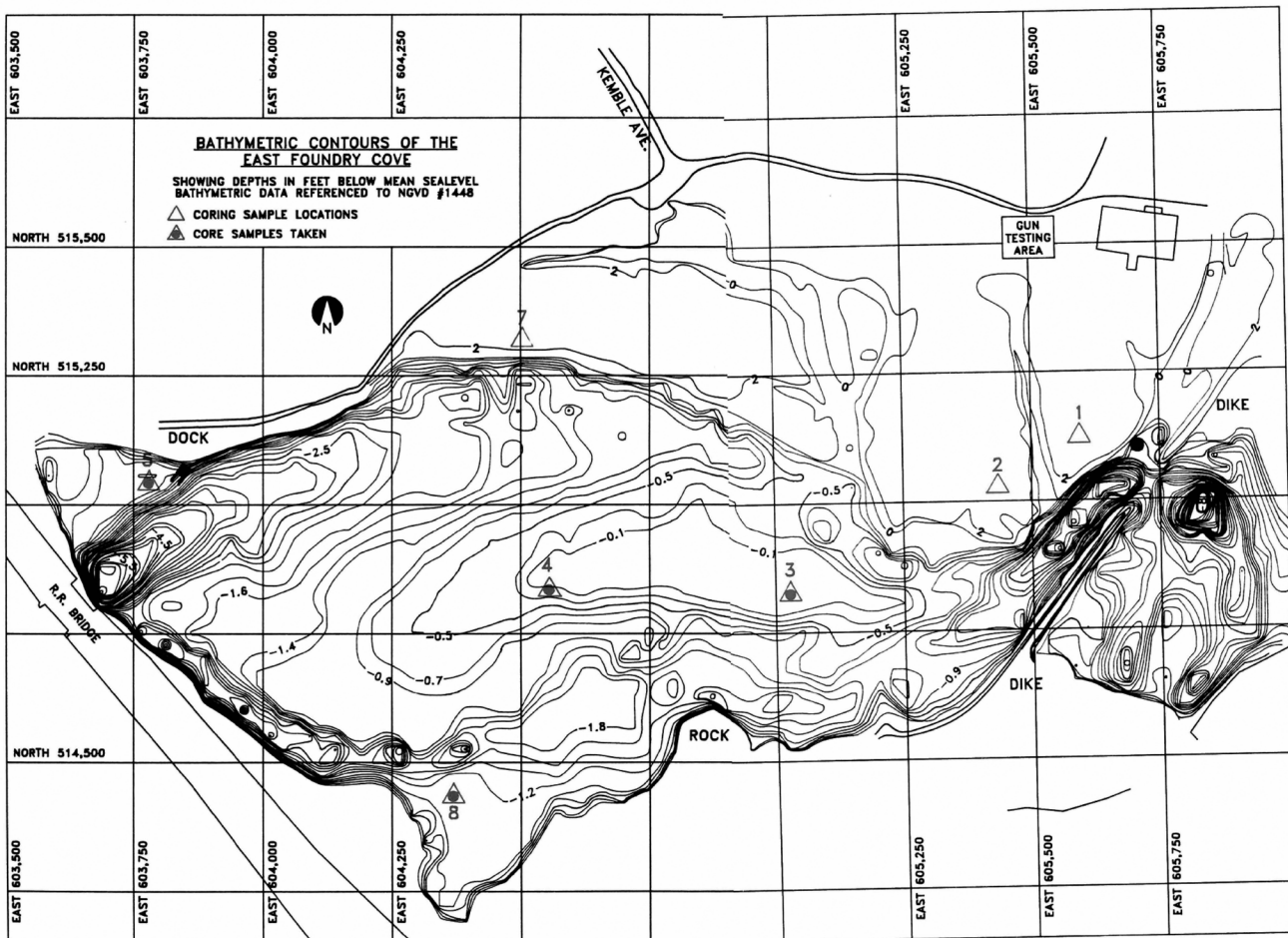
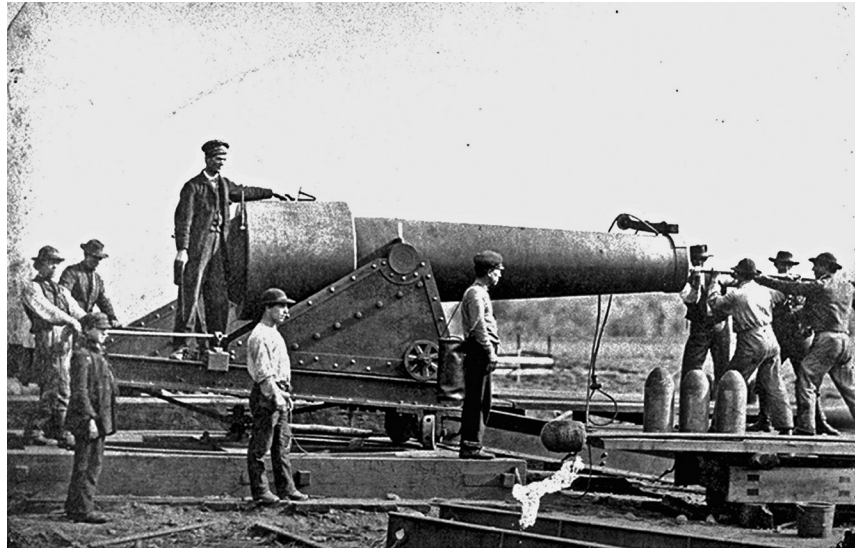


Figure 3. Detailed bathymetric map of coring all sample locations relative to core samples. The triangles with dots show where five were recovered. Map by G. Myers.

Based upon the comparison of eleven discrete sets of overlapping depth readings, both the absolute depth accumulations and the computed rate of sedimentation between different areas of West Foundry Cove and the shoreline of Cold Spring showed a wide range of variation. The computer-based comparisons of historic bathymetric records showed varying sediment accumulation totals, ranging between 6 in. and 9 ft. for different areas of West Foundry Cove between 1857 and 1905. Negative accumulations identified for the period spanning 1905–1933—that is, where the cove was deeper in places than indicated on previous surveys—suggested that extensive areas of West Foundry Cove and the shore front had been dredged during the first half of the twentieth century. Because of this heavy dredging activity, it was not possible to use this more recent map series (1905–1933) for establishing estimates of sediment accumulations for this period. Nevertheless, the earlier comparisons between 1857 and 1905 showed significant differences in the depth soundings within West Foundry Cove. One area near sample location (Core 4) showed sediment loss by almost 9 ft. as indicated by lead-line readings between 1857 and 1933.⁷

In addition to the historic map investigation, side-scan sonar and magnetometer instruments crisscrossed the river in front of the Foundry to help identify, avoid, and protect any submerged resources. Together, they defined the presence and location of twenty-seven anomalies, of which fourteen could be associated with discrete submarine remains. These included two historic barges, two probable shipwrecks, as well as a range of magnetic targets which could not be identified as to function. They did not, however, establish the absolute depth relative to the proposed dredging operations of the anomalies identified by the sonar and magnetometer.

The definition of the depth of the submerged Civil War-era surface, or “historic cove bottom,” and the magnetic and sonar anomalies presumed to be on that buried Civil War surface would require other investigative procedures to date the different layers in the vertical column of sediments. Grossman selected metallic trace element analysis as a possible method to identify the depth of the buried historic interface. Analysis of “Vibra-core” sediment cores taken across the study area identified shifting concentrations of historic metallic trace elements in a series of sub-bottom cores. Distinct fluctuations in lead and copper concentrations were identified as potential historic fingerprints because of the belief that their initial presence demarcated

the onset of foundry operations in 1817 and that the increase in metal concentration recovered at shallower core depths was coterminous with the surge in foundry output from 1858 to 1867, the years of peak artillery production around the Civil War.

Field Sampling and Laboratory Procedures

A total of six core samples were successfully recovered from within the project area. Three additional cores located within East Foundry Cove Marsh (Cores 1, 2, and 7 in figures 1 and 3) resulted in no recovery of sediments or data. Consequently, no useable sediment or trace element data is available for the marsh area. Of the six useable cores, four (Cores 3, 4, 5, and 8) were successfully recovered to depths of 5–6 ft. within East Foundry Cove. Core 6 was taken in West Foundry Cove, near the intersection of the rail trestle and the Long Dock. It was selected because its location corresponded to the historic bathymetric map coverage provided by the various U.S. Coastal and Geodetic Service (USCGS) sounding records. The sixth, Core 9, served as the control sample and was extracted from the southern embayment of Little Stony Point, to the north of, and outside, the study area to aid in comparison and evaluation of trends in historic trace element fluctuations detected within East and West Foundry Cove. Given the distance and the up-river and generally up-wind location of this control sample core, it served to differentiate between area wide trends in trace metal concentrations through time versus foundry-specific fluctuations within the coves. As such, all interpretations of sediment core data must be evaluated relative to fluctuations indicated by the control Core 9.

All cores were taken from the survey boat using sections of 4-in. diameter aluminum irrigation pipe. A commercial portable gasoline-driven vibration unit was utilized to drive and extract the cores from the sediments of the cove (figure 4). A numbered section of coring pipe was lowered into the water until it reached the upper surface of the cove sediments. At water level, a mark was scribed on the outer wall of the pipe. A second mark was then scribed into the pipe wall 5 ft. above the first. The location of the upper mark served as a visual guide to the coring crew that the limit of the 5-ft. depth had been reached. The bracket holding the Vibra-core hammer was clamped to the core pipe and the vibration unit was used to drive the core pipe into the cove sediments to the upper mark scribed on the pipe wall. The open-air end of pipe was then capped



Figure 4. HASMAT team taking marine *Vibracore* sediment cores to define the Civil War-era Hudson River channel interface and historic sediment depths through trace element analysis in East and West Foundry Coves, Cold Spring, New York. Photo by Joel W. Grossman.

with a rubber plug to reduce compression and the loss of samples upon extraction. In most cases the core was manually winched to the surface and the bottom of the core pipe was capped. The motorized Vibracore assembly was used to retrieve cores which did not release easily from the cove sediments. Water was drained from the core pipe by sawing two drain cuts above the upper mark which designated the upper limits of the core. After the water was removed, the excess coring pipe was cut off and both ends of the core were capped.

