DEFENDING AMERICA'S SHORES: A HISTORICAL ANALYSIS OF THE DEVELOPMENT OF THE U.S. ARMY'S FORTIFICATION SYSTEM, 1812-1950

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE
Military History

by

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B.S., Oregon State University, Corvallis, Oregon, 1988

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This study investigates the contributions of the U.S. Army's coastal fortification system to execute the coastal defense policy of the United States, in view of the tremendous technological advances and developmental shortfalls it had to contend with over the course of its existence. The concept presented is one showing the ultimate failure of the entire fortification network to maintain its viability to defend critical harbors when individual fortifications underwent their baptisms of fire.

Until the conclusion of World War II, the U.S. Army has traditionally been the instrument entrusted with executing the land-*based element of American coastal defense policy. The overall challenge was to organize a coastal defense establishment properly resourced to meet any threat within the fiscal restraints imposed by the national leadership.

The study explains the development of the coastal fortification system in relation to the Army's concept of organizing and equipping organizations to conduct operations in support of its mission and the technological impacts influencing coastal fortifications. This study will promote the lessons from the Army's failure to continually develop a system capable of adapting to technological changes and will serve as an example of the consequences of flawed policy decision making for future force developers.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

DEFENDING AMERICA'S SHORES: A HISTORICAL ANALYSIS OF THE DEVELOPMENT OF THE U.S. ARMY'S FORTIFICATION SYSTEM, 1812-1950 by LCDR TIMOTHY J. CHARLESWORTH, USN, 162 pages.

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CHAPTER 1

INTRODUCTION

Since the American Revolution, the nation's vital estuaries and harbors have been fortified and garrisoned to protect them from naval attack and to prevent the seizure of vital American coastal cities during the course of a conflict. Until after the end of World War II, the army has traditionally been the instrument entrusted with executing the land-based portion of coastal defense policy. To most economically meet long-range defensive needs, American military engineers devised several systems of permanent seacoast fortifications between the War of 1812 and World War II to shield the nation's coastal cities. An overview of our efforts in coastal defense reveals a repeating pattern of insufficient resourcing, inflexible defense planning, and an inability to grasp the impact of new technological advances to warfare when building these defenses. Although the means of conducting coastal defense operations would radically change over time, twice within the short military history of this country, these fortifications would resemble a hollow shield, unable to adequately defend America when called upon. Ultimately, decades of insufficient resource allocation and flawed coastal defense policy decision making during the generational development of the fortification system would lead to its systematic failure to adequately defend the United States during the Civil War and World War II.

To construct, maintain, and man a viable coastal defense system capable of defending the shores of the United States is a vast undertaking. The building of a coastal defense system properly resourced to meet any perceived threat within the fiscal restraints imposed by the national political leadership became the army's primary

organizational challenge for almost 150 years. The elaborate use of fortifications in the United States began when military engineers took advantage of the civilian bureaucracy's fear of maintaining a large peacetime army by advocating the establishment of a fortification system in its place as a more economical alternative. Upon completion, these structures could be maintained in a perpetual state of readiness for war at a minimal cost to the government. In effect, while the army mobilized the required manpower to garrison them in the weeks of preparation leading to the beginning of hostilities, these fortifications would be a shield always ready to counter a potential adversary. Over the years, the ambitions of the engineers to build several systems of large, complex coastal fortifications were never realized. Planning considerations would always exceed the ability of the nation to finance construction costs and provide adequate amounts of trained manpower and advanced armament. A hollow shield eventually emerged and some of these systems even reached obsolescence before fiscal resources could be found to complete construction efforts. Once the use of forts became the predominant element of American defense policy, the army consistently experienced difficulties implementing the lessons learned from previous conflicts to develop the next generation of "modern" fortifications. Adequate resourcing was a recurring problem as Congress had to be continually persuaded to provide the necessary funding to finance improvements and install new types of seacoast artillery to keep pace with emerging threats.

Although the means of conducting coastal defense operations would change over time, inflexible defense planning continued characterize the implementation of every new system of fortification. American coastal fortifications, by planning and design, were only capable of countering a naval threat to the locales they were tasked to defend.

Never envisioned or designed to counter a land threat, American coastal fortifications were quickly reduced to rubble once an enemy force became established ashore. This was seen in the examples provided by the reduction of Forts Pulaski and Sumter during the Civil War and the Japanese bombardment of Corregidor during the early days of our involvement in World War II. American fortifications experts would "continue to put their faith in forts, probably because of mankind's immemorial bad habit of mistaking the part for the whole."[1] Instead of integrating the use of coastal fortifications into the entire defensive structure of the United States, fortifications were fully expected to defeat the enemy without any assistance from other elements of the army. Besides traditional competition between the army and navy for service predominance, additional bureaucratic infighting between the engineers, artillery, and the ordnance department for control of fortification operation and standardization prevented efforts of the army to concentrate planning efforts to fully integrate the potential defensive uses of fortifications. This methodology of the use of coastal fortifications continued to dominant the planning of American defensive strategy and coastal defense doctrine for over one hundred and fifty years.

Over the course of history, the army would be slow to realize existing coastal defenses were no longer capable of being a viable element of our defensive structure. An inability to grasp or recognize the impacts of new technological advances to warfare eventually emerged when a system of coastal defenses had been in existence for several decades or its completion would be drawn out for the lack of monetary resources. The emergence of rifled ordnance during the Civil War, the operational development of the airplane, and continuing advances within the field of naval gunnery made entire coastal

fortification systems obsolete in a matter of a few years. Modernization of a coastal defense system throughout its service life often did not keep pace with the technological developments being introduced to warfare. Economic limitations forced defense planners to continually resource, maintain, and expand obsolete coastal fortification systems for several decades until engineers could design and obtain the financial resources to build and equip a more modern version capable of countering existing technology.

To demonstrate the ultimate failure of the coastal fortification system to adequately conduct its mission, this study will examine the coastal defense policy of the United States forward from the conclusion of the War of 1812 to the end of World War II. The structure of the coastal fortification system will be considered in relation to the United States Army's concept of conducting coastal defense to conduct operations in support of this policy. Technological innovations that impacted the development of seacoast fortifications throughout this period will be analyzed. Comparisons will also be conducted to determine if the actual fortification system that was financed and constructed met the expectations and requirements laid out by defense planners. The overall impact of the Army to perform its coastal defense mission will be documented by exploring the lessons learned from the participation of seacoast fortifications in particular conflicts. In conclusion, the failure of the army to effectively perform its coastal defense mission was due to its inability to effectively plan and resource coastal fortifications capable of adapting to changing technological challenges. This historical study offers significant insights on the development of forces to meet the challenges of missions being undertaken by the military to meet future emerging threats.

Documenting the inadequacies of the defense establishment to develop several fortification systems properly structured and resourced will be of interest not only to historians of this era, but to force development and force integration experts as well. Force development teams are responsible for the process of determining doctrine, leader development, training, organizational development, and material development and translating them into programs and structure, within allocated resources, to accomplish army missions and functions. Force integration efforts within the army focus on proactively assessing the combined impacts of army functional systems on organizations and ensure the appropriate mix of resources are available and fielded to support a combat-ready unit at the appropriate time. With the ending of the Cold War, the United States has emerged as the lone superpower in the world and the missions that the military have been engaged in after the end of the Gulf War have been non-traditional in nature. Humanitarian relief, peacekeeping, and nation building are examples of the missions undertaken by the armed forces within the last decade. The modern force structure and resources used by the army to assume these missions has been criticized as being too large and heavy to deploy in a timely manner. The central issue of this debate for force developers and integrators has been to restructure a force that is currently designed to fight a Cold War-era battle into one that is rapidly deployable and effectively organized to conduct the type of non-traditional missions that are envisioned in the future. As the army begins the process of developing the structure of the medium brigade that could be employed in future contingences, the analysis contained within this thesis outlining the historical consequences of not adequately developing a modern coastal fortification system will illustrate for historians and force developers and integrators, the result of

flawed decisions to properly resource and structure military forces to fight in future conflicts.

CHAPTER 2

GENESIS OF THE AMERICAN SYSTEM OF FORTIFICATION

Introduction

History reveals that the kinds of operations practicable in any war have been determined, to a large extent, by the types of armament available. The particular armaments in use have influenced both the strategy and tactics of the participants. Leaders who have appreciated the impact of new weapon systems on the battlefield and adopted new tactical methods to exploit them have been the ones to achieve victory.[1] Wide ranges of technological innovations have influenced the battlefield since the end of the American Civil War. The political leadership has resourced and army strategist and tacticians have incorporated these innovations into the organizational structure of armies and orchestrated, with varying degrees of success, new methods to conduct combined arms warfare on the battlefield. As Western armies were phasing out smoothbore firearms and artillery by the mid-1800s, the tacticians who were able to quickly grasp and competently exploit the new advantages of technological changes being introduced to warfare were the leaders who were emerging victorious on the battlefield.[2]

Ever since the introduction of artillery onto the battlefields of the world, it has been the most immobile part of an army. The immobility of the heavier types of artillery led to its division into several different classes.[3] The two most common uses of artillery within the army were for coastal defense and for mobile operations supporting other formations on the tactical battlefield. Field artillery is capable of accompanying the army into the field and possesses the mobility to be organized as an integral element of an army to conduct combined arms warfare. Seacoast artillery is mainly defensive in nature and

because of its great weight is mounted on carriages in permanently fixed fortifications. The U.S. Army adopted and incorporated additional types of artillery into the organizational structure of its coastal artillery organizations to counter important technological changes introduced to warfare. Trench and railway artillery units were initiated into the force structure to assist the infantry in penetrating the elaborate defenses of the trench systems of World War I. Anti-aircraft artillery development occurred as a result of the introduction of the airplane to conduct tactical missions on the battlefield.

As the nineteenth century drew to a close, the Army was undergoing a prolonged period of organizational, technological, and doctrinal change. The amount of funding coastal fortifications received to develop new coast artillery weapons and build new installations depended on the prevailing fiscal priorities within the army. Other branches were in direct competition with the artillery for scarce fiscal resources to finance defense requirements. The army had a long history of not committing enough resources to fully develop the coastal fortification systems envisioned by the coastal defense policy decisions it made and the period this study seeks to explore was no exception. A generation of bare-bones budgets kept the Endicott coastal defense program, the Army's major peacetime defense project, perennially behind schedule.[4] This lack of resource allocation, coupled with flawed coastal defense policy decisions in the generational development of the coast artillery fortification system, eventually eroded their defensive potential.

Americans have always been attracted to coastal fortifications because they were a more attractive economical alternative to a large standing army and their very existence would act as a deterrent to a potential opponent while being non-aggressive in

appearance. After the Revolution, the use of coastal fortifications became a cornerstone of American military policy and the systematic construction of installations would be the principal peacetime activity of the regular army for the next one hundred and fifty years. The intent of this chapter is to explore the historical background responsible for the creation of the Bernard Board in 1816 to design and construct the nation's first comprehensive and permanent system of fortifications, known to history as the Third System. Despite the successful efforts of the Bernard Board to bring order to all the various aspects of fortification construction, this section of the study will show they set into motion several precedents that would ultimately be responsible for undermining the effectiveness of any system of fortifications to defend the nation during a conflict. When the Bernard Board advocated the use of fortifications to protect naval bases and the economic potential of vital coastal cities from naval attack, they elevated the use of fortifications as the only obstacle facing an invading enemy instead of incorporating fortifications into the entire defensive structure of the nation. Once the American uses of fortifications were traditionally established, their use in future conflicts would be doomed to failure.

This chapter will also illustrate the intention of the military to maintain these fortifications in a perpetual state of readiness while the army mobilized to garrison forts in the weeks leading to the beginning of hostilities. In essence, these fortifications would be a shield always ready to counter a potential adversary. The historical record investigated in this section will establish a foundation as to why this ambition would never be realized. Over the years, a cycle will emerge demonstrating the inability of the engineers to build a system of large, complex coastal fortifications. Planning

considerations would always exceed the ability of the nation to finance construction costs and provide adequate amounts of trained manpower and advanced armament. A hollow shield would eventually emerge as the Third System reached obsolescence before fiscal resources could be found to complete construction efforts. The effects of this cycle will be demonstrated by the failure of Third System installations to counter enemy intentions during the American Civil War.

First and Second Systems of Fortification, 1794-1812

The first two periods of the American fortification system were developed under the urgency of pending international crisis. With the threat of war with Great Britain was looming, the fortifications of the First and Second Systems were hastily built and short lived to meet the requirements of an emergency.[5] At the end of each crisis, fortifications were normally abandoned or allowed to lapse into disrepair. Engineers worked independently of each other under very broad instructions given to them directly by the Secretary of War. The War Department did not assign a particular department or bureau with the specific responsibility of coordinating planning, promulgating standards, or supervise the actual construction of fortifications.[6]

The components of the First System of Fortifications were neither uniform nor durable and did not really constitute a true system.[7] These open works normally consisted of earthen parapets, mounting from eight to several dozen muzzle-loading 24-, 32-, and 42-pounder smoothbore guns depending on the size and importance of the defended harbor. Many different types of carriages were in use to mount guns in this system. A mixture of traditional four-wheel naval truck carriages, heavier versions of field artillery mounts, and a fixed French seacoast carriage that could traverse the weapon

horizontally were utilized at various installations.[8] Most of these fortifications were very simple to construct and quickly fell into ruin after their usefulness had ended. Very few of these works survive in their present form today, but two good examples may be seen at Fort Mifflin near Philadelphia and Fort McHenry in Baltimore.[9]

Although the Second System of Fortifications consisted of some substantial works, they were marked by dissimilarity among its elements, particularly the armament and the architectural style used to construct them.[10] Work on this particular system commenced in earnest in 1807 in anticipation of a second war with Great Britain. Most of the defenses were completed before the beginning of the War of 1812. These fortifications were more elaborate than those of the First System, but still lacked from coordinated planning and a consistent style of construction. In addition, all masonry forts were introduced to the normal complement of open, earthen batteries and masonry-faced earth forts. These all masonry-constructed forts were viewed as a turning point in the progress of American military architecture and when combined with the casemated gun emplacement, led to the development of the high, vertical walled harbor defenses.[11] Seacoast cannon could be more protected by mounting them inside the fortification instead of being unprotected from enemy fire by being mounted on top of the exterior wall.

The most significant military advantage derived from this style of all masonry construction lay in making it possible to mount the armament of the fortification in several tiers. The amount of firepower achieved by a single installation increased several times and an important channel could be protected by only one or two similar fortifications.[12] Castle Williams constructed on the north point of Governors Island in

New York Harbor is the largest example of this type of fortification built between 1807 and 1812. Its design consisted of four levels built within a circular plane, 210 feet in diameter. The two lower tiers consisted of twenty-six gun casemates, while the third tier was used to mount another twenty-six cannons or used as a barracks for up to 300 men. Originally intended to mount forty-eight lighter cannon, the barbette tier was converted during construction to mount an additional twenty-six heavy caliber seacoast cannons.[13]

The Corps of Engineers were primarily responsible for the fortifications of the Second System that extended from Portland, Maine to New Orleans. In some locations the engineers reconditioned elements of the installation already in place and constructed additional batteries of guns.[14] The most common weapon in use at the time was the muzzle-loading 42-pounder smoothbore cannon mounted on a horizontally traversing gun carriage specifically manufactured for each fortification. An American designed 50-pounder "Columbiad" also made its appearance during this period. This weapon became the first major American contribution to the development of artillery by being able to fire an explosive shell in addition to the normal solid shot normally fired by large seacoast cannons of the period.[15]

A small number of First and Second System Fortifications came under fire during the War of 1812 with results ranging from brilliant defense to outright surrender. The works at Fort McHenry, Fort Bowyer, and Fort St. Philip stood up very well to bombardment. Although the major defenses of Boston, Charleston, and New York were not attacked during the course of the war, Castle Williams withstood a test firing by the U.S. Navy in April, 1812.[16] By 1815, almost every important port city within the United States had one or two forts, combining features from the first two systems of fortification,

constructed for their defense.[17] A grand total of approximately sixty installations of various size, style, and strength made up the mostly respectable First and Second Systems of Fortifications within the United States. The lack of cohesive design, inconsistency in planning and their inability to be a mutually supporting body of defenses became the most important drawbacks to both of these systems of fortification.[18]

Implementation of the Bernard Board

Despite the drawbacks of the First and Second Systems of fortification, engineers and military planners concluded that the casemated multi-tiered mason fortifications had achieved a deterrence effect against attack during the War of 1812. This type of installation subsequently became the model for all fortifications constructed after 1816.[19] These works became collectively known as the Third System of Fortification within the United States. Congress began by appointing a board of officers tasked to create a third "permanent" and comprehensive system of fortifications. Organized in 1816, Simon Bernard, a French military engineer who had served under Napoleon as a Brigadier General, was appointed to head the board.[20] Although the individuals assigned to the board would periodically change, in time this board will become known as the Bernard Board or the Board of Engineers. Two Army engineers, Lieutenant Colonels Joseph G. Totten and William McRee, and a naval officer were initially assigned to the board. The responsibilities and tasks of the board included making decisions on the priority of sites to be fortified, the determination of fortification design for each site, the dispatch of engineers to each site under consideration, and to supervise fortification construction. This board began a process that represented a significant development in the history of American fortification. For the first time a competent authority had been established to

supervise all the aspects of constructing military fortifications from the start of individual projects until their completion.[21] This board set the precedent for other groups in various forms to supervise the construction of American military fortifications until the end of World War II.

The board had considerable influence in making recommendations concerning overall coastal defense policy before its focus was narrowed to fortification considerations. Several of the diverse elements of coastal defense policy studied by the board included interrelating the navy, fortifications, avenues of communication in the interior, the regular army, and the role of an well-organized militia in the overall structure of coastal defense policy.[22] The board's first report in 1821, noted the primacy of the navy in a total system of defense and indicated locations for major facilities and naval bases. Fortification recommendations were made to protect both these proposed bases and major ports and coastal cities. Only eighteen sites were listed as requiring fortifications "of the most urgent necessity" and an additional thirty-two sites of lesser priority for consideration for future construction as appropriation became available.[23] Cost estimations to build the entire system envisioned by the board totaled $17.8 million, while the number of troops required to garrison the forts in peacetime would number 4,690. The number of troops required to man and defend the fortifications during a war would total 37,962.[24] Eventually the Bernard Board would envision a long-range coast fortification plan to defend every major locale along the eastern seaboard and gulf coast of the United States. Over 200 fortification sites were recommended for completion by 1850. This type of long-range planning would set the precedent for future boards to

make far-reaching recommendations concerning the coastal defense of the United States.[25]

Third System of Fortification, 1817-1860

The most spectacular projects of the Third System, were the large group of massive, vertical-walled masonry forts. The brick and stone material used to construct these works were resistant to the effects of the natural elements and the use of this material allowed the inclusion of the casemate gun emplacements in the design of these fortifications. These installations also possessed considerable structural durability against round shot and employed a high concentration of firepower from its armament protected in multi-tiered casemates against the entrance channels that would be used by enemy fleets. This type of fortification was designed to maximize the number of gun emplacements along the defensive front.[26] Some of these massive fortifications were destined to play significant roles in the American Civil War. These would include Fort Sumter, Fort Pulaski, Fort Monroe, Fort Morgan, and Fort Jackson. These forts were designed to hold out against a siege for at least ten to fifty days, until relief could arrive. These massive fortifications were also designed to take into consideration the variations in the topography of a particular site, the sort of area to be defended by the work, and the state of weapons technology when it was being constructed.[27]

Tremendous variations existed through out the system in the types of construction material used to build the installations, the architectural license used to design them, and the number and type of armament emplaced in the forts. Most forts were polygonal or hexagonal in plane, some having four faces while others had as many as seven, and mounted armament from fewer than fifty to about four hundred guns. At least one or

more tiers of arched casemates extended along the seaward front of the fort and a roof tier of barbette-mounted weapons existed on every exterior wall. The forts were built within a few feet of sea level to deny ships passage that might slip underneath the guns of a fortification built on an elevated site, and to permit the use of ricochet fire. The technique of ricochet fore only required gunners to train their pieces in the general direction of the target, eliminating the requirement to estimate distances. Most designs were devoid of bastions to protect the seaward faces of a work and some forts were provided with detached positions, moats, or ditches to protect the landward approaches. As the period progressed, the construction of large forts decreased, due to the ability of railroads to transport troops to the location of a fortification besieged by a foreign invader, thereby reducing the requirement for installations to withstand prolonged sieges. Some of the envisioned installations would take decades to construct and some would ultimately be scaled back or would never be completed. More than thirty fortifications were constructed after 1816 to provide coastal fortifications for important seacoast cities from Maine to California. The construction of the entire system would encompass a fifty-year time span.[28]

Implications of the Bernard Board to National Defense Policy

The new permanent fortifications of the Third System were designed to quell the fears of the American public from another foreign invasion. The mere presence of strong coastal fortifications along important points of the coast would act as a deterrent against invasion in the minds of the American public. The navy's participation within a total defensive system was vital. As the "first line of defense," they would be called upon to protect commerce and operate against invaders inshore. The army would claim its share

of the national defense budget by building fortifications to protect the navy's bases and repair facilities. With the lessons learned from the War of 1812 fresh in the minds of the American public, the Bernard Board answered public fears of another foreign invasion. To invade the United States using the prevailing tactics of the period, an invader had to seize a port to sustain the operations of his land and naval forces. To prevent this from happening, the Bernard Board envisioned the construction of strong coastal fortifications at important points along the coast.[29]

The board also argued that the country needed to assemble the militia, sometimes recognized as a institutional failure, and volunteer forces more rapidly to augment the small regular army in an emergency. A larger regular army would be required to man the recommended fortifications while the militia was upgraded into a more professionally trained reserve force. The board's recommendations also called for the construction of more installations than the 6,000-man army was capable of garrisoning in addition to meeting all of its other required responsibilities. Improved roads, waterways, and canals were also needed to rapidly mobilize and concentrate military forces. The foundation of modern day "pork-barrel politics" was laid during this time period when most towns and cities of the interior wanted better access to the coastal commercial centers of the country. To improve and develop the military potential of roads, harbors, and canals through out the country and to gain support for the proposed system of coastal fortifications, Congressman from both the interior and coastal states needed to realize the strategic value of improving the interior lines of communications as well as the defenses of the nation's vital centers of commerce.[30] "It was only a matter of time before Congress would realize the benefits to its members of spending the unprecedented sums

of money that the board's vision would require."[31] Since the army Corps of Engineers was also responsible for improving the military potential of waterways and transportation networks through out the country, this historic precedent would forever dilute the focus and involvement of the Corps of Engineers in the development and construction of coastal fortifications.