The sediment column of each core was recovered by clamping the core pipe horizontally to a cutting table and sawing each section lengthwise through the core pipe wall with a circular saw. After the core pipe was cut away, the sediment column was measured to determine the actual core length and to establish sampling increments. Each sub-sample was cut and handled with disposable plastic implements to minimize the possibility of contamination between samples. All sampling increments were split and sealed in pairs of zip-lock plastic bags, providing one sample for analysis and one for storage in the event that the trace metals analysis required replication.

Although each core was sampled to a depth of 5 ft., the actual core lengths were slightly shorter due to compression of the sediment matrix within the core pipes. The sampling procedure was designed to take sub-samples at 6-in. increments so that a 5-ft. core would yield 10 equal sub-samples. Cores in which the actual lengths measured less than 5 ft. were standardized by spreading the loss due to compression over their entire length. For example, a core taken to a depth of 5 ft. with an actual measured length of 4.7 ft. was sub-sampled at increments of 0.47 ft. (Table 1).

All core samples were analyzed by Robert J. Taylor of the Trace Element Research Laboratory, Department of Oceanography, Texas A&M University. Samples were received on December 24, 1990, in plastic bags, with each plastic bag packed inside a glass jar. Sediment

Table 1
Trace Element Results from East and West Foundry Coves and the upriver control sample, Core 9 (ppm).

	CORE 3				CORE 4				CORE 5				CORE 6				CORE 8				CORE 9 (Control)			
Interv.	D(ft.)	Pb	Cu	Cd	D(ft.)	Pb	Cu	Cd	D(ft.)	Pb	Cu	Cd	D(ft.)	Pb	Cu	Cd	D(ft.)	Pb	Cu	Cd	D(ft.)	Pb	Cu	Cd
1	0.24	120	—	—	0.21	179	111	1246	0.25	141	—	—	0.25	113	—	—	0.24	102	83	—	0.25	70	65	3
2	0.71	141	—	—	0.62	143	100	211					0.75	98	—	—	0.72	124	90	—	0.74	98	71	10
3	1.18	147	—	—	1.04	99	60	8					1.25	64	—	—	1.20	57	43	—	1.23	13	17	<0.5
4	1.65	64	—	—	1.45	83	50	<0.5					1.75	14	—	—	1.68	81	41	—	1.72	14	14	<0.5
5	2.12	33	—	—	1.87	36	31	<0.5					2.25	11	—	—	2.16	53	43	—	2.21	12	13	<0.5
6	2.59	15	—	—	2.28	11	14	<0.5					2.75	12	—	—	2.64	27	23	—	2.70	10	13	<0.5
7	3.06	14	—	—	2.70	7	13	<0.5					3.25	13	—	—	3.12	9	12	—	3.19	11	13	<0.5
8	3.53	11	—	—	3.11	5	12	<0.5					3.75	13	—	—	3.60	10	12	—	3.68	12	14	<0.5
9	4.00	12	—	—	3.53	6	12	<0.5					4.25	12	—	—	4.08	9	12	—	4.17	10	13	<0.5
10	4.47	13	—	—	3.94	7	13	<0.5					4.75	12	—	—	4.56	11	13	—	4.66	8	13	<0.5
11													5.20	12	—	—								

samples were homogenized, sub-sampled into plastic vials, and freeze-dried. Dry sediment was then ground and homogenized in a Spex ball mill. Aliquots of dry sediment (~1 g, weighed to 0.01g) were transferred to 180 ml, tall-form Pyrex beakers. *Aqua regia* (5ml; 3:1 HCl:HNO₃) was added, the beakers were covered with watch glasses, and the samples were refluxed on a hot plate for thirty minutes. Sediment adhering to the walls was washed down with ~10 ml of distilled water, and the samples were refluxed for an additional forty-five minutes. The beakers were removed from the hot plate and allowed to cool, and the samples were diluted to volume (20 ml) with distilled water. Samples were analyzed for Pb, Cu, and Cd by flame atomic absorption spectrophotometry (FAAS) on a Perkin-Elmer 306 AA spectrometer, using an air-acetylene flame. Calibration standards were diluted from commercial standards (Ricca Chemical, 1000 ppm) and were matrix-matched to the acid composition of the samples. Background correction was accomplished using a deuterium arc lamp. Reference samples of USEPA municipal digested sludge showed excellent recovery of all three elements. Samples analyzed in duplicate showed that analytical precision was excellent at all concentrations. Procedural blanks processed as samples were below the detection limit of the technique.

Trace Element Time Markers as Proxies

The quantified analysis of trace element levels of lead and copper assumed that the presence and relative concentration of these elements within the sediments of East and West Foundry Cove derive from historic foundry smelting and manufacturing procedures. The team hypothesized that the initial accumulation of both lead and copper correlated in time with the beginning of foundry ordnance production when the foundry opened in 1817. It was also hypothesized that a subsequent peak in lead and copper-alloy concentrations could be correlated with the 1858–1867 period of maximal output of military production for the Civil War under the superintendence of Robert P. Parrott, inventor of the famed Parrott Gun. Finally, the cadmium concentrations would correspond to the era of nickel-cadmium battery production on the site after World War II.

Lead

Lead was used at the foundry in the manufacture of munitions, as a coating medium for weatherproofing guns, for elements of early versions of rifled shells, and for a number of lead-based commercial products

before, during, and after the Civil War. The use of lead as a basic element of foundry production probably began prior to the Civil War with the onset of production in 1817, continued through the war years of 1861–1865, and persisted in non-military production at least through the first decade of the twentieth century.

The clear association with—and use by—the foundry of lead and lead-based products was established through the archival investigation as having begun during the initial years of the foundry's operation. The review of the primary archival sources in the National Archives identified a circular or General Order from the Board of Navy Commissioners that refers to the use of lead as early as November 13, 1818—the first year of the foundry's operation. The communication specified that as of that date, all federal cannon at U.S. Navy installations (presumably also including the foundries producing cannon) were to be painted with a lead-based lacquer to protect against the elements.⁸ Other entries refer to lead both in the context of the production of ordnance and in reference to its being used as a preservative, but this document in particular establishes that lead was being used as early as 1818.

Based on the primary archival sources it appears that the most intensive use of lead and lead byproducts was in the production and testing of rifled shell designs, specifically for the manufacture of the “sabot” or expanding ring at the base of rifled shells. The body of the elongated rifled shells was formed of cast iron, however, its base was generally manufactured from softer lead alloys. Upon detonation of the shell in the gun, the sabot expanded due to the heat and pressure created by explosive firing. This force melted the sabot which expanded and filled the spiraled grooves of the rifled barrel of the cannon, thereby causing the shell to spin.

Later in the war effort, Parrott replaced his lead sabot with one of brass. Parrott's late Civil War-era rifled shells were distinguished by the use of a brass sabot for the expanding material at the base of the shell, which was adapted for high volume production by 1862. Prior to this date, and at least as early as 1858 if not several years before, Parrott was actively involved in experimenting with different kinds of rifled shells and expanding sabots of different alloys. Some shells were of his own design; others were produced by various manufacturers within the U.S. and in several instances by foreign producers.⁹ It has also been implied that

Parrot was experimenting with British shell designs prior to 1862. The diversity of shells being manufactured and tested at West Point Foundry was significant because many of these designs used a lead sabot to impart spin to the shell. Thus, given the diversity of the then-ongoing research and development in shell design, it is highly probable that Parrot was experimenting with lead sabots for rifled shells both shortly before and during the Civil War period (*c.*1858 to 1867). Rifled shell production may have continued for at least a year (possibly through 1867) following the cessation of hostilities.

In addition to the archaeological recovery of shells at the foundry, investigations in the vicinity of the gun testing platform revealed the presence of lead seals from shipping boxes for friction primers and fuses used in the firing of guns. Although secondary to shells and lead-based coatings on guns as a source of lead recovered in the cores, the presence of lead friction primer and fuse box seals on the buried Civil War surface, in addition to other artifacts made of lead, illustrated the range of lead-based products in use at the Foundry site throughout the nineteenth century.

Based on these archaeological associations and archival references, three assumptions can be made regarding the use of trace elements as time markers. First, there should be a clear temporal association between the appearance of lead in cove sediments and the growth of the foundry as a center of weapon development after 1817.¹⁰ Second, based on the archival evidence suggesting both the diversity and volume of ordnance being produced (7,000 shells per week),¹¹ it appears that the highest levels of lead use and dispersal into the environment probably occurred during the period immediately prior to and during the Civil War. Third, based on the fact that cannon and shell production apparently came to a near standstill at the end of the war, there would have been a significant decrease in lead use and dispersal into the environment at that time. This assumption is further supported by the fact that Parrott retired from the foundry in 1867, marking the beginning of an economic and production decline which lasted until its takeover by the Cornell works at the turn of the century.¹²

Despite the possibility that the output levels of lead products may have dropped substantially after Parrott's departure in 1867, relevant evidence suggests that lead was processed for a variety of products from the 1880s

through the first decade of the twentieth century. The most specific evidence survives in the form of three dated Sanborn insurance maps which detailed the location, dimensions, and function of each standing structure at the foundry as of 1887, 1905, and 1912. The 1905 map clearly illustrates a long rectangular building flanking the northern west hillside at the foundry that was described as a "Sash Weights Foundry." Assuming that sash weights for double-hung casement windows were made of both iron and lead, the use of the word "foundry" in the building description on the map suggests that the metal was probably being melted and cast into cylindrical weights at this location. The time span of this activity is bracketed by the fact that the same location on the previous 1887 Sanborn map is referred to as a place for the storage of patterns, indicating that the lead sash weight production did not begin until after 1887. The end of this activity is indicated by the 1912 Sanborn map which labeled the same building as "Sash Weight Foundry (vacant)."