Despite the overall ambitious fortification recommendations put forward by the Bernard Board, the vast program was never fully completed due to congressional indifference and the vast expense involved in completing all the projected works and the additional manpower requirements to garrison them when they were completed. Recommendations made by the Bernard Board combined military idealism and political realism.[32] Many of the older harbor defenses would eventually replace the recommendations for new fortifications within the Third System after they had been repaired and modified.[33] Eventually, about two-dozen of these reconditioned or reconstructed fortifications were to be included within the system.[34] Even extra-detached batteries were recommended for inclusion, with the massive forty-gun casemated water battery at Fort Monroe as the primary example.[35]

The Fiscal Realities of Constructing Fortifications

The cost of constructing Bernard's vision was considerable. Bernard believed by constructing the entire system over several years, appropriations would be sufficient to complete the work as rapidly as possible. Based on the board's first report of recommendations in 1821, and later revised in its final report in 1826, Secretary of War John C. Calhoun won suitable funding from Congress for a few years. To arm the fortifications under construction, the Secretary of War urged Congress in 1823 to

appropriate $100,000 annually over the next decade to purchase cannons. The size of the Corps of Engineers gradually increased, as more engineers were required to supervise the construction of fortifications as well as overseeing improvement projects in various harbors and rivers throughout the nation. Work progressed steadily over the next ten years until decreases in the annual appropriations for construction began in 1831. When Congress granted no appropriations in 1834, work stopped altogether in 1835. When the Third System was twenty years old in 1836, the Senate asked Secretary of War Lewis Cass to review the entire system and report on the required amount of funds to finish the system. After reviewing the potential enemies in relation to the geographical position of the United States, he concluded that it unlikely for any large invasion force to land on the shores of the United States and it would be impossible to conquer the entire country. He believed that the navy was the first line of defense and funding for naval expansion should be increased. The Bernard Board originally designed individual installations of the Third System to counter a massive foreign invasions conducting prolonged sieges against isolated works while Secretary of War Lewis Cass was convinced that naval raids instead of invasions would occur in the event of war.[36]

Since Secretary of War Cass believed that forts no longer were required to withstand prolonged sieges, the present long-range fortification plan was overdrawn in light of the increases and advances in population, transportation, and industry. Secretary of War Cass also advocated the development of steam-powered floating batteries to meet future coastal defense requirements. He suggested that funding within two fortifications bills before Congress for the completion of existing fortification could be reduced or eliminated, while appropriations for new fortifications be eliminated and funding

allocated to finance floating batteries. Acting Chief Engineer Joseph G. Totten objected to the Secretary of War Cass' reasoning. Totten was convinced that the forts under construction could withstand any punishment that a potential adversary could bring against them and should be completed as planned by the Bernard Board. Secretary of War Cass used Fort Monroe in Hampton Roads as an example of the extravagance of the system proposed by the Bernard Board. He observed that the entire installation "covered six-three acres and required 2,700 men to man its projected 412 guns in the time of war."[37]

Critics of the Bernard Board construction plan picked up on Secretary of War Cass' objections on the scale of Fort Monroe and it ultimately became a huge embarrassment to the War Department.[38] Congressmen observing Fort Monroe firsthand after vacationing in the Hampton Roads area wondered if the rest of the Third System was as equally extravagant. As a result, Congress did not favorably commit appropriations for fortifications for the next several years. The questions being asked by Congress and the criticisms being issued by Secretary of War Cass caused a protracted struggle for funds.[39] The War Department never refined the country's fortification needs and Chief Engineer Totten doggedly continued to defend the plan developed by his mentor Simon Bernard. Funds appropriated for fortification construction between 1836-1842 were very meager and shortages of engineers continued to plague construction because the Corps of Engineers was also heavily involved in projects throughout the nation to improve harbors and major waterways. When Congress required Chief Engineer Totten to submit periodic reports to justify the costs of coastal fortification construction, he continued to submit updated versions of the original Board of Engineers

plan. Throughout Totten's struggles to obtain funding for the envisioned fortification system, he often did not have the support of the administration's Secretary of War. With very few allies, Totten continued to press for funding to complete the system throughout the 1840s, but work stopped altogether in 1842 due to a lack of appropriations..[40]

When appropriations were restored and construction work on the coastal forts recommenced in 1844, the engineers were supervising the building of forty-eight fortification projects of which forty were declared ready or almost ready for armament. Secretary of War William L. Marcy, however, advised that the system was far from complete and asked Congress for larger appropriations. Congress granted the princely sum of $1.3 million in 1846, but appropriation for fortifications continued to be an issue until Jefferson Davis assumed the office of the Secretary of War in 1853.[41] Chief Engineer Totten found an ally in Secretary of War Davis as he pushed for funding to complete scheduled construction. The government committed over $14.9 million over the next eight years to continue construction on existing projects while Totten continued to plan additional works to protection to all the coastal areas considered under the original blueprint drafted by the Bernard Board.[42] As the country continued to expand westward, concerns started to be raised about fortifying the new coastal enclaves along the Pacific Coast. The War Department initially appointed a joint board of army and navy officers to determine the fortifications needs of the Pacific Coast and eventually separate Boards of Engineers were established for both the Atlantic and Pacific coasts by 1851. The pace of fortification construction increased in the late 1850s as the impact of steam-powered warships to existing fortifications was being assessed. Totten's overall

aim throughout the 1840s and 1850s was to complete the Third System as well as extend its protection to vital estuaries and harbors along the Pacific Coast.[43]

When the Crimean War erupted and several technological advances having the potential to impact the traditional methods of fortifications were starting to emerge during the 1850s, Americans began to question the validity of the entire coastal defense strategy. Major Richard Delafield, Corps of Engineers, used his observations from the Crimean War in 1856 to write a report for the War Department calling for a complete review and redefinition of the American coastal defense policy. Secretary of War John B. Floyd advocated moderation of the current fortification construction program and believed a shift to the construction earthworks for coastal defense would be more appropriate and cost effective. Lieutenant James St. C. Morton conducted a study of the defenses of New York City at the request of Secretary of War Floyd and recommended the government concentrate on completing unfinished works with earthen batteries and only complete masonry forts in the remotest locales. Morton also recommended the construction of extensive trench systems to guard the approaches of major coastal ports and commence a series of experiments with torpedoes.[44] The Delafield and Morton reports were to have some impact on the use of fortification during the Civil War, but they did not bring overwhelming change in time to influence the completion of the Third System.

Summary

By the beginning of the Civil War, America had one of the most extensive coastal fortification systems in existence. Masonry forts and heavy guns were guarding all the important harbors and coastal cities and were the cornerstone of the American coastal defense policy. The coastline was defended by a policy that was over four decades old

and more importantly was never revised to reflect new methods of conducting warfare. Some of the forts were beginning to deteriorate after almost forty years of construction and many were not armed when the Civil War began.[45] The Third System was designed to be the best system of fortifications that could be possibly be constructed to counter every possible threat that an enemy naval force could present while attempting to invade critical points along the coast of the United States.

An examination of the historical record covered by this chapter demonstrates the fortifications of the Third System could not be maintained in a perpetual state of readiness for war and the army was incapable of mobilizing enough trained manpower to garrison them in time before the beginning of hostilities. Over the years, the ambitions of the engineers to build several systems of large, complex coastal fortifications were never realized and planning considerations always exceeded the ability of the nation to finance construction costs. By the beginning of the Civil War a hollow shield emerged and the entire Third System reached obsolescence before construction efforts were completed.

The construction of the entire system was expensive, but was designed to be durable and take advantage of the features of the terrain they were constructed to defend. As illustrated by the previous sections of this chapter, the primary challenge for army engineers designing and building the Third System was convincing the national political leadership for the need to properly resource a system capable of meeting any perceived threat. The historian Marguerita Herman summarized the overall value of the Third System of fortifications by stating, "Although the system was never tested by a foreign invasion, they satisfied the nation for at least four decades that their very existence would deter a potential enemy, thus achieving the goal of that most basic policy of national

defense in the nineteenth century."[46] This myth will be dispelled in the next chapter when it demonstrates that the developmental advances to smoothbore artillery and the introduction of rifled ordnance beginning in the 1850s require coastal defense structures and strategies to be flexible enough to absorb emerging technological developments and changes in offensive tactics of potential opponents.

Over time, inflexible defense planning continued to characterize the implementation of every new system of fortification. American coastal fortifications, by planning and design, were only capable of countering a naval threat to the locales they were tasked to defend. Never envisioned or designed to counter a land threat, American coastal fortifications were quickly reduced to rubble once an enemy force became established ashore. This will be seen in the next chapter by the examples provided by the reduction of Forts Pulaski and Sumter during the Civil War. The accumulated effects of decades of insufficient resource allocation and flawed coastal defense policy decision making during the generational development of the Third System of fortification would lead to its systematic failure to adequately defend coastal cities from attack.