Finally, conversations with local informants yielded additional insight into the production of other lead-based products after the Civil War. One informant spoke of the use of lead compounds for the manufacture of alternator bushings. A local shop owner also mentioned having seen a catalogue of foundry products which included the production of lead and tin ceiling tiles. Although no fixed dates can be assigned, the fact that these references occurred in the context of oral historical recollections indicates that lead compounds and products were produced in considerable volume and diversity throughout the late-nineteenth and early-twentieth centuries.

Investigations of historical patterns of lead accumulation by others in the environment provide some regional and international vectors of contamination by trace elements in general and by lead in particular. Studies of dated historic period sediment cores from the Sacramento-San Joaquin Delta in California identified early lead contamination dating to *c.*1425 CE.¹³ Long before European contact, the authors postulate that this early spike in lead levels in California derived from ore smelting in China. Drexler et al. also suggested that a second spike in lead levels took place around 1850 which they associated with California Gold rush. They identified a third benchmark as the period of leaded gasoline, in use from the 1920s through its 1980-1985 phase-out. The eventual removal of lead from fuel in 1988, as well as the effects of the

Clean Air Act of 1970 that removed airborne lead and other contaminants, resulted in a sharp drop in lead levels in several of the most recent uppermost core samples from the West Point Foundry.¹⁴

Closer to the study area, the measurement of lead levels from high resolution sampling of four shallow (50 cm) cores was undertaken at the Central Park Lake in Manhattan, New York. Plots of lead concentration through time showed a constant increase in lead levels from the late 1800s through to the 1960s and a drop off after the 1980s.¹⁵ The authors attributed the twentieth-century increase in lead levels to the introduction of large-scale incineration of municipal solid waste (MSW), and Chillrud noted that “the similarities between the history of MSW incineration in NYC and the accumulation of trace metals in [Central Park] Lake sediments . . . are consistent with incineration being a major source of several metals in the NYC atmosphere.”¹⁶

Finally, another study of sediment cores from the Pettaquamscutt River basin in Rhode Island showed a “clear maximum in anthropogenic lead isotopes in the mid-1800s.”¹⁷ The decline of lead contributions from ore smelting was accompanied by the rise of coal combustion, and at the turn of the twentieth century, “contributions from smelting of Pb ores had decreased to 5% and coal was responsible for 65% of the Pb input.”¹⁸

These different studies illustrate the diversity of potential sources for lead contamination, both local and regional. The California data attributed early lead levels to smelting in Asia. The Rhode Island data attributed nineteenth-century upticks in lead to the smelting of ore and burning of coal. The West Point Foundry data, however, highlights the importance of localized industrial sources of lead pollution.

Copper

The second metal selected as a chronological indicator is copper. Prior to the Civil War, the foundry was engaged in the production of cannon and ordnance, as well as a wide range of non-government commercial products. One secondary reference clearly alludes to the production of brass products early in the foundry's history. In his brief account of the foundry, William Tyrrell stressed the fact that within three years of its initial production “the West Point Foundry was manufacturing iron and brass of all kinds.”¹⁹ While it is clear that the foundry was later engaged in the testing and rifling of brass cannon prior to the Civil War, the level

of copper alloy production between the 1820s and 1858 cannot be established based on available sources.

Despite the paucity of early references, the role of copper and brass in the production activities at the West Point Foundry during the Civil War is well documented. While there is evidence for the experimental use of lead in Parrott's early prototypes of his rifled shells, as discussed above, by 1862 Parrott had shifted from using a wrought-iron sabot at the base of his shells to using a cast-brass sabot. As detailed elsewhere, Parrott's rifled cast-iron shells represented an adaptation of an earlier design by Dr. Reed, who invented the use of a wrought-iron ring, or sabot, bolted onto the base of the cast-iron shell.²⁰ While Parrott's earliest rifled shells produced between 1860 and 1862 copied Reed's use of wrought iron as a malleable expanding material, by 1862 Parrott shifted to, and received a patent for, the manufacture of cast-iron shells with a brass ring.²¹ Although no figures exist for the amount of copper used during the war, the Union was reported to have produced 1.3 million shells.²² Although no details are available on production levels at West Point Foundry, it is clear from surviving archival sources and the archaeological evidence that Parrott produced large numbers of fuses and friction timers. Both utilized brass as the primary element for their construction.

The continued use of copper after the Civil War is also documented on Sanborn insurance maps. The earliest of these detailed Sanborn insurance maps dates to 1887 and documents the presence of a brass foundry as a discrete production area in the post-Civil War layout of the complex. No detailed references exist to fill in the use of copper during the time gap between the earlier Civil War era ordnance production which peaked between 1858 and 1867 and the postwar 1887 map. Nevertheless, the combined archival and archaeological evidence clearly document that copper was used at the foundry from the first decade of its operation for both military and non-military products, that it was used in high volumes for shell and ordnance production during the Civil War, and that its use continued after the Civil War at least until 1887, if not later.

Cadmium

In this study, the initial appearances of lead and copper in the vertical core samples were demonstrated to be chronologically significant indicators for the onset of foundry operations during the first quarter of the nineteenth century. The appearance of cadmium, how-

ever, serves as a marker to date and calibrate the range of late twentieth-century sediment depths and rates of sediment accumulation within East Foundry Cove. The appearance of cadmium in the sediment records can be fixed in time with some certainty. The initial appearance of cadmium discharge into the general area of Cold Spring began in 1953 and continued until 1979. Between these dates, a nickel-cadmium battery factory discharged 179 metric tons of cadmium-laced toxic waste into the local environment.²³

This twenty-seven-year period is also punctuated by two shifts in cadmium effluence—in 1965 and 1971. During the initial phase, 1953–1965, the Marathon Battery Company utilized the Cold Spring sewer system to discharge directly into the Hudson River in the vicinity of the Cold Spring pier. During this early period, the battery plant also used its bypass system “approximately 10% of the time” to discharge into a storm sewer and directly to East Foundry Cove. This fact is important because it documents that the initial appearance of cadmium in East Foundry Cove began as early as 1953 and continued on a periodic basis until 1965. By 1965 it was determined that the village of Cold Spring sewer and treatment plant could no longer treat the battery plant’s volume of effluent. The plant, then owned by the Sonotone Corporation, responded by discharging cadmium-laden effluent directly into East Foundry Cove marsh. The final phase of cadmium deposition occurred after January 1971 when the company was prohibited from making further discharge into East Foundry Cove. In response, all effluents and cadmium discharge were again redirected into the village of Cold Spring storm sewer and into the Hudson River. This redirection of the cadmium output continued until March 1979 when all battery manufacturing operations and cadmium discharge were discontinued.²⁴

Cadmium levels were identified and extracted from East Foundry Cove. Core 9, the upriver control sample, was used to establish background readings from the deepest sample fractions outside and upriver of the ambient limits of foundry impacts. Post-1953 cadmium concentrations recovered from Core 4 yielded high levels of 1246 ppm in the uppermost sample interval (at 0.24 ft. deep). The second sample interval (0.62 ft.) showed a decrease to 211 ppm and the third interval (at 1.04 ft. deep) a further decrease to 8 ppm. Below 1.04 ft., readings for cadmium measured less than 0.5 ppm. In other words, the “background” or prehistoric level for ambient cadmium was less than 0.5 ppm

(Table 1). Core 9 also showed very low levels in the upper two intervals and practically undetectable background levels of 0.5 ppm below that depth.

The issue of residual or low-level concentrations of trace metal elements deposited beneath significant accumulations of Cadmium was highlighted within Core 4. In this core, it is suggested that the 211 ppm Cd reading at 0.62 ft. and probably the 8 ppm reading at 1.04 ft. appears to be the artifact or byproduct of human or biological mixing (figures 5-12). The lead author’s experience with the archaeological excavation of cadmium deposits underscores the fact that deposits of cadmium are bright yellow and are sharply demarcated by color from underlying deposits.²⁵ That depositional scenario was encountered during the excavations at West Point Foundry. It suggests that the low concentration levels indicated by the 211 ppm and 8 ppm readings represent residual byproducts of mixing, either from natural or anthropogenic sources from the uppermost sample fraction, downward. Bioturbation, including the actions of worms and burrowing animals are more than adequate vectors of mixing to account for the presence of low levels of cadmium at levels 2 and 3 in the sampling sequence. The near-surface reading of 1246 ppm at 0.21 ft. suggests primary deposition after 1953 (Table 1).

Patterns Through Time

The primary assumption of this study is that the presence of trace elements of copper and lead appear to have derived from historic foundry smelting and manufacturing operations after 1817. Furthermore, the initial uptick, and subsequent increase in deposition of both metals correlated with the onset of foundry ordnance production. The depositional concentrations of copper and lead tripled initially, and then increased ten-fold in East Foundry Cove samples recovered higher in the cores. This increase in concentration presumably represents peak production levels for the period leading up to and including the Civil War (figures 5, 6, 7, and 8). Finally, we assume that the selection and study of both copper and lead were not fortuitous. Both metals have been shown to be associated with key products of ordnance production throughout the military phase of foundry operations from 1817 to 1867.

This study has highlighted six patterns of fluctuations in trace metal element concentrations through time: 1) Strong archival, statistical, and historical correlations through time confirm the presence of lead and

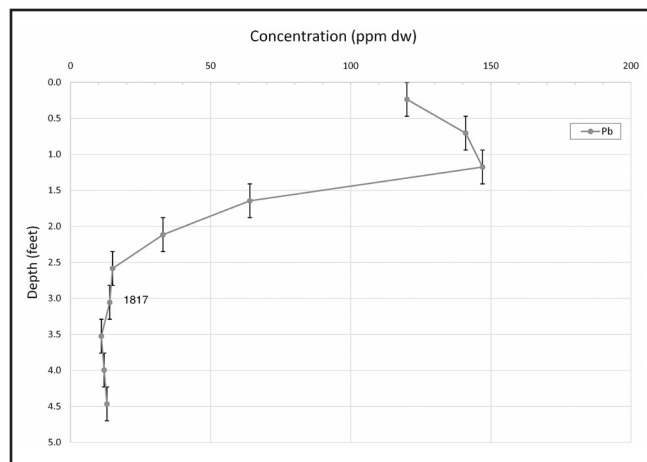


Figure 5. Trace element plot of lead (Pb) by depth for Core 3 in East Foundry Cove. Chart by R.J. Taylor.

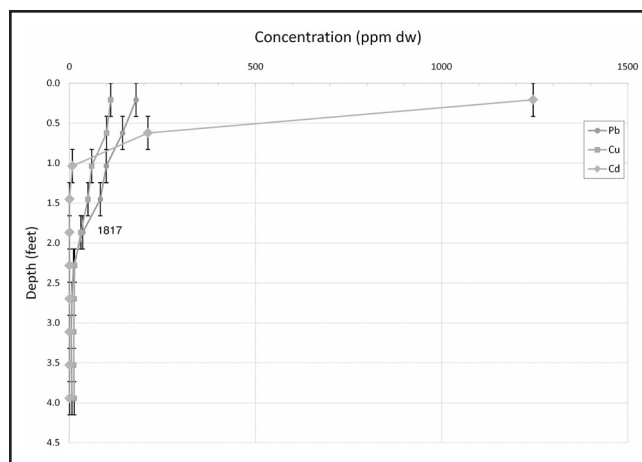


Figure 6. Trace element logarithmic plots of copper (Cu) and lead (Pb) relative to cadmium (Cd) by depth for Core 4 in East Foundry Cove. Chart by R.J. Taylor.

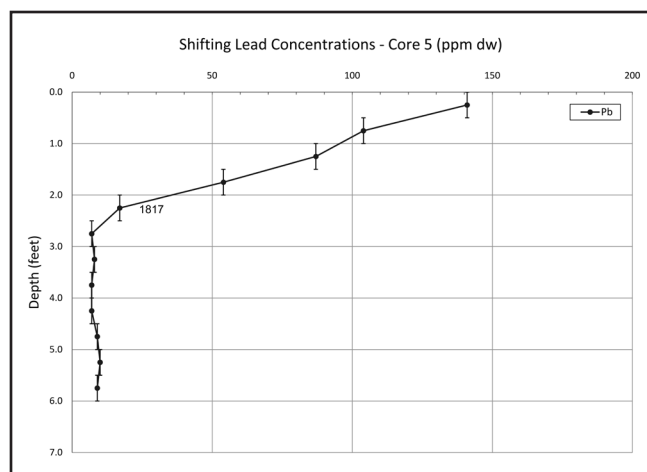


Figure 7. Trace element plot showing shifting concentrations of lead (Pb) in Core 5 in East Foundry Cove. Chart by R.J. Taylor.

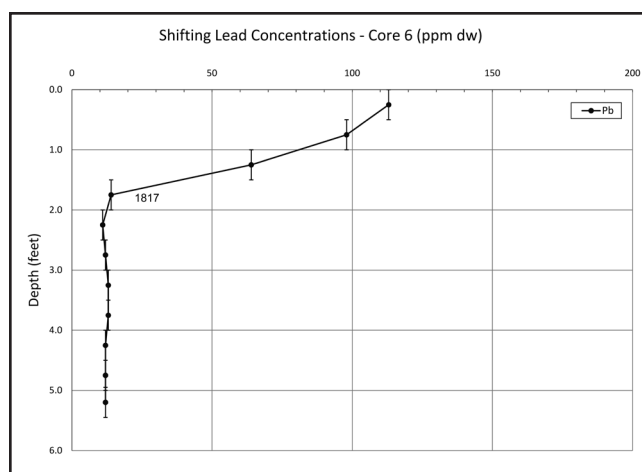


Figure 8. Trace element plot showing shifting concentrations of lead (Pb) for Core 6 in West Foundry Cove. Note uptick in lead levels between 1.25 and 1.75 ft. in depth. Chart by R.J. Taylor.

copper at the foundry. 2) Sufficient evidence from the cores exists to establish low baseline levels of lead and copper concentrations prior to the onset of foundry operations in 1817. 3) Initial upticks in lead and copper levels in the depositional environment correlate with the beginning of foundry production in 1817. 4) Evidence suggests that subsequent peaks in the concentrations of lead and copper from near surface samples correlate with the period of increased production during the Civil War (1858–1867). 5) The presence of significant decreases in concentrations of lead and copper in recent near surface deposits suggests a

decrease in post-1971 ambient levels. And 6) interpretation of the sixth pattern is more problematic because the data display incrementally increasing concentrations of copper and lead throughout Cores 4, 5, and 6 with no drop-off in the near surface samples.

As pointed out by Robert Taylor, the historical association of lead and copper as time markers was matched by a strong statistical correlation between copper and lead (figure 9). Copper and lead showed a correlation coefficient (R^2) of 0.965 which suggests that they were deposited in the environment at about the same time.

TRACE ELEMENT TIME MARKERS AS PROXIES

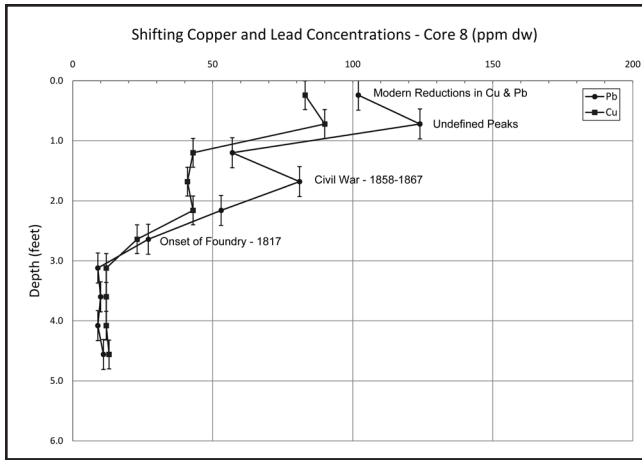


Figure 9. Trace element plots of lead (Pb) and copper (Cu) by depth for Core 8 in East Foundry Cove. Chart by R.J. Taylor.

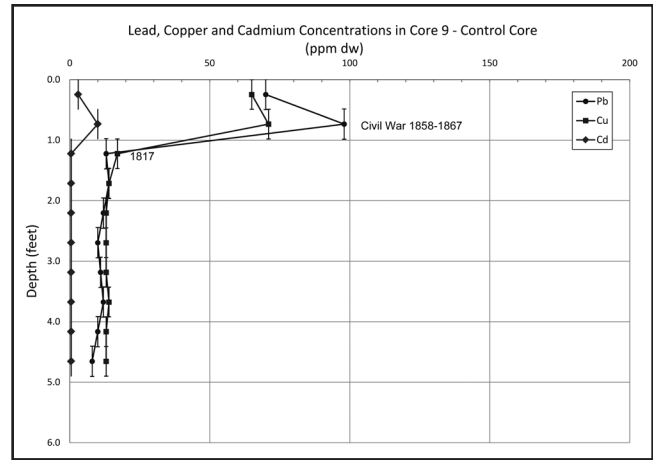


Figure 10. Trace element plots of Copper (Cu) and lead (Pb) relative to cadmium (Cd) in the upriver control Core 9 off Little Stony Point. Chart by R.J. Taylor.

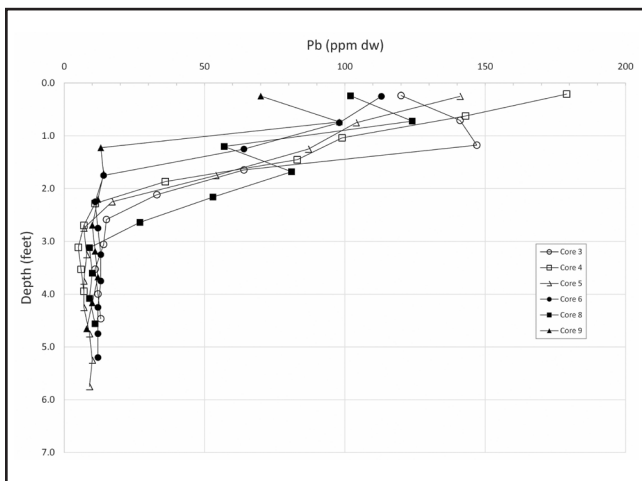


Figure 11. Plot of lead (Pb) values by depth for all six cores. Chart by R.J. Taylor.