CHAPTER 3

THE AMERICAN FORTIFICATION SYSTEM IN TRANSITION

Introduction

One unique rule of contemporary military science dominated the design and construction of the bastions of the Third System. For centuries, the principal of the superiority of shore-based weapons over cannons mounted on naval vessels withstood the test of time. In the face of a concentrated network of heavily armed coastal fortifications, a foreign invader would have to risk his fleet or attempt an amphibious landing at a more distant point. Choosing this second option, the enemy would often be faced with landing his forces in unsheltered waters without the aid of port facilities and sustaining his army over the beach as it made a lengthy approach march through hostile territory to seize the defended harbor.[1] This principle became ingrained into the military and engineering training received by the members of the Bernard Board. Its influence would be seen when they began to conduct surveys and inspections of the harbors dotting the Eastern Seaboard and Gulf Coast to assist them in preparations to draw up the engineering plans for the Third System of Fortification in 1816.[2] The overall design of the new emerging system of forts was looked on as a way to make the invasion of the coastline so unattractive to a potential adversary, the mere existence of the fortification system would in themselves be a deterrence to invasion.[3]

Cannons influencing the design of nineteenth-century fortifications have been found on the battlefield for the last two hundred years. In modern times the pace of technological change is astounding. During the development of the Third System, the development of artillery had become stagnant. The only real difference found in

nineteenth century cannons when compared to their seventeenth and eighteenth century cousins was size. Although larger in size, nineteenth century guns were still the same smoothbore muzzleloaders firing solid spherical projectiles of varying weights.[4] Using examples from history of previous engagements between ships and coastal forts, the engineers of the Third System used the accumulated knowledge of the effects of contemporary ordnance to design the new system of fortification. As the members of the Board of Engineers were advocating the supremacy of masonry fortifications, a technological revolution in the development of artillery was underway that would simultaneously wreck the preconceived understanding of the strengths of seacoast fortifications and the durability and impregnability of the walls built at a great expense of wealth and time.[5]

Over the course of history examined in this chapter, the army will be slow to realize existing coastal defenses within the Third System were no longer capable of being a viable element of our defensive structure. After coastal defenses had been in existence for several decades and their completion were being drawn out for the lack of monetary resources, an inability to grasp or recognize the impacts of new technological advances will eventually emerge when the Third System is tested during the course of the Civil War. The emergence of rifled ordnance during the Civil War made the entire coastal fortification system obsolete in a matter of a few years. Later discussion will focus on how the modernization of a coastal defense system throughout its service life often did not keep pace with the technological developments being introduced to warfare. Economic limitations forced defense planners to continually resource, maintain, and expand obsolete coastal fortification systems for several decades until engineers could

design and obtain the financial resources to build and equip a more modern version capable of countering existing technology.

Once the use of forts became the predominant element of American defense policy with the implementation of the Third System, this chapter will illustrate how the army consistently experienced difficulties implementing the lessons learned from previous conflicts to develop the next generation of "modern" fortifications. Adequate resourcing would continue to be a recurring problem in the future as it had in the past, as Congress had to be continually persuaded to provide the necessary funding to finance improvements and install new types of seacoast artillery to keep pace with emerging threats. American fortifications experts would continue to put their faith in forts by continuing to mistake the part for the whole. Instead of integrating the use of coastal fortifications into the entire defensive structure of the United States, fortifications were fully expected to defeat the enemy without any assistance from other elements of the army. This methodology of the use of coastal fortifications continued to dominant the planning of American defensive strategy and coastal defense doctrine for the next several decades.

The Nineteenth Century Revolutionary Development of Artillery

General Totten and his fellow engineers who would be primarily responsible for the shaping and development of the Third System over its lifespan were blind to the artillery developments which would make the entire system obsolete even before it would completed. When the engineers designed the new bastions at the conclusion of the War of 1812, this fundamental change had not yet taken place.[6] Masonry fortifications displayed a unique resistance to the solid spherical shot fired by most of the cannons then

available. In early tests, solid shot fired from smoothbore muzzle-loading cannons only penetrated a brick to a depth of two inches when fired at close range.[7] Thousands of rounds of ammunition and a great deal of time would be required to batter down a small section of a fortification wall in order to create a breach for an assault or to dismount every piece of ordnance mounted within the work. The weapons available for the armament of a fortification were still considerably superior to the type of ordnance found on most warships around the world.[8] Therefore, engineers used the prevailing assumptions concerning fortifications and the existing ordnance technology to justify the design of the new fortifications.

At the end of the War of 1812, the heavy seacoast cannons found within the American arsenal were limited to about five hundred ancient 24- and 32-pounders, plus the limited number of 42- and 50-pounders Columbiads arming Castle Williams in New York City. Many were of doubtful strength due to their age and varied widely in pattern.[9] The years leading up to the American Civil War saw many advances in the evolution of the design of seacoast cannons mounted within the fortifications of the Third System.[10] The Bernard Board initially recommended the mounting of 24-pounder cannons within the new fortresses being constructed. This cannon began to be manufactured in quantity after the initial construction efforts were initiated and would be the largest piece of ordnance manufactured in this country until 1829.[11] In that year, due to revisions in the Board of Engineers armament plans, manufacturers began to cast heavier 32-pounder cannons, closely followed three years later by 42-pounder models.[12] The introduction of the 24-pounder flank howitzer in the late-1820s replaced several models of smaller

cannons assigned the task of defending the exterior faces of the walls to provide protection against an assault by enemy infantry.[13]

While the engineers building the new fortifications were secure in their belief of the invincibility of their projects, the 1840s marked the development and introduction of new models that would be responsible for revolutionizing the use of artillery in the American Civil War. Engineers such as George Bomford and Thomas Rodman of the army and John Dahlgren of the navy would introduce new technological innovations responsible for advancing American cast-iron smoothbore ordnance to its ultimate level of development.[14] George Bomford's contribution was the development of a versatile new weapon of greater size and flexibility, and substantially greater range of the standard 32- and 42-pounder cannons presently in use. The older cannon were only capable of being elevated to a maximum of five or ten degrees using a flat trajectory or ricochet fire off the water to hit the hull of an enemy vessel. Bomford's design could fire either shot or shell at any angle from zero to nearly forty degrees.[15] The new weapons, known as Columbiads (see Glossary) and patterned after the models introduced just prior to the War of 1812, were produced in 8- and 10-inch calibers, allowing a shot weighing sixty-four or 125 pounds (using the old system of measurement) to be fired at a range three times than normally seen in older models. The range of Bomford's 10-inch model could exceed three miles in comparison to the maximum range of one mile demonstrated by contemporary 42-pounders.[16]

A problem encountered with the use of large caliber artillery was the tendency of large cannons to burst during firing after extended use or with heavy charges of power.[17]

Two primary areas of ordnance design were involved -- the external shape of the cannon and the manufacturing technique used to cast the gun tube. For hundreds of years cannon makers used extensive moldings, rings, knobs, and handles as ornamentation in the belief they added substantially to the overall strength of the piece. Evidence gathered during the 1850s actually showed these devices did not contribute to the strength of the gun tube and in some cases ornamentation cast onto the exterior of the weapon actually contributed to weakening the gun tube.[18] Thomas Rodman developed a new type of gun during this period that markedly reduced this traditional danger by devising a cannon whose shape was based on the distribution of gas pressures within the piece during firing. He patterned the cannon's exterior on a curve obtained from actual gas pressure measurements taken at various points along the cannon's bore during firing. At any given point along the gun's length, the thickness of the metal would be proportional to the stress being experienced at that point. John Dahlgren would be responsible for developing a similar weapon for the navy.[19]

Thomas Rodman's greatest contribution to the manufacture of powerful seacoast cannon would be in fundamentally changing the method guns were cast. He determined that the normal process of cooling and hardening the gun tube normally occurred from the outside in, leaving a pattern of stress in the metal running in the opposite direction. Rodman also ascertained that the pressures of firing the weapon were directed radially outward from the bore. The accumulation of these stresses often caused the weapon to burst at some undetermined time in its service life. Thomas Rodman devised a method to reverse the patterns of stress by circulating cold water through the hallow core of a casting while keeping the exterior heated, allowing the gun tube to harden from the inside

out. Artillery tubes cooled in this fashion were safer to fire, since firing actually reduced the total stress on the metal. This casting problem had been negligible with regard to the smaller weapons used by the field artillery because the problem increased with the mass of iron involved in the manufacturing process. Rodman's new gun casting method allowed weapons with calibers as large as 15- and 20-inches to be manufactured.[20]

Other engineers developing different methods to improve the design and reliability of cast-iron smoothbore cannons were Robert Parrott and John Mercer Brooke. Robert Parrott was a Federal ordnance officer who developed a highly successful design involving the installation of a wrought-iron band to reinforce the breech area of the gun. This design was taken one step further by Confederate engineer John Mercer Brooke. His method involved overlaying or wrapping three wrought-iron reinforcing bands around the breech. Artillery pieces of this type, when they did explode would burst at the muzzle instead of at the breech. In some extreme cases, the entire breech area behind the reinforcing bands would be blown away.[21] While Rodman's and Dahlgren's guns were both smoothbores, Parrott took his design one step further by introducing rifling into his cannon designs.

Rifling is the spiral grooving of a cannon's bore to impart spin onto a projectile. This allowed the use of elongated projectiles in artillery. Elongated projectile have a greater mass than a spherical projectile of comparable diameter and do not encounter as much air resistance while in flight. Rifled cannons were capable of delivering a much heavier projectile at greater ranges with a substantial increase in accuracy.[22] By the summer of 1862, Parrott guns were being cast with a 10-inch bore capable of firing a projectile weighing 250 pounds. The more common 8-inch model fired a shell weighing

150 pounds at a maximum range of 8,000 yards. Parrott rifled guns not only had a greater range than the smoothbore Rodman models, but also were more accurate because of their rifling. The introduction of the Parrott rifled gun sealed the fate of masonry fortifications.[23]

The Demise of the Deterrence Effect of the Third System of Fortification

The contribution to the development of heavy seacoast artillery made by Thomas Rodman, John Dahlgren, and George Bomford among others in the 1840s and 1850s only marked the beginning of the artillery developments that would undermine the deterrence effect of the Third System. The introduction of rifling by Robert Parrott into the interior of large gun tubes evolving from the pioneering work done by these engineers on the eve of the American Civil War will be the one unforeseen technological development not taken into account by the designers of the new fortification system. Masonry casemated fortifications would not last long under the prolonged bombardment of these new weapons. American fortification engineers did not immediately recognize this situation. When naval vessels or the artillery batteries of a besieging army were armed with these new long-range rifled guns, the casemated fortifications high, exposed brick walls would be to vulnerable to remain the cornerstone in the American coastal defense system. [24] Rifled cannons rendered the entire fortification system obsolete almost overnight.[25]