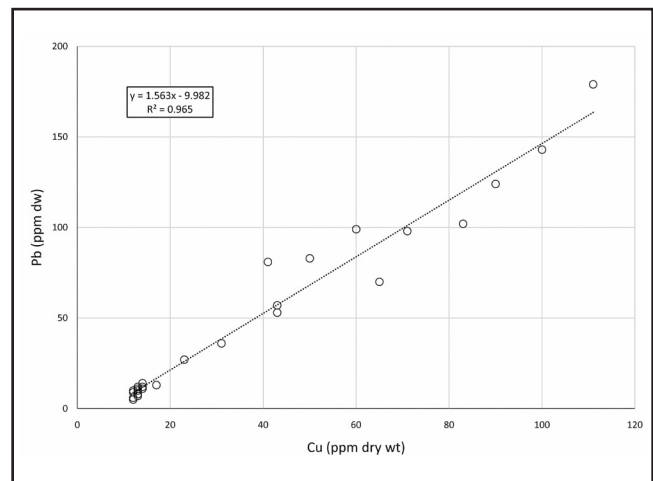


Figure 12. Plot showing strong correlation between copper (Cu) and lead (Pb) in Cores 4, 8, and 9, indicating that both copper and lead followed similar historical trends in East Foundry Cove and for the upriver control sample, Core 9. Chart by R.J. Taylor.

As Taylor underscored:

There is a strong correlation between Pb and Cu. Enclosed is a scatter diagram including all points from the three cores in which both Pb and Cu were measured [figure 9]. It appears as if there is a similar source for the two elements, and anthropogenic input sure seems like the best bet. The degree of similarity in these profiles vs. depth suggests that the introduction of Cu and Pb commenced at about the same time, and that their relative increases have been similar.²⁶

The six statistical plots of core data showed two contrasting long-term trends. Both patterns spanned from the initial uptick in trace metal elements around 1817

through the twentieth century (figures 6, 7, and 8). The first group of three cores (4, 5, and 6) displayed parallel linear patterns of increasing lead and copper concentrations over time throughout their depositional history. However, as a group, the cores lacked a spike corresponding with archival documentation describing a surge in copper and lead output during the Civil War (figure 9)

The second group of cores (3, 8, and 9) were internally consistent, but showed opposing patterns from the first group. In addition to being statistically cor-

related through time, copper and lead followed a parallel “zig zag” or “ebb and flow” pattern in tandem with each other. All three cores document a significant decrease in lead and copper values in their near surface samples (figures 5, 9, and 10). In Core 9 (figure 10), the biggest decrease occurred in the two near-surface samples (0.0–1.0 ft.) in which lead dropped from 98 ppm to 70 ppm (down 29 percent). In Core 8 (figure 9) the two near-surface samples (0.0–1.0 ft) showed a drop in lead from 124 ppm to 102 ppm (down 18 percent). In Core 3 (figure 5) lead concentrations decreased incrementally from 147 ppm to 141 ppm to 120 ppm within the three near-surface samples (0.0–1.5 ft). This represents a 29.5 percent decrease in lead in the upper 1.5 ft. of the core.

The six cores establish the pre-Civil War levels of copper and lead in East and West Foundry Coves and in the upriver control sample (Core 9). The baseline readings documented ranges of concentrations over time with depth for each trace metal element. Figure 11 presents a statistical plot of lead levels in concentration versus depth for all cores. Below 2.5 ft., the lead values record a range of similar, low concentrations. Sample data from the deepest intervals in all cores, presumably pre-nineteenth-century historic and pre-historic levels, yielded background concentrations ranging from 5–14 ppm for lead (Table 1). In Core 8 at levels deeper than 2.64 ft., copper displays background, or prehistoric, levels of 12–13 ppm.

The onset of foundry operations in 1817–1818 was initially recorded in the stratigraphy of Core 4 at 2.28 ft. (Table 1) by an uptick in lead ranging from 5–7 ppm

to 11 ppm (up 37 percent) (figure 6). Copper initially increased minimally to 14 ppm at 2.28 ft. It nearly tripled in value to 50 ppm at 1.87 ft. These two benchmarks demarcate the depth of the initial, early nineteenth-century output of industrial effluents in East and West Foundry Coves. In comparison, the upriver control sample (Core 9) displayed a significantly shallower increase in copper levels from 13 ppm to 17 ppm at 1.23 ft. (figure 10).

In general, the combined sediment core samples showed increased levels of lead and copper at depths of between 2.12 and 2.64 ft. below the modern bottom in the East Foundry Cove cores (Cores 3, 4, 5, and 8). The recorded “uptick” depths (Table 2) for Cores 6 and 9 differed, coming from different areas of the Hudson River. Core 6 was from West Foundry Cove and was distinguished by different deposition rates and shallower deposits of trace elements than was the case for the East Foundry Cove core samples (figures 1 and 8). Control sample Core 9 also showed shallower precipitation depths and higher benchmarks for onset of trace element records (figures 1 and 10).

Both lead and copper elements showed significant increases in detectable levels at 1.68 ft. in Core 8 and at 1.87 ft. in Core 4. Both increases correlate with what appears to have been a massive increase in smelting operations during the Civil War years (Table I; figures 6 and 9). This increase is interpreted by the senior author to correlate with higher Civil War-era output at West Point Foundry and is expressed best by the Core 8 data. Lead in Core 8 surged to 81 ppm at 1.68 ft. from an earlier level of 53 ppm at 2.16 ft. deep. The sequence then dropped down to 27 ppm at 2.64 ft., and then down to background counts of 9–11 ppm below 3.12 ft. in depth. The track taken by the copper trace elements also broadly follows the historical outlines of the ebb and flow of brass production at West Point Foundry.

Table 2
Depth of the Initial Uptick in
Trace Element Readings

Location	Core No.	Depth of Sediment (ft.)
East Foundry Cove	3	2.12
	4	2.28
	5	2.25
	8	2.64
West Foundry Cove	6	1.75
Control	9	1.23

The plot of copper in Core 8 suggests an apparent stand-still in brass production. The three samples showed copper levels ranging from 41 to 43 ppm, occurring between 1.20 ft. and 2.16 ft. in depth, but without displaying any significant variation in concentration. However, the subsequent reading at 0.72 ft. deep, showed copper concentration increased to 90ppm. Copper then dropped to 83 ppm in the uppermost surface sample (0.24 ft. deep). Although specu-

lative, it is intriguing to think that the stagnation the copper levels encountered at these middle-depth ranges (1.20–2.64 ft.) potentially correlates with the diminution of the use of copper and brass for ordnance during the Civil War years in favor of reinforced rifled iron cannon (figure 9).

One sample (Core 6) in West Foundry Cove, northwest of the inlet into East Foundry Cove, was tested only for lead (figures 1, 3, and 8). This “outside” sample displayed a different diachronic pattern compared with cores to the southeast taken inside East Foundry Cove. In Core 6 the initial presence of lead in the vertical plot occurs at a shallower depth in comparison with the plots in East Foundry Cove. The initial uptick in lead to 14 ppm (at 1.75 ft.), above its background range of 12–13 ppm in West Foundry Cove, indicates the depth of the buried historic surface or shoreline bottom. The Core 6 data suggest that the early nineteenth-century surface in West Foundry Cove lies beneath nearly 2 ft. of more recently deposited modern sediments (figure 8).

Taken together, these trends suggest that the local sediment accumulation increased significantly in East Foundry cove following the onset of operations in 1817 and that the increases in lead and copper levels closer to the submerged sediment surface corresponded with the increased production levels of the Civil War years. The data sets indicate three major proxies or trace element markers: the onset of foundry operations in 1817, the apex of maximal operations between 1858 and 1867 correlated with peaks in lead and copper concentrations, and the initial appearance of cadmium in 1953. These historical proxies furthermore suggest one case study for which trace elements, when linked to a specific industry, can help delimit the depth of historic sediments.

Notes

1. We are using 1858 for the onset of the Civil War era because that is when the U.S. Army and Navy began to ramp up military production of ordnance and rifled cannon. This was the period of the Crimean War, and the U.S. was actively involved in the Bosphorus with Army and Navy ordnance officers collecting intelligence on cannon design, performance, survivability, and precision, as well as information on European weapons production and deployment. Armaments contracts between Parrott and the Naval and Army Ordnance Bureaus continued until 1867. Joel W. Grossman, “High Caliber Discovery,” *Federal Archaeology* 7, no. 2 (1994): 38–43; Joel W. Grossman, “The Role of Espionage and Foreign Intelligence in the Development of Heavy Ordnance at the West Point Foundry, Cold Spring, New York,” in *Look to the Earth: The Archaeology of the Civil War*, ed. C. Geier (Knoxville: Univ. of Tenn. Press, 1994), 215–255.
2. The following article is meant to be read in conjunction with the report and associated data tables from the Texas A&M Trace Element Research Laboratory: Robert J. Taylor, “End of Laboratory Report to Joel W. Grossman,” in Joel W. Grossman, et al., “A Stage I Archaeological and Historical Sensitivity Evaluation of Foundry Cove and the Cold Spring Waterfront [GIS, Marine Geophysics and sub-bottom sedimentation & Trace element coring],” prepared for Malcolm Pirnie Inc. under contract with the U.S. Environmental Protection Agency, New York, 1992, Appendix B, www.GeospatialArchaeology.com/RTaylor1991.pdf.
3. See the special issue of *IA* 35.1 and 2 (2009) devoted to the West Point Foundry for further information.
4. For full information on this research, see Joel W. Grossman, “The Archaeological Discovery and Excavation of R.P. Parrott’s Civil War Era Gun Testing Facility at West Point Foundry,” prepared for the USEPA, Region II under contract with Malcolm Pirnie, Inc., 1991; Grossman, “Stage I Archaeological” (see n. 2); Joel W. Grossman, “High Caliber Discovery” and “The Role of Espionage” (see n. 1); Joel W. Grossman, “From Raritan Landing to Albany’s Riverfront: The Path Toward Total 3D Archaeological Site Recording,” in *People, Places and Material Things: Historical Archaeology of Albany, New York*, ed. Charles Fisher, New York State Museum Bulletin 499 (Albany, NY: State Education Department, 2003), 167–186; Joel W. Grossman, “Inter-Regional Studies: Archaeology of Toxic and Hazardous Environments,” in *Encyclopedia of Archaeology*, ed. D. Pearsall (Oxford: Elsevier/Academic Press, 2008), 3: 2134–2156.
5. For the terrestrial discoveries, see Grossman, *Archaeological Discovery*; Grossman, “Stage I Archaeological” (see n. 2) and “From Raritan Landing” (see n. 4); Harold Holzer, “Lincoln’s Secret Arms Race,” *Civil War Times* 34, no. 4 (1995): 32–39; and Tamara Stewart, “Excavating Hazardous Sites,” *American Archaeology* 14, no. 1 (2010): 38–43. For the riverine discoveries, see Grossman, “Stage I Archaeological.”
6. Grossman, “Stage I Archaeological,” Appendix A (see n. 2).
7. *Ibid.*
8. *Journal of the Board of Navy Commissioners*, vol. 1, Record Group 45, National Archives and Records Administration, Washington, DC.
9. Grossman, “Archaeological Discovery,” 186–189 (see n. 4); Grossman, “High Caliber Discovery” and “The Role of Espionage” (see n. 1); Jack W. Melton Jr., “Sabot and Stability System,” <http://www.civilwarartillery.com/sabotsystems.htm>.
10. M. Wilson, *Thirty Years of Early History of Cold Spring and Vicinity, with Incidents. By One Who Has Been a Resident Since 1819* (Newburgh, NY: Schram Printing House, 1886 reprint).
11. William G. Tyrell, “Parrott’s Famed Cannon Perfected and Produced at Cold Spring Foundry,” *New York State and the Civil War* 1, no. 11 (1962): 38.
12. Katharine Cornell Gorka and Andrew H. Cornell, *Cornell Iron Works: The history of an enduring family business* (Mountaintop, PA: Cornell Iron Works, 2013).
13. Judith Z. Drexler, et al., “A millennial-scale record of Pb and Hg contamination in the peatlands of the Sacramento-SanJuaquin Delta of California,” *Science of the Total Environment* 551–552 (2016): 746.
14. *Ibid.*, 738, 746–749.