Another factor sealing the fate of the Third System of fortifications during the 1850s were the technological advances being undertaken by several European powers to introduce armored, steam-propelled warships. The French began conducting experiments to determine the effects cannon fire would have on solid iron plates in the early 1850s. These experiments, and similar ones undertaken in England, advocated the construction

of armored floating batteries to reduce coastal fortifications during the siege of Sebastopol in the 1854 Crimean War. The French would use the success of these batteries to support the decision to curtail the construction of wooden-hulled warships and the launching of the first armored warship, the *Gloire*, by the end of 1859.[26] The Federal and Confederate Navies quickly followed the example of Europe by developing their first ironclad vessels, the *Monitor* and the *Virginia* respectfully, during the early stages of the American Civil War.[27]

Armored warships or ironclads were a new innovation not taken into account by the engineers responsible for building the Third System. Warships in the immediate future would be less vulnerable to the fire of seacoast cannons than the wooden-hulled vessels they would be replacing. These new armored warships could duel with coastal fortification for longer periods of time with a reasonable chance of success. The introduction of steam propulsion into wooden-hulled vessels would make them more maneuverable in place of traditional sails and lessen the vulnerability of even these ships to cannon fire. With the introduction of armor, the traditional concept of the superiority of coastal fortifications over naval vessels was reversed. The strength of the masonry walls of American fortifications was now weaker against the strength of the hulls of enemy vessels they were designed to defeat.[28]

American fortification experts remained unconvinced of the vulnerabilities of masonry fortifications presented by the introduction of the rifled artillery cannon, steam propulsion, and armored warships. The lessons brought about from the experiences of the British and French Navies successful reduction of the Russian coastal fortifications at Sebastopol during the Crimean War were lost on the engineers. They remained

convinced of the superiority of the system of fortification presently under construction. The engineers believed large quantities of superior American ordnance emplaced in huge fortifications could still overwhelm the limited armored protection provided by the primitive designs of the new ironclads. The far-reaching developments of ordnance technology taking place in the United States and the expanding use of armored warships around the world did not change the options of engineers. Only through the widespread use of these weapons against Third System fortification during the Civil War would the light dawn of the necessity to devise and introduce new methods to fortify the critical harbors and estuaries of the United States.[29] The fates suffered by Forts Pulaski and Sumter during the course of the American Civil War, provide graphic examples of the effects these new artillery developments would have on the masonry fortifications of the Third System.

Fort Pulaski

Brigadier General Simon Bernard began developing the plans to build Fort Pulaski in 1827, shortly after completing final revisions to the report of the Board of Engineers to Congress. Actual construction got underway in 1829 under the supervision of Major Samuel Babcock. Robert E. Lee's first posting after graduation from West Point would be to the new fort site at Cockspur Island to assist with the early stages of construction until he was reassigned to Virginia in 1831. The fort's construction would be conducted intermittently over a period of twenty years and would be named in honor of the Polish Count Casimir Pulaski, a Revolutionary War hero who was mortally wounded at the Battle of Savannah on 9 October 1779.[30] It was an enormous project. All the materials used for the construction of the installation were imported from all over the

country. Upon completion in 1847, its massive walls cost nearly a million dollars to build and consumed approximately 25 million bricks.[31]

The fortification is located on a marshy island in the middle of the Savannah River, fourteen miles downstream from the city bearing the same name. Fort Pulaski consists of five sides or faces, including the gorge, are casemated on all sides, and its walls are seven and a half feet thick. An earthen demilune outwork covers the approach to the rear facing gorge wall. The main work and demilune are both surrounded and separated by a wet ditch.[32] The fort's 140 guns were mounted in one tier of casemates and one tier mounted en barbette. A total of fifty-five guns could be mounted within the casemates while the remaining eighty-five were arranged on the barbette tier.[33] In one critical respect, the fort was never truly completed. At the time of President Abraham Lincoln's election in 1860, only twenty cannons were mounted in the entire installation.[34] The twenty 32-pounder guns and carriages mounted at the start of the war were rusting and rotting and were not in a serviceable condition. The fort was overgrown and silt choked its wet ditch.[35] In addition, no Federal garrison existed at the post. Only a caretaker and an army ordnance sergeant were assigned to maintain the defenses in a questionable state of readiness.[36]

With the impending secession crisis looming on the horizon, Fort Pulaski's overall condition became an example of the continued failure of the U.S. Congress to adequately appropriated enough funds to maintain the entire fortification system in a defensible condition to be quickly mobilized in the event of an attack. In anticipation of Federal forces seizing the post, Georgia militia forces took possession of the fort on 3 January 1861. After Georgia's succession from the Union, control of the fort was

eventually turned over to Confederate military forces and became an important Confederate stronghold.[37] Several weeks of defensive preparations were needed by the defenders to raise the overall readiness condition of the installation.[38] Cannons within the fort were remounted and others were being brought in from other locations, slaves dug out the wet ditch while the defenders drilled at the guns and built sandbag traverses to protect the fort's magazines. A telegraph line to Savannah and a regular packet service for logistics purposes were established.[39] The fort was at least defensible by the time the Confederates opened fire on Fort Sumter in April.

With almost a year to prepare Fort Pulaski for siege, Confederate forces were able to stock pile a substantial amount of ammunition and powder within the magazines of the fort and to mount forty-eight guns of various types, of which twenty were capable of firing on Big Tybee Island in opposition of the entrenched Federal batteries. Five companies with an aggregate strength of 385 men under the command of Colonel Charles H. Olmstead garrisoned the installation. Several Confederate officers thought successful siege operations against Fort Pulaski could not be conducted, therefore, additional measures to strengthen the fortifications were meager in nature.[40] Robert E. Lee, who was then a Brigadier General in charge of Confederate forces in South Carolina, Georgia, and eastern Florida, told the defenders he was confident the thick walls of the fort could not be penetrated by artillery fire by telling the defenders "they cannot breach your walls at that distance." He made two inspections trips to Fort Pulaski before the Federal siege and gave specific instructions concerning the defenses of the fort.[41]

Most Federal officers were also convinced that Fort Pulaski could not be reduced by artillery fire alone. Chief Engineer Totten, the architect of the system of fortifications

Fort Pulaski was a member of, stated, "The work could not be reduced in a month's firing with any number of guns."[42] Federal naval and military forces were moving south during the Fall of 1861 conducting joint operations to capture and blockade southern ports along the Atlantic seaboard. Planning the operation to reduce Fort Pulaski were under the cognizance of Captain Quincy C. Gillmore, chief engineer of the forces stationed at the Federal base at Hilton Head Island, South Carolina. Captain Gillmore convinced his superiors he could build earthen artillery batteries containing mortars and rifled guns on Big Tybee Island to complete the reduction of the fort without the need for naval support.[43]

The occupation of Big Tybee Island was completed in December 1861 and Federal batteries were positioned upstream on the Savannah River to logistically isolate the fort.[44] Big Tybee Island was largely marsh in 1862, but contained enough firm ground to support the construction of eleven earthen artillery batteries. Two infantry regiments, and several companies of heavy artillery and engineers labored at night for seventeen days to build batteries, unload ordnance and material, and move the guns into position.[45] Federal forces arrayed a total of thirty-six guns and mortars against Fort Pulaski.[46] The batteries secretly positioned by Gillmore's forces ranged from 1,650 to 3,400 yards from the walls of the fort. The ten rifles designated as breaching batteries were positioned at a mean distance of 1,700 yards.[47]

Upon the commencement of the artillery reduction of Fort Pulaski, the effectiveness of sand and earth over brick and stone could not have had any better demonstration.[48] After receiving a refusal to surrender the fort, the Federals began a massive artillery bombardment on the morning of 10 April 1862 aimed at destroying the

powder magazine in the Northwest corner of the installation by breaching the Southeast pan coupe. While Confederate return fire from the fort was totally ineffective against the Federal batteries, the Federals were able to cause the complete reduction of the fort within thirty hours with the effects of artillery fire alone.[49] After the federal guns exposed the powder store contained in the Northwest magazine, Colonel Olmsted, fearing an explosion, surrendered the fort.

The summary effect of the firing of the Federal Army is an interesting item of discussion since this was the first example of the devastating effect rifled artillery would have on masonry fortifications during the entire Civil War. A total of 5,275 shells were fired during the siege of Fort Pulaski.[50] Two casemates in the southeast angle of the fort were opened to the width of thirty feet and the adjacent walls on each was so badly shattered the shelling could of doubled the width of the breach within a few hours. All the guns capable of firing on the Federal batteries were dismounted except one and the ditch were so filled up with debris, assaulting infantry could passed over the moat without getting their feet wet.[51] At the breach itself, most notable were the penetrating power and accuracy of the James rifles. The 84-pounder James shot could penetrate a total of twenty-six inches of masonry while the much lighter 30-pounder Parrott rifle shot to a depth of 18 inches. This is compared to the 128-pound round shot of the 10-inch Columbiads, which could only penetrate the work to a depth of thirteen inches.[52] Also of note, was the complete ineffectiveness of the firing of the seacoast mortars. Over 90 percent of the 13-inch and 50 percent of the 10-inch mortar shells missed the fort. Although intended to break the arches of the casemates, none of the 13-inch shells had any significant effect on the fort.[53]

The Federal seizure of Fort Pulaski effectively closed down Savannah as a port of entry to the rest of the South. Federal troops would eventually rebuild over a hundred feet of wall along the southeast angle and repair all the other damage caused by the bombardment. The installation would remain in Federal hands for the rest of the war and would remain an active post until 1872.[54] Captain Gillmore's efforts during the siege earned him a brevet promotion to Brigadier General and assignment to Charleston, South Carolina to tackle the reduction of Fort Sumter using the same methods he used at Fort Pulaski. Most significantly, the devastating effect of rifled artillery fire during this operation marked the obsolescence of the Third System of Fortification.[55]

Fort Sumter's First Experience of War

Most Americans associate the history of Fort Sumter only with the events of the secession crisis and the opening of hostilities between the North and the South in April 1861. This episode was only the beginning of the ravages Fort Sumter would experience during the course of the war. From the establishment of the Federal blockade on 11 May 1861 until the Confederates were forced to evacuate Charleston in February 1865 in advance of General Sherman's March to the Sea, Fort Sumter became the cornerstone in the defense of this important Southern city. For several years, guarded by the guns of Fort Sumter, Charleston would remain an important base of operations for numerous blockade runners carrying out the lucrative trade of cotton for important munitions and luxury items in a futile attempt to keep the South militarily and economically in the war.[56]

The genesis of Fort Sumter resulted from the deliberations of the Bernard Board to build one of the new works of the Third System on the shoals opposite Fort Moultrie to

create a crossfire to effectively close the access of the main entrance of the harbor from an enemy fleet.[57] Planning for the new fortification began in 1827, but the plans were not finalized until 1828. Progress on the new work was slow and by 1834 Fort Sumter was no more than a hollow pentagonal "mole" two feet above low water and open on one side to allow the passage of supply vessels into the interior of the structure to deliver construction materials. A land dispute over the ownership of the fortification site caused construction to be suspended until 1841. Work was difficult. The granite foundation could only be laid between the periods of high and low tide and yellow fever was a constant problem due the excessive summer heat in the area. The slow pace of construction was compounded by the necessity for most of the materials to be delivered from Northern states and the small capacity of local brickyards to manufacture the millions of bricks required.[58] The new fort would be named in honor of Thomas Sumter, the Brigadier General commanding the South Carolina militia during the American Revolution.[59]