15. Ibid. and figure 5, p. 660.
16. Stephen N. Chillrud, et al. "Twentieth Century Atmospheric Metal Fluxes into Central Park Lake, New York City," *Environmental Science and Technology* 33, no. 5 (1999): 660–661.
17. Anna Lúcia Lima, et al., "High-resolution historical records from Pettaquamscutt River basin sediments: 2. Pb isotopes reveal a potential new stratigraphic marker," *Geochimica et Cosmochimica Acta* 69, no. 7 (2005): 1813–1824 at fig. 2, p. 659.
18. Ibid., 1819.
19. Tyrell, 4 (see n. 11).
20. Grossman, "Archaeological Discovery" (see n. 4).
21. Ibid. See also Robert P. Parrott. Projectile For Rifled Ordnance. US patent 33,099; and Robert P. Parrott. Projectile For Rifled Ordnance. US patent 33,100. Both filed Aug. 20, 1861.
22. Tyrell, 8 (see n. 11).
23. Jeffrey Levinton and Josepha Kurdziel, "Foundry Cove and Constitution Marsh: History and Ecology of a Polluted Site and Its Restoration," report and video prepared for NY Dept. of Environmental Conservation, the Hudson River Foundation, and Stony Brook Univ., 1989, <http://life.bio.sunysb.edu/marinebio/foundryframe.html>; Jeffrey S. Levinton, "Foundry Cove: Icon of the Interaction of Industry and Aquatic Life," in *Environmental History of the Hudson River: Human Uses that changed the Ecology, Ecology that Changed Human Uses*, ed. Robert Henshaw (Albany, NY: SUNY Press, 2011), 233–247.
24. P.L. Klerks, *Adaptation to Metals in Benthic Macrofauna*, PhD diss., State Univ. of New York, Stony Brook, 1987; A.B. Knudson, P.L. Klerks, and J.S. Levinton, "The fate of metal contaminated sediments in Foundry Cove," *Environmental Pollution* 45 (1987): 291–304; Joshua A. Mackie, Susan M. Natalia, Jeffrey S. Levinton, and Sergio A. Sañudo-Wuillhelmy, "Defining metal levels at Foundry Cove (Hudson River, NY): Response to localized dredging of contaminated sediments," *Environmental Pollution* 149, no. 2 (2007): 141–148; Levinton, "Foundry Cove" (see n. 23).
25. Grossman, "High Caliber Discovery" and "The Role of Espionage" (see n. 1); Grossman, "Inter-Regional Studies" (see n. 4).
26. Robert J. Taylor to Joel Grossman, personal communication, 1991; and Taylor (see n. 2).

Lincoln's Secret Arms Race

New information shows the Union president used any means necessary to make America a military superpower—even stealing cutting-edge military technology from Europe.

By HAROLD HOLZER



Despite everything Abraham Lincoln accomplished in his 56 years, he never completely shed the stereotype associated with his roots in the Western backwoods. To many people he remains essentially a simple man.

That image of Lincoln is false, certainly. But a recent archaeological dig and subsequent research have yielded evidence that the 16th president was in fact much more politically sophisticated, globally aware, and technologically informed than anyone has ever imagined. The real Lincoln emerges, in the

When Abraham Lincoln visited the West Point Foundry in 1862, he observed the pouring pit operation depicted in this 1866 painting by artist John Ferguson Weir.



PITMAN COUNTY HISTORICAL SOCIETY

words of the archaeologist who led the excavation and research effort, as "an international operator" on the level of Franklin D. Roosevelt.

According to Joel W. Grossman, head of the New York archaeological firm of Grossman and Associates, Lincoln seems to have orchestrated an international spy ring to help him develop the most powerful, technologically advanced military force in the world. "It's not by chance that foreign powers stayed out of the Civil War," says Grossman. "Lincoln made sure our weapons could not only outfight the Rebels, but outfight the Europeans as well."

Grossman developed the notion of an internationally aware and technologically astute Lincoln after leading a team of archaeologists in an excavation of

the former site of the West Point Foundry in Cold Spring, New York (see sidebar). The foundry, run by Robert Parker Parrott, manufactured rifled cannon known as Parrott guns, along with the ammunition they required, and supplied them to the Union army during the Civil War.

When artifacts that emerged from the Cold Spring site seemed to contradict traditional historical accounts of Parrott and the foundry, Grossman decided to follow up the excavation with research in the National Archives in Washington, D.C. The research soon turned into a historical detective case. It began with a revelation about Parrott, and the cannon he was credited with developing: his namesake, the Parrott gun.

Parrott's cannon was rifled—that is, it had a grooved bore that put a spin on

The Dig: How Archaeology Opened New Windows Onto Parrott's Foundry

In the winter of 1992, a team of archaeologists dug into historic ground at Cold Spring, New York, across the Hudson River from West Point. Layer by layer, they scrutinized the earth, reaching the soil of the Civil War era about five feet down.

The ground under scrutiny was the former site of the West Point Foundry, a privately owned plant that supplied ordnance—in particular, the rifled artillery pieces known as Parrott Guns—to the Union army during the Civil War. The place was listed as a National Register Historic Site, but it had become little more than a mass of weeds, rubble, and junked automobiles.

When toxic nickel cadmium from a battery factory active in the 1950s and '60s was found in the Hudson River and a marshy area adjacent to the foundry site, the U.S. Environmental Protection Agency allocated Superfund money for a cleanup. The project required the construction of a soil treatment facility and a haul road on the old foundry grounds.

Under the National Historic Preservation Act, the site's archaeological value had to be determined before work could proceed. A continuous process of evaluation and approval began; at each step of the investigation, EPA officials weighed the merits of continuing the archaeological work against budgetary and time constraints and issues of safety.

The New York archaeological firm of Grossman and Associates began the investigation for the EPA, and the company's head, Joel W. Grossman, quickly realized there was more to the site than met the untrained eye. Disturbed vegetation suggested that something unusual lurked below the surface. Aerial photographs and computer imaging pinpointed underground "hot spots," long-buried former centers of human and industrial activity. The spots were surveyed with magnetic sensors to produce detailed, three-dimensional underground maps that revealed the location and size of each.

Once excavation was authorized, the scientists began removing encrusted objects for x-raying and reconstruction in an on-site laboratory. It soon became apparent that there was more beneath the surface than even the most imaginative historical detective could have surmised.

A high point of the dig came when the archaeologists unearthed the remains of the gun testing platform that President Abraham Lincoln saw when he visited in 1862 to watch Parrott guns fire shells across the Hudson. Also

found was a railroad bed that led back to the plant. When the foundry was in operation, workers used the small railroad to roll newly manufactured guns into place for test firing. The archaeologists also exhumed two 100-pound shells nearby, one of which was an incendiary shell.



GROSSMAN AND ASSOCIATES

Remains of the cannon-testing platform.

The recovery of the testing platform and rail bed was soon overshadowed by the discovery of six homes that sat on stone masonry foundations beyond the testing area. These were more elaborate dwellings than the simple cabins of the laborers who lived and toiled on the site.

The yield of artifacts from the dwelling area grew to a mind-boggling 5,000 objects a week at one point. By the end of the dig, some 145,000 artifacts had been recovered, washed, x-rayed, analyzed, and dated. The dazzling array of family keepsakes, imported goods, jewelry, toys, and other items suggested the people who owned them were foreign-born, wealthy, and well educated.

From the cellars of the excavated houses came the greatest find of all: scientific instruments and weaponry paraphernalia of all kinds. Grossman called the cache "unambiguous evidence that scientists once worked here—the sophisticated tools for calibrating and testing weapons." Here was evidence that a previously unknown community of scientists and researchers had lived at Cold Spring. They were "pretty spiffy people," Grossman concluded, upper-class professionals who boasted "sophistication, experience, expertise, and foreign training."



Members of the archaeology crew methodically excavate the foundry's artifact-rich soil inside a heated temporary shelter.

The presence of such scientists at the West Point Foundry, said Grossman, is inconsistent with accepted historical accounts of the foundry's operations, Union arms development, and the origins of Union military technology. Research into this supposed inconsistency led him to some surprising conclusions (see main article).

Artifacts from the dig, including the gun testing platform, are on display at the Orange County Historical Society in upstate New York.

Harold Holzer



Robert Parker Parrott.

its bullet-shaped projectiles, making them fly farther and more accurately than the missiles of smoothbore cannon. In a rifled cannon, the projectile was seated in the rifling grooves, requiring a more forceful explosion to push it through the grooves and send it on its way. As a result, the breech, or firing chamber, of a rifled cannon had to be strong enough to withstand the extra pressure.

The Parrott gun had an iron reinforcing band around its breech to accommodate the greater pressure. So did other rifled cannon. What made the Parrott gun different was the way its reinforcement band was attached. The band was slipped over the breech hot, and was turned constantly on rollers while its interior was sprayed with water. When the band cooled and shrank, it gripped the barrel tightly around its whole circumference, rather than in just a few spots, as on other reinforced cannon.

By 1861 Parrott had patented his cannon (on the basis of the method used to attach the band) and its corresponding projectile, and had geared up to mass-produce them. Fortunately for him, his supply coincided perfectly with Union demand. Just two weeks before the July 21 First Battle of Manassas, Secretary of War Simon Cameron wrote a secret memorandum to Lincoln conveying a blunt warning about the nation's dwindling store of military hardware.

"The government arsenals at Little Rock, Baton Rouge, Mount Vernon, Apalachicola, Augusta, Charleston, &

Fayetteville [sic] had been "seized by disloyal hands," reported Cameron. With the capacity of the remaining arsenals clearly "not equal to the supply needed," the secretary felt it "absolutely necessary" to procure arms to some extent from private manufacturers. "It is believed that from these sources they can be obtained equal in quantity and not much higher in cost than those made in the national workshops."

Seeking such supplies from foreign manufacturers was an option, Cameron acknowledged. But the secretary, a devoted friend of private enterprise (perhaps because he often profited personally from War Department contracts), had a different idea.

"It would appear a wise policy on the part of the Government to encourage domestic industry, by supplying our troops in part from private factories of our own country, instead of making purchases from abroad," he wrote. "As rifled cannon are in point of effectiveness far superior to smooth-bored, arrangements have been made to rifle a large portion of guns on hand, and the work is still in progress."

There is no record that the White House received Cameron's message, and no reply from Lincoln has been found. The original memo is not part of the Lincoln Papers. Only a handwritten copy survives within the crumbling, leather-bound records of the Secretary of War, stored in the National Archives' vaults. One thing, however, is evident: Cameron's advice was heeded, and no one benefitted more from the resulting shift in federal ordnance policy than Parrott.

Soon the West Point Foundry was turning out rifled cannon at a record pace. Parrott guns were made in various sizes, each identified by the weight of the solid shot it fired. There were 10-pounders, 20-pounders, 30-pounders, and eventually massive 300-pounders, all wearing the distinctive iron breech band and all stamped "WPF RPP," for West Point Foundry and Robert Parker Parrott. Complete manufacturing records have not survived, but historians estimate that at peak production, the cannon works churned out 25 heavy guns and a staggering 7,000 shells weekly. According to one estimate, by war's end the foundry had produced a total of 1,700 Parrott guns and more than 3 million shells.

Army and navy alike used Parrott's fearsome products. Parrott guns ravaged countryside and city, sank ships at sea, and laid waste to battalions in the



The foundry thrived during the Civil War as the Union's main supplier of Parrott guns and of the projectiles they fired.

field. Parrott rightly conceded his design was not perfect. The muzzle would sometimes break off (though Parrott insisted the rough edge could be shaved down and the gun fired again with little loss of efficiency). Still, no ordnance developer ever received, or seemingly deserved, more credit for successfully arming a nation at war.

During the archaeological investigation at Cold Spring, Grossman began to suspect that the credit was undeserved. Near the foundry, the excavation team uncovered the remains of houses whose inhabitants seemed to have been affluent European munitions scientists. This surprised Grossman—especially in the light of accepted historical accounts that indicated Parrott had worked alone to develop his important new weapon. As soon as the dig was finished, Grossman dispatched a group of researchers to reexamine the written evidence that had spawned conventional history.

At the National Archives, Grossman's team found not only the copy of the Cameron memo urging the "privatization" of federal ordnance, but an array of other important documents. Nothing was found about the scientists who had lived in the houses Grossman's team unearthed. But, says Grossman, the paper evidence did show that innovations long credited to Parrott depended very heavily on "borrowed" foreign technology.

Parrott himself actively cultivated the image of lone inventor. "I was led to the construction of my gun wholly by my own experiments and conclusions," he wrote in 1862. Three years later he testified before Congress's Joint Committee on the Conduct of the War. "In

1860, I made the first of these guns," he told the representatives. "I made it from my own ideas upon the subject of what would make a gun of moderate cost and of good strength." The committee chairman pressed him on this point. "You were the inventor of these guns, were you?" he asked. This time Parrott replied more candidly. "I do not pretend to be the inventor of the idea of putting a band on the gun because that thing has been tried before," he elaborated, "but I believe my gun is the first banded gun that was ever actually introduced into the service of any country as part of its armament."

That was the one time Parrott approached the truth about his complex enterprise. Still, he did not reveal that, as Grossman's team learned, his "own ideas" for banded, rifled cannon had come to him not in a moment of inspiration, but in the person of a foreign military agent determined to acquire a prototype of the new banded-breech technology. In 1860, a "Captain Schwartz" of the Russian Imperial Navy visited Parrott at the foundry and asked him to make a copy of the British Armstrong rifled cannon for the Russian government. When Parrott explained he did not have access to the Britons' secret plans, the captain supplied a full set of blueprints. Within weeks Parrott made and personally patented the first Parrott gun.

Reliance on foreign innovation was nothing new for Parrott or for the American military. Grossman believes the Russian officer's well-documented appearance was merely the opening act of a cozy diplomatic relationship that culminated in 1863, when pro-Union Russia sent its imposing fleet into

Fayetteville [sic] had been "seized by disloyal hands," reported Cameron. With the capacity of the remaining arsenals clearly "not equal to the supply needed," the secretary felt it "absolutely necessary" to procure arms to some extent from private manufacturers. "It is believed that from these sources they can be obtained equal in quantity and not much higher in cost than those made in the national workshops."

Seeking such supplies from foreign manufacturers was an option, Cameron acknowledged. But the secretary, a devoted friend of private enterprise (perhaps because he often profited personally from War Department contracts), had a different idea.

"It would appear a wise policy on the part of the Government to encourage domestic industry, by supplying our troops in part from private factories of our own country, instead of making purchases from abroad," he wrote. "As rifled cannon are in point of effectiveness far superior to smooth-bored, arrangements have been made to rifle a large portion of guns on hand, and the work is still in progress."

There is no record that the White House received Cameron's message, and no reply from Lincoln has been found. The original memo is not part of the Lincoln Papers. Only a handwritten copy survives within the crumbling, leather-bound records of the Secretary of War, stored in the National Archives' vaults. One thing, however, is evident: Cameron's advice was heeded, and no one benefitted more from the resulting shift in federal ordnance policy than Parrott.

Soon the West Point Foundry was turning out rifled cannon at a record pace. Parrott guns were made in various sizes, each identified by the weight of the solid shot it fired. There were 10-pounders, 20-pounders, 30-pounders, and eventually massive 300-pounders, all wearing the distinctive iron breech band and all stamped "WPF RPP," for West Point Foundry and Robert Parker Parrott. Complete manufacturing records have not survived, but historians estimate that at peak production, the cannon works churned out 25 heavy guns and a staggering 7,000 shells weekly. According to one estimate, by war's end the foundry had produced a total of 1,700 Parrott guns and more than 3 million shells.

Army and navy alike used Parrott's fearsome products. Parrott guns ravaged countryside and city, sank ships at sea, and laid waste to battalions in the



The foundry thrived during the Civil War as the Union's main supplier of Parrott guns and of the projectiles they fired.

field. Parrott rightly conceded his design was not perfect. The muzzle would sometimes break off (though Parrott insisted the rough edge could be shaved down and the gun fired again with little loss of efficiency). Still, no ordnance developer ever received, or seemingly deserved, more credit for successfully arming a nation at war.

During the archaeological investigation at Cold Spring, Grossman began to suspect that the credit was undeserved. Near the foundry, the excavation team uncovered the remains of houses whose inhabitants seemed to have been affluent European munitions scientists. This surprised Grossman—especially in the light of accepted historical accounts that indicated Parrott had worked alone to develop his important new weapon. As soon as the dig was finished, Grossman dispatched a group of researchers to reexamine the written evidence that had spawned conventional history.

At the National Archives, Grossman's team found not only the copy of the Cameron memo urging the "privatization" of federal ordnance, but an array of other important documents. Nothing was found about the scientists who had lived in the houses Grossman's team unearthed. But, says Grossman, the paper evidence did show that innovations long credited to Parrott depended very heavily on "borrowed" foreign technology.

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Northern harbors in a show of might that Navy Secretary Gideon Welles heralded as "a source of pleasure and happiness to our countrymen." It would have been in Russia's interest to help strengthen the Union so it would intimidate Great Britain, Russia's old enemy in the Crimea (and a potential ally of the Confederacy). According to historian T.A. Bailey, the Czar's government wanted nothing more than to build up "a new world rival that would curb England's power and pride."