By December 1860, Fort Sumter was the shell of a five-sided masonry fort designed to accommodate up to 135 guns within two tiers of casemates and one barbette tier mounted on the open terreplein above. Its five-foot-thick walls towered nearly fifty feet above the low water line and enclosed a parade ground about one acre in size. The main salient of the bastion pointed northward and the gorge wall faced the south towards Morris Island.[60] Owing to the sheer magnitude of the project and the glacial pace of the approval of construction funds, the fort stood unfinished when the events of the secession crisis caught up with it.[61] Eight-foot square openings existed in the embrasures of the second tier gun casemates and only fifteen cannons, most of them apparently 32-

pounders, were mounted within the walls of the fortress.[62] Workers building the fort occupied the unfinished barracks, temporary wooden structures and construction material filled the parade ground, and sixty-six guns with their carriages remained to be mounted. In no condition to mount an adequate defense, Fort Sumter was about to take on a political significance far beyond the military function it was intended to originally serve.[63]

When South Carolina voted to succeed from the Union on 20 December 1860, the actions of the Federal garrison at Fort Sumter became the spark igniting the powder keg the secession crisis had generated. Six days later in a well-executed plan, the Federal garrison under the command of Major Robert Anderson, fearing their position at Fort Moultrie was no longer tenable, occupied Fort Sumter. Sending the secessionist leaning construction workers ashore, Major Anderson set about to make Fort Sumter as defensible as possible. Furious over the actions of the garrison's movement to the island fortress, Governor Francis Pickens ordered state forces to seize Castle Pinckney, Fort Moultrie, the arsenal, the customs house, and the post office.[64] An attempt to reinforce and reprovision the fort by the *Star of the West* expedition ended in failure on 9 January 1861 after shore batteries fired on the vessel forcing its return to New York. Tensions increased and demands were made to the Federal government to make no further attempts to resupply or reinforce the garrison. A standoff ensued between both sides until the inauguration of the newly elected Lincoln Administration. The garrison periodically obtained subsistence stores and mail from the inhabitants of the city.[65] The Confederates used this time to their advantage by continuing to mount additional cannons in the forts

already in their possession, build additional shore batteries, and move additional troops into the city.[66]

The events influencing the fate of Fort Sumter accelerated on 3 March with the appointment of Confederate General P. G. T. Beauregard to command all the military forces in Charleston. When Major Anderson's command of eighty-five men moved to Sumter in January, they were able to stockpile enough foodstuffs to last about four months. Even with the meager amount of stores they were able to obtain from Charleston, the command would only have enough provisions to hold out until the beginning of April.[67] The garrison and some of the remaining loyal engineering workers continued to enhance the defensive capabilities of the fortress. A total of forty-eight guns were mounted in both tiers with an additional five Columbiads to serve as mortars to fire shells at the batteries at Cummings Point and the city itself. An ample supply of powder and shot were on hand, but the amount of shells, primers and cartridge bags were extremely limited.[68] After learning of another attempt to reinforce the garrison in mid-April by a joint army-navy expedition being organized by the new Lincoln Administration, General Beauregard demanded Major Anderson to surrender the fort on 11 April before the military expedition's arrival would complicate the situation. Major Anderson's refusal marked the beginning of a thirty-four hour bombardment to force the surrender of the Federal garrison.

At the beginning of the bombardment, the Confederate fortifications within the harbor mounted thirty guns and seventeen mortars stocked with a sufficient amount of ammunition.[69] Ironically foreshadowing the eventual doom of masonry fortifications by the end of the war, the Confederate's were able to obtain a Blakely Rifled Cannon from a

loyal Charlestonian residing in England and mounted it on Cumming's Point in time to participate in the bombardment.[70] The Confederate's began firing at 0430 on 12 April with the Federals returning fire at approximately 0700. Using only the casemated cannons aimed at the Confederate fortifications, the amount of cartridge bags and the number of men available to serve the guns severely limited the amount of return fire from the Federals. The overall effectiveness of their fire was extremely poor due to a shortage of long-range ordnance. Most of the return fire from the Federal guns was limited to Fort Moultrie and the Floating Ironclad positioned east of Moultrie. The damage caused to Fort Moultrie was mitigated by the efforts of Confederate engineers to protect the barbette mounted guns on its masonry walls by erecting earthen glacis, merlons, and bomb-proofs, essentially converting the entire work into a new earthen protected fortification with casemated cannons. Although struck several times during the bombardment, only one Federal shot managed to penetrate the protective armor of the ironclad battery, wounding one man.[71]

The overall effectiveness of the Confederate bombardment was extreme in comparison to the efforts from the Federal gunners returning their fire. Confederate batteries would fire a total of 3,200 rounds during the course of the entire battle. Vertical fire from the seacoast mortar batteries was particularly effective in limiting the number of guns that the Federals could man. Over one-half of the mortar shells fired at the fortress fell within its walls, therefore, causing Major Anderson to make the critical decision of not manning his heaviest ordnance emplaced on the barbette tier to prevent casualties to his limited number of personnel. The effectiveness of Confederate direct fire against the walls of the Fort Sumter was limited in the early portions of the bombardment due to the

large proportions of their shots missing the fort. The aim of these artillerists would improve throughout the thirty-four hour bombardment. Direct fire damage from two days of shelling caused over 600 shot marks to the masonry scarp wall, disabled three guns on the barbette tier, knocked off large portions of brick on the parapet and chimneys, and set all the wooden barracks structures on fire with hot shot. The burning buildings produced great amounts of smoke and heat, forcing the garrison to close all the powder magazines, thus limiting the amount of powder available to the gunners to continue firing. Only two embrasures were struck and attempts to use two 8-inch Columbiads and the Blakely rifle located on Cummings Point by the Confederates to create a breech in the right gorge angle (total penetration was twenty-two inches) did not succeed. These weapons managed to penetrate the masonry walls to a depth of eleven inches at a range of 1,250 yards during the course of the bombardment.[72]

The effects and volume of the Confederate bombardment would not cause the defeat and surrender of the Federal garrison. The lack of prior preparation for war and the proper manning of the fortifications throughout the entire Third System would be the ultimate cause of Major Anderson's surrender on the afternoon of 13 April. The ultimate weakness of the defense of Fort Sumter can be attributed to three factors. The lack of cartridge bags and the material to make them slowed the rate of return fire and nearly suspended it towards the end of the battle. An insufficient number of men to man the heaviest ordnance mounted on the barbette tier and the risk of losing several to the effects of Confederate vertical fire, prevented any effective return fire at the ironclad floating batteries and Fort Moultrie. Finally the want of provisions to supply the garrison through a prolonged battle would be the immediate cause of the Federal surrender. The last of the

rice was served to the garrison, with pork, the only other type of food remaining, for breakfast on the morning of 13 April.[73]

Flaws in the construction methods utilized by the engineers responsible for the building of Fort Sumter and its sister bastions would also be exposed during the course of the Confederate bombardment. The lack of fire proof buildings with the perimeter of the work immediately located to the rear of the firing batteries made it difficult for the gunners to serve the cannons during the battle. Mounting Fort Sumter's heaviest ordnance on the terreplein without the benefit of overhead protective cover made it useless during the battle and limiting the return fire of the fort to lighter weapons not capable of damaging Confederate positions. No provisions were made in planning the fort to include the emplacement of heavy seacoast mortars capable of conducting counter-battery fire would also limit the effectiveness of the defense.[74]

The final ironic chapter of the Federal defense of Fort Sumter was played out with the arrival of the Federal relief expedition under the command of navy Captain Gustavus Fox on the morning of 12 April just in time to watch the commencement of the bombardment. Ships assigned to the expedition were loaded with a year's supply of provisions and 200 recruits to reinforce the garrison. Each of the ships sailed separately to maintain operational security and avoid detection. Only the revenue cutter *Harriet Lane* was at the rendezvous when Fox arrived on the transport *Baltic*. Bad weather delayed the arrival of critical tugs needed to transport troops and material into the harbor under the cover of night. The frigate *Powhatan*, commandeered by Secretary Seward at the last minute for another errand to Fort Pickens, would have been responsible for providing the necessary covering fire and large boats for transportation. The ships at the

rendezvous considered themselves too weak to attempt a passage of the channel even under the protection of darkness and would remain anchored beyond the range of Confederate cannon fire for the duration of the battle.[75]

Expecting the navy to attempt a reinforcement of the garrison, Major Anderson had no method at his disposal to directly communicate with the vessels of the relief expedition to determine their intention not to force the channel. Another oversight during the construction of Fort Sumter was the failure to install the necessary devices for communicating with warships.[76] Without any further means of offering resistance to the Confederate cannonade, Major Anderson surrendered the fort on the afternoon of 13 April with only four barrels of pork and three cartridges of powder remaining and marched the garrison out the fort under arms the following day to board a steamer to join the fleet off the bar to return north as the first heroes of the American Civil War.[77]

Subsequent Federal Attempts to Reduce Fort Sumter

The events of the succession crisis and the Federal garrison's inability to holdout against a prolonged Confederate cannonade only marked the beginning of the ravages of war to be experienced by Fort Sumter. After the departure of Major Anderson's command, the Confederate's promptly set about improving the defensive capabilities of the fortress and garrisoning it with a force under the command of Lieutenant Colonel R. S. Ripley. Confederate forces also erected several other fortifications and batteries shortly after the commencement of hostiles around Charleston to assist Forts Moultrie and Sumter to close the land and sea approaches to Federal attack.[78] From a military standpoint, the relative importance of Charleston was minor in comparison with the other major ports of the south such as New Orleans and Wilmington, North Carolina.

Unfortunately, the North considered Charleston as the cradle of the Confederacy and Fort Sumter itself as a significant symbol of the Southern cause. Heeding calls to promptly bring the ravages of war to this city, plus the inability to maintain an extensive blockade early in the war, political considerations often called for the mounting of "expedition after expedition [be] gotten ready, necessitating many subsidiary operations, and all in an effort to acquire Fort Sumter."[79]

Confederate efforts to repair the damage caused by the April bombardment consisted mainly of building protective features for exposed gun positions located on the barbette tier, strengthening the magazines, building barracks not exposed to fire, and adding traversing circles to allow cannons to be laid continuously on moving targets in the channel.[80] Eventually, a total of eighty-five guns and seven seacoast mortars, ranging from ancient 32-pounders to newly manufactured 10-inch Columbiads, manned by up to 550 men of the 1st South Carolina Artillery would be mounted within the walls of Fort Sumter to deter a naval attack. Of this number, only twenty-four cannons mounted on the eastern right face wall and the mortars could be effectively used to defend Charleston from an attack by the new Federal armored warships soon to see action in the approaches to the harbor.[81]

Besides the other armament mounted within the other fortifications assisting Fort Sumter in the defense of Charleston, the Confederate's constructed two ironclad warships, the *Palmetto State* and the *Chicora*, patterned after the plans used to construct the *Virginia* in Hampton Roads. The deep draft and the limited maneuverability of these large vessels would limited their defensive contributions to the inner reaches of the harbor. Equally frustrating to the Confederates, would be the limitations of their attempts

to plant physical obstructions in the main shipping channels of the harbor. Strong currents and frequent gales, would eventually sweep away the timber piles and booms emplaced along several of the approach channels. These currents and tides would also be responsible for sweeping away the Federal attempts to install two separate series of stone laden hulks across the bar of the harbor to prevent the entrance of blockade runners. A device destined to achieve an almost mythical reputation and arguably responsible for deterring more aggressive action by the Federal Navy to reduce Fort Sumter would be the placing of fixed torpedoes or mines throughout the harbor. The Confederates would see limited success with these devices throughout the war depending on the length of time the device was placed in the water and the maintenance of the triggering mechanisms ashore.[82] For the first time in American history other weapons and elements of naval power were used together to develop a total system of coastal defense that would ultimately reach it ultimate level of development during the construction of the Endicott System of fortification.

The seizure of Port Royal, located about sixty miles southwest of Charleston, by Federal forces in November 1861 created a base of operations for land forces and the blockading squadron. The ultimate potential of ironclad warships demonstrated during the inconclusive action between the Confederate *Virginia* and the Federal *Monitor* in Hampton Roads and the use of ironclads to reduce the forts at Port Royal, prompted Union naval planners to devise a plan to use a similar fleet of vessels to reduce Fort Sumter with the cooperation of land forces.[83] Reinforcing the need of a naval attack of this nature was the only foray of the Confederate ironclads *Palmetto State* and *Chicora* into the outer harbor against the Federal blockading squadron. After disabling the steam

drums of two Federal ships, the rest of the warships from the blocking squadron drove both vessels back into the protection of Charleston harbor.[84]

The Federal naval attack commenced on 7 April 1863, when Rear Admiral S. F. Du Pont engaged Fort Sumter with a squadron consisting of eight ironclad monitors and the ironclad frigate *New Ironsides*. After an engagement lasting almost three hours, the devastating fire of the fortifications defending Charleston battered and disabled five of the monitors, one of which (the *Keokuk*) would later sink in the shallow water off Morris Island. The attack developed into a naval engagement against Fort Sumter. The supporting land forces operating on the island approaches southeast of the city were prevented by Confederate's from participating in the attack. The Federal ironclad squadron was struck a total of 439 times out of the total of 2,006 rounds fired at it during the battle. In return the Federal fleet only struck Fort Sumter a total of thirty-four times of the 139 shots fired. Both sides suffered a total of thirty-seven casualties during the engagement, most of them onboard the ill-fated *Keokuk*. Admiral Du Pont's fleet remained in the area for another five days attempting to blow up the *Keokuk* before returning to Port Royal for repairs.[85]

Besides having no means to coordinate their actions with the attacking Federal army, Du Pont's command only mounted a mere thirty-two guns to contest the hundreds of cannon mounted in the Confederate works, of which only three were rifled. Instead of using the superiority of steam engineering and armor protection to maneuver ships intact past the defending forts, and by making the reduction of Fort Sumter the focal point of the attack it was only a matter of time before the superior number of cannons mounted in the Confederate land defenses would substantially damage the primitive ironclad

squadron. The predominant presence of the smoothbore ordnance onboard the Federal vessels doomed the attack to failure before it began, allowing the perceived dominance of static masonry constructed fortifications over warships to continue for a few more years.

Admiral Du Pont's distrust of the new ironclad warships and his overall lack of aggressiveness and inadequate leadership during this attack would the central elements responsible for reliving him of command. Rear Admiral John A. Dahlgren, the naval ordnance expert, would replace him. Federal officials realizing Fort Sumter could not be reduced by naval bombardment alone, brought in General Q. A. Gillmore of Fort Pulaski fame to formulate a plan to coordinate the efforts of the army and navy to reduce Fort Sumter.[86] The predominant assumption considered during General Gillmore's planning efforts was the necessary requirement to reduce Fort Sumter before further operations against Charleston could be considered. Fort Sumter continued to dominate military thought during the planning process as the key to taking the city. The battle for Fort Sumter illustrates the primary weakness of Union strategy for the remainder of the war when fortifications protecting southern port cities remained the focal point of attack of combined naval and land forces directly assaulting a landmass from the sea.

While the Federal's used the next three months to change commanders, repair battle damage to the monitor fleet, and position troops, the Confederate's were not idle. Fort Sumter's damage was repaired and the defensive works throughout the harbor were further strengthened. The shifting of armament provided more effective fire against naval targets and the construction of a sandbag traverse provided additional protection to cannons mounted on the barbette tier. Reflecting the lessons of Fort Pulaski, the upper magazines were abandoned and the lower ones provided further protective cover. The

most pronounced change to Fort Sumter occurred when Confederate engineers converted the two faces of the work facing southeast into a compact redan of sand encased in brick up to thirty-five feet thick by filled unused casemates in the walls. Further work to protect the gorge scarp wall and sallyport with a sandbag wall up to twenty-five feet was not completed in time.[87] The engineers were starting to learn the lessons from the reduction of Fort Pulaski and convert existing fortifications into earthen structures for additional protection. The total number of guns fortifying Fort Sumter had been reduced from its wartime high of eighty-five guns and seven mortars to thirty-eight guns and two mortars to provide adequate ordnance and artillery personnel to man the works protecting Morris Island.

The new joint Federal operation commenced on 10 July 1863, when the Federal Army with exceptionally improved assistance from the navy, took the southern three-fourths of Morris Island from the Confederates and threatened Fort Wagner and Battery Gregg on the northern end. After failing to take Fort Wagner in the initial assault on 11 July, Federal forces paused to construct siege batteries before attacking Fort Wagner again unsuccessfully on 18 July with heavy losses.[88] Finding Fort Wagner stronger than had been anticipated and still realizing his primary objective remained the reduction of Fort Sumter, General Gillmore determined Federal artillery could be positioned to fire on Fort Sumter over the tops of Battery Gregg and Fort Wagner while the balance of his force contained the Confederates within the confines of their works. By 17 August, a total of eight breaching batteries were completed on ground already in Federal hands. A total sixteen Parrott rifles of various sizes and two Whitworth rifles capable of shooting projectiles in excess of 4,000 yards were positioned in the batteries.[89]

These batteries began firing on Fort Sumter on 17 August 1863 supported by naval vessels conducting suppressing fire on the Confederate outposts on Morris Island. In a prolonged bombardment destined to last seven days, and known to history as the "First Period of the First Great Bombardment," over five thousand shells dismantled the entire masonry structure of the fort causing a total of one killed and forty-three wounded. The Parrott rifles alternated in firing shot and shells with percussion fuzes at the left flank and face walls of the fort, taking the face wall in reverse on the first day. The accuracy of the Federal gunners was incredible. Judgments of the accuracy can be rendered from the estimates of the firing on 17 August. From a total of 949 shells fired, 445 struck inside the fort, 233 impacted outside the work, and 270 shots were seen to pass completely over the fort. It became a forgone conclusion and merely a question of time before the destruction of the fortification was completed.

Damage was so severe from the first day of bombardment, General Ripley, the Confederate garrison commander at Fort Sumter, ordered the removal and transfer of ammunition and stores from the fort to Sullivan's Island on the night of 17-18 August. The only criticism of the operation up to this point, would be the failure of the Union Navy from preventing the Confederates to remove artillery and ordnance material from the fort and interfere with the efforts of Confederate engineers to repair critical portions of the fortification after firing had concluded for the day. Gillmore's artillerists concentrated their efforts on different portions of Fort Sumter in turn. The completeness of the damage to Fort Sumter ended its effectiveness as an artillery emplacement on 23 August. The last cannon capable of firing would be silenced on 1 September. The continued fire by Gillmore's batteries using the lessons he derived from his experience at

Fort Pulaski eventually formed a wall of masonry debris that gradually accumulated over the top of the sand and cotton filled casemates and eventually built for the defenders an impenetrable wall of rumble capable of being defended by infantry against assault.[90]

The "First Great Bombardment" of the fort continued between 24 August and 2 September 1863 and was concluded by the navy's first direct attack on the walls of Fort Sumter since its abortive bombardment of April 1863. Admiral Dahlgren personally led an attack on the fort by five monitors on the night of 1-2 September. Despite the tremendous damage caused by General Gillmore's batteries, the navy made no attempt to pass the fortification due to the presence of obstructions and torpedoes in the channel leading into the inner harbor. Although a measurable improvement in the coordination between the army and navy can be seen in the conduct of operations, both services still had the tendency to operate independently of the other when desired. The Confederate evacuated their outposts on Morris Island after fifty-four days of siege operations had caused tremendous casualties to the assaulting Union infantry. The defensive nature of Fort Sumter changed on 7 September, when General Beauregard ordered the artillery garrison to be replaced by an infantry battalion under the command of Major Stephen Elliott just in time to repel an infantry assault the following night by 400 seaman and marines from the Federal blocking fleet. This event marked the transformation of Fort Sumter from an important element of the coastal defense network to a mere infantry outpost. General Gillmore in the second time in his career reported to his superiors in Washington "Fort Sumter today is a shapeless ruin . . . no longer of any avail in the defense of Charleston."[91]

Fort Sumter would be subjected to two further period of intense bombardment during the remainder of 1863 and lasting well into 1864. At a tremendous cost in time and resources the Federal gunners continued to focus on the complete reduction of Fort Sumter instead of shifting the focus of operations to the navy by attempting to bypass the remaining fortifications and obstructions and force their way in the harbor. General Gillmore continued to add more artillery to the breaching batteries with the predictable effect of causing further destruction to Fort Sumter by the end of September 1864; however, the Confederates chose not to evacuate the fort. After firing on Fort Sumter for 280 days and destroying the fort's ability to effectively resist a naval attack, it would be the events surrounding General Sherman's march on Savannah and the continuing struggles of both armies in the vicinity of Richmond that would lead to the evacuation of the fort and the city in February 1865. General Gillmore's report documented the reluctance of the Union fleet to stage an attack on the city after Fort Sumter's reduction because of the number and nature of the physical obstacles blocking the channel. After the evacuation of the city, it would be learned that the importance placed on these obstructions were greatly exaggerated. The events surrounding the cannonade of Fort Sumter demonstrate the requirement for army and navy commanders to have a complete understanding of each other's functions and capabilities in order to have cooperation between the services on the battlefield.[92]