Yankee ingenuity may have stoked the pit inside the West Point Foundry, but it seemed to Grossman that the designs for the weapons it molded relied heavily on the successes and failures of nearly 20 years of European experimentation. The covert delivery of plans for the prized British cannon, Grossman came to believe, was just one thread in a complex web of intrigue that led back to Lincoln himself.

Some valuable information on European artillery would have come to Parrott honestly enough. There was, for instance, the report by American ordnance officer Alfred Mordecai. In the 1850s Mordecai undertook an official mission to Europe to observe battles of the Crimean War and saw a variety of heavy artillery in operation. He returned home with drawings and plans for no fewer than 13 foreign-made cannon. He also brought a valuable research paper, *Memoire sur Divers Perfectionnements Militaires*, featuring the 1844 test results of experimental rifled guns from Italy, some of which fired shells three miles to within 15 to 30 feet of their targets. But perhaps the most important fruit of Mordecai's journey abroad was the monograph he published in 1861, featuring detailed descriptions and plans of the British Lancaster rifled cannon and the Krupp cast steel cannon. The Krupp gun fired a 20-inch-long, 259-pound shell with a wrought iron expansion ring that made the projectile follow the barrel's rifling grooves—a design Parrott obviously studied and probably adapted for his own shells.

The Krupp gun, despite the fanfare, soon disenchanted American designers and military experts. Colonel John G. Barnard, chief engineer for the wartime defenses of Washington, D.C., and later chief engineer on Major General Ulysses S. Grant's staff, told a Congressional committee that the process for manufacturing Krupp guns proved both "expensive" and "uncertain." Worse, its shells

sometimes exploded prematurely. More research was needed to perfect rifled cannon.

Fortunately for the Union, access to foreign designs and devices, so open during the 1850s, apparently continued unabated in wartime. In the previously mentioned memo from Cameron to Lincoln, the war secretary documented the receipt of "a perfect battery of the six Whitworth 12-pounder rifled cannon, with three thousand rounds of ammunition, the magnificent donation of sympathizing friends in Europe."

The disclosure of this "donation" proves Lincoln was well aware of foreign rifled-cannon technology. He was certainly kept abreast of technological advances; the most convincing proof of this came in another startling document from the National Archives. It was an



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unrecorded memorandum written to Lincoln on January 24, 1863, by Captain John A. Dahlgren, chief of the Union navy's Bureau of Ordnance, which all but oversaw ordnance production at Parrott's ostensibly private foundry. The memo stated, "Captain Dahlgren presents his respects to His Excellency, the President of the United States, and submits copies of official letters in relation to Mr. Horatio Ames, which will supply the information which the President has called for."

Horatio Ames, as other letters in Lincoln's White House papers reveal, was a Connecticut-based gun manufacturer later summoned to Washington to test-fire his own 100-pounder gun designs. The precise meaning of Dahlgren's reference to Ames in this memo is unknown. But folded inside the Dahlgren memo was an extraordinary handwritten document labeled "Tables of Comparative Power of American and Euro-

pean Navy Rifled Ordnance."

The detailed chart, based on European field tests, gave Lincoln an astoundingly frank comparison of caliber, gun weight, bore length, powder charge, shot weight, muzzle velocity, pressure per square inch, and energy per inch of a wide range of rifled cannon made in Prussia, Italy, England, France, and America. Nothing like it is known to exist in the entire archive of surviving correspondence with Lincoln. From this reassuring secret study, Lincoln learned that American weaponry had become from 5 to 20 percent stronger in velocity and firepower than any European nation's, including those superpowers whose intervention in the war on the side of the Confederacy Lincoln most feared.

Lincoln had visited and inspected Parrott's foundry in 1862. Less than a year later, the president probably knew more about international rifled cannon



Two 300-pounder Parrott guns (above), one of which appears better prepared for duty than the other. Although tipping over wasn't a common problem with the guns, they were notorious for exploding at the muzzle (left). No amount of testing at the foundry's cannon-testing facility (below) could guarantee a gun would not blow up in battle.

technology than all but a tiny handful of his contemporaries. He knew precisely how American weaponry compared to European weaponry, just as he knew exactly how dependent the domestic variety had been on European prototypes.

The discovery of the artillery chart instantly raises certain questions. Did Lincoln know about and approve of the comparative cannon study? Had he approved or encouraged a wide-ranging effort to gather military intelligence from foreign nations, friendly and hostile, to provide the blueprints to jumpstart laggard American research and development? Did he know of the undocumented foreign scientists laboring to improve these foreign technologies at the foundry? Grossman believes the answer to all these questions is "yes." If that is the case, Lincoln deserves far more credit for wartime weapons development than historians have acknowledged.

Parrott, Grossman believes, was merely a "patsy, a manager taking orders from the military, not a Horatio Alger-type genius inventor." In a chapter in a recent book from the University of Tennessee Press, *Look to the Earth: Histori-*

cal Archaeology and the American Civil War, he argues that his findings "suggest that the Union was actively and covertly working to gain access to, and to apply, the results of early European research efforts in heavy rifled cannon development, which had been underway since the 1850s."

"This policy of industrial and military espionage and its manifestation in the products of the West Point Foundry," Grossman contends, "in effect saved the Union millions of dollars and years of development time—time that, at the onset of hostilities in 1861, the North did not have."

Perhaps the most intriguing link between Lincoln and foreign ordnance was a little-known naval captain named Henry A. Wise. A marine and intelligence officer during the Mexican War, Wise began his Civil War service as John Dahlgren's assistant. He took over as chief of the navy's Bureau of Ordnance when Dahlgren was given command of the South Atlantic Blockading Squadron in July 1863.

Following his Mexican War service, Wise became a close friend of Lincoln's assistant private secretary, John M. Hay. As young men in wartime Washington, Hay and Wise dined out together regularly, often with Assistant Secretary of the Navy Gustavus Fox. Wise also frequented the White House, where Hay and his fellow presidential secretary, John G. Nicolay, shared liv-

ing quarters across the hall from Lincoln's office.

Grossman believes that Wise, as head of the navy's ordnance bureau, at the very least personally "directed the flow of ongoing research and testing work for the development of heavy weapons systems for the Navy, at the West Point Foundry and other munitions centers." He reasons that what Wise learned overseas and applied domestically, Hay learned also. And what Hay knew, Lincoln knew.

Wise brought to his work broad experience in gathering information about foreign military technology. He had visited Europe, Mexico, and Asia. His entry in the *National Cyclopaedia of American Biography*, published 56 years after the Civil War, acknowledged that he had undertaken at least one secret visit to the Krupp cannon works in Germany. In testimony before Congress's Joint Committee on the Conduct of the War in 1865, Wise concluded reassuringly: "We have in this country more powerful rifled cannon than any we know of abroad." There could be little doubt that the captain's knowledge came from firsthand experience.

In attempting to flesh out a clearer profile of Wise, Grossman uncovered letters sent to the captain in 1862 by an operative in England named Abram S. Hewitt. The letters reported on a wide range of intelligence "I have collected in regards to ordnance," including in-



GROSSMAN AND ASSOCIATES



The 1863 visit of a Russian fleet to New York Harbor was seen as a show of support for the Union. Russian sailors like these (left) were greeted warmly, and their officers enjoyed a lavish ball (below) at Manhattan's Academy of Music. In reality, however, the fleet had come to New York to avoid hostile French and English ships. A real show of support had come in 1860, when a Russian officer passed British cannon plans to Parrott.

formation about armor plates, steel casting techniques, firing mechanisms, and comparisons between wrought iron and cast iron. "Full details on the subject of the manufacture and experiments" were to follow later.

"Of course it has not been easy to get at the details I have described, and I have promised two copies of Capt. Rodman's book on his Big Gun, and two copies of the Ordnance Manual," Hewitt wrote regarding informants who divulged data about Britain's feared Armstrong gun. "I will be obliged therefore if you will apply to the Ordnance Bureau for these and forward them without delay to the American Legation here [in London], addressed to me."

Wise, of course, was not the only Federal official investigating foreign weapons production. At an 1865 Senate hearing, John Barnard reported on the results of the Krupp works' latest tests of 200-pounder rifled guns made of "cast steel, which is probably the strongest of all materials." Barnard concluded, "The process of forging large masses seems yet to be uncertain."

What now seems indisputable is that right up to the end of the war, Union engineers and ordnance officials continued to search overseas for stronger metals and new manufacturing techniques that might correct lingering deficiencies in Parrott cannon, flaws that occasionally caused the gun to explode when overheated. As late as December 1864, Rear Admiral David Dixon Porter complained that Parrott 100-pounders burst prematurely so often during the attack on Fort Fisher, North Carolina, that they almost seemed "calculated to kill more of our own men than those of the enemy."

Earlier in 1864, Wise insisted to Congress's Joint Committee on Ordnance that the navy's Bureau of Ordnance "has searched in vain among the systems of European nations and the



improvements of our own country for a better gun, taken as a whole, than the Parrott rifle." His conclusion is not surprising, but it is astonishing that he so readily acknowledged the covert search.

The results of all these intelligence efforts were enough to convince some experts at the time that the Union was approaching invincibility—even on an international scale. At a Senate hearing in February 1864, Commodore John Rodgers of the Union navy boasted that, flaws notwithstanding, American weapons "are the best in the world." He went on to reveal that Union ironclads were being designed to rival British, not just Confederate, warships, and boasted of their ability to sail to the West Indies or Europe if necessary. Rodgers believed those ironclads could defeat the pride of the British fleet "all at once."

"What emerges from all of this," Grossman believes, "is a story of nationally and internationally based intelligence operations which flourished under the sanction of President Lincoln and an inner circle of military advisors." The previously unrecognized implications, Grossman contends, suggest Lincoln possessed unimagined levels of "technological and geopolitical sophistication." The Union weapons development program, he says, was clearly not "the stumbling operations of some nice country lawyer from the west." ■

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