Despite the failure of the Federal's to capitalize on the results they achieved in reducing Fort Sumter, the efforts of General Gillmore's artillerists amply demonstrated the rapid obsolescence of the entire Third System of masonry fortification using the technological advances seen in the development of artillery during the course of the

American Civil War. Fortification engineers would still be evaluating the impact of the lessons learned given to them by General Gillmore's actions at Forts Pulaski and Sumter well into the 1870s. Artillery development would continue at an even faster pace after the conclusion of the American Civil War. Until a new cost-effective means of fortification could be planned to counter the new artillery technological advances, the forts of the Third System would be forced to continue to meet the fortification requirements of the United States. The post-war experiences of Forts Pulaski and Sumter serve as examples of the events shaping the methods of fortification development after the war. The damage caused to the masonry walls of Fort Pulaski was repaired and it would continue to serve as an active fortification for the remainder of the war until its abandonment in the 1880s. Fort Sumter would be reconstructed during the 1870s to only half of its original height of fifty feet and would remain in this configuration until the construction of a modern Endicott battery was begun within its hollow shell during the Spanish-American War.[93]

Interpreting the Coastal Defense Lessons of the Civil War

The lessons presented by the battles of the American Civil War concerning the use of masonry fortifications were abundantly clear. Ironclads were too primitive in their evolutionary development to outright destroy a masonry fort, but they might eventually be able to do so in the future. A fortification of the Third System did not possess the firepower to overwhelm an armored warship. The introduction of the rifled cannon had demonstrated its ability to destroy masonry fortifications in short order, but had not yet demonstrated its ability against the ironclad.[94] "In any case, the Third System did not prevent the Civil War and had little real influence on it course. On the contrary, that war

suggested a military irrelevance in the kinds of works the engineers had wrought for over five decades."[95] America's only chance before the war to change the course of the bureaucratic institution the building of the Third System had become came to late. When engineer Richard Delafield returned from witnessing the plight of Russian coastal defenses at the hands of the British and French during the Crimean War, the report he wrote in early 1861documenting the observations of the military commission that masonry forts were obsolete was swept under the rug by the events propelling the nation to war.

Records levels of appropriations were earmarked for completing the existing works under construction and an abundance of temporary works to guard Union harbors from enterprising Southern or European interference. Congress budgeted $1.4 million for fortifications in 1861 and then $5.3 million to fund construction efforts during the course of 1862 and 1863. The Corp of Engineers became hard pressed to continue supervising fortification construction during most of the war when most of its officers could be found serving in the field with the army, but a quarter of its officers would be back working on building the permanent fortifications in the last full year of the war.[96] The army began to reflect on its use of earthen fortifications during the various land campaigns and in 1864 the War Department appointed a board of engineers to examine their practicality in the construction of seacoast defenses. Reflecting some of the Confederate efforts to use earth and sand to strengthen the masonry walls of Fort Sumter, they would naturally conclude earth would be the most economically feasible material to construct fortifications resistant to the firepower of the new rifled cannons. At the conclusion of the war,

Delafield, in his new position as Chief of Engineers, would order several new boards to continue to study the best methodology of modifying the existing fortification system.

Along with the additional requirements of mounting the heavier rifled ordnance in the existing fortification structure and repairing the damage caused by the war to forts located throughout the south, Delafield ceased to be the visionary he was prior to the war and set out on a course to become the caretaker and proprietor of a system advocated by his mentors. Accordingly he began to press his superiors to go to Congress in the immediate postwar era for further appropriations for coastal defense to continue funding the status quo or at best make marginal improvements to the original planning concept. "He shared the corps's attachment to its grand vision. He failed to appreciate the full nature of the changes occurring within military and naval science. Merely piling earth or attaching iron plates to the old forts would not sufficiently answer the new technologies."[97]

Another lesson from the American Civil War not absorbed by the engineers was the shattering of the assumption of the ability of a coastal fortification to prevent the passage of warships through a channel by gunfire alone. The Federal steam-powered frigates and ironclads under the command of Admiral David Farragut would prove how false this assumption was on two separate occasions. The first one occurred during Farragut's attempt to run past the forts guarding the city of New Orleans on 24 April 1862. His fleet of seventeen vessels proceeded up the Mississippi River past two well-armed Confederate forts, Forts St. Phillips and Jackson, without loss or sustaining heavy material damage. The exceptional speed of his modern ships proved to be fast enough, only a few volleys of cannon fire effected them because the defenders simply did not

have the ability to load and shoot any faster to stop the passage of the fleet. Admiral Farragut repeated this demonstration when he ran his fleet past the forts guarding the approaches to Mobile Bay, Forts Gaines and Morgan, on 5 August 1864. On both occasions, Admiral Farragut did not use the strength of the naval guns mounted on his ships to silence the forts. Instead he used the increased maneuverability of his ships to make the forts and supporting obstructions useless to the defense of the city once he got past them.[98]

The locations originally selected for Third System fortification on the shores of the harbors were ideal for the cannon technology they were originally armed with and expected to face from enemy warships, however these type of cannons were beginning to become obsolete at the start of the Civil War. As artillery development rapidly progressed during the Civil War, the old Third System fortifications were no longer strategically located nor designed to influence engagements at the greater ranges new cannons would bring to future conflicts. As the range of artillery would increase with further development, naval engagements with coastal fortifications will eventually move further offshore as a result.[99]

As fortification engineers began to take into account new naval technology to develop a new system of fortification, they also began to realize the future potential of other weapons derived from the Civil War to augment the use of coastal batteries as the traditional means of conducting coast defense. The Confederate use of torpedoes or mines during the course of the war was responsible for sinking twenty-nine Federal vessels and damaging another fourteen. The devices did not always function as planned or when required, but their mere existence partially dictated the movements of vessels in

restricted waters. Other innovations used by the Confederates to assist fortifications in defending harbors were devices like the *David*, a submergible torpedo ram armed with a spar torpedo or the world's first combat use of a submarine, the *Hunley*, to sink or damage vessels. After seeing the deadly effects of these types of weapons, military officers began to realize the future potential of weapons such as torpedoes and submarines to augment coastal fortifications.[100]

Summary

This chapter demonstrated that the traditional methods used by United States Army to build fortifications and protect the coastline of the United States were significantly altered by the events shaping the outcome of the American Civil War. Casemated masonry fortifications could no longer be depended upon to be the cornerstone of the American system of coastal defense when faced with the new technological innovations developed during the American Civil War. All of these new innovations posed complex problems to fortification engineers who did not know how much the traditional assumptions and theories of coast defense policy would have to be altered. After consuming five decades to construct the present system of fortification, American military officers were not flexible enough to institute immediate change resulting from the short-term evaluation of effects of developments encountered during the American Civil War. They would require time to "adjust and experiment before moving on into a future where past experience might no longer serve as a guide.[101]

Throughout its history, the army's peacetime failure to recognize the need for change led to the loss of individual installations in time of war. An institutional pattern of insufficient resource allocation and flawed coastal defense policy decision made

during the generational development of the fortification system was mainly responsible for its systematic failure. The examples provide in the previous sections concerning the reduction of Forts Pulaski and Sumter by Federal forces during the Civil War and the example of the Japanese Army's destruction of the seacoast artillery batteries fortifying the island of Corregidor in early 1942 in the upcoming chapter are defeats resulting from the inability of the military to make sufficient change over time. The next chapter will continue to show that the American fortification systems became the victim of a repeating cycle of inflexible defense planning, insufficient resourcing, and a general lack of awareness of the emerging technological advances in other areas of warfare having the potential to influence future methods of coastal fortification.

Regardless of the circumstances in which the American military found itself at the conclusion of the Civil War, military planners were already commencing the initial steps to develop a brand new comprehensive system of coastal defense. At the close of the nineteenth century, America's harbors would be guarded by a system of modern batteries constructed from concrete and steel using the natural terrain to conceal their presence from opposing naval forces. New long range rifled guns and mortars capable of firing a shell twelve miles down range become the primary armament of these new batteries. The tremendous pace of artillery development continued in the decades following the Civil War and the new system of fortification will continue to be challenged by the pace of technological innovation. New weapons, such as controlled submarine mines, also come into use in a systematic approach to develop a coastal defense organization flexible enough to continue to meet the new challenges always present in warfare. "As

impressive as they were, these new coastal defenses would also fall prey to advancements in the art of war."[102]

CHAPTER 4

DEVELOPMENT OF THE MODERN SYSTEM OF FORTIFICATION

Introduction

The short and violent battering of the bastions of Forts Pulaski and Sumter by rifled ordnance during the American Civil War provided more than ample evidence to the engineers responsible for building the Third System that no fortification is "impregnable." Civil War history repeatedly demonstrates time and again the futility of the side, which relied on the defensive, especially the use of static defenses of coastal fortifications, to keep the enemy at arms length.[1] The myth of deterrence provided by the construction of these works was shattered in the opening shots of the war. Inflexible defense planning, insufficient resourcing, and an overall lack of awareness of the technological advances impacting warfare were the major reasons dooming the Third System to failure during the course of the war. American military history up to this point proves the uselessness of a massive system of coastal fortifications to provide the main line of defense during modern warfare, but military engineers would continue to build on the American tradition of building extensive fortification systems to defend our shores for the next half century.

Looking to the future, it would take the Corps of Engineers several years to sort out the lessons of the Civil War. In the end, however, the engineers would continue to advocate the design of a new system of fortifications that would essentially be responsible for achieving the same defensive purposes of the Third System. Evidence from history suggests forts will eventually fall, yet Americans in particular continued to

put blind faith into their ability to keep the enemy at bay. Fortification engineers and the American Army as a whole would continue to mistake the place of coastal fortifications within the military establishment until the end of World War II. The American military would never realize fortifications were only part of a defensive system. The principal role of a system of coastal fortifications was to delay an enemy naval attack and subsequent landing to provide the necessary time for the rest of the armed forces to be massed to defeat the enemy in the field. Unfortunately, the American government would continue to construct an entirely new ambitious system of fortifications designed to counter the technological advances of the Civil War while allowing the rest of the American Army to wither. Fortification construction continued to be a popular method of defense well into the new century because forts in being were much more inexpensive to maintain in readiness than sizeable standing forces.[2] The same factors dooming the readiness of the Third System would also eventually destroy the utility of the next system of fortifications to emerge from the ashes of the Civil War.

Absorbing the Lessons of the American Civil War

For several years after the conclusion of the American Civil War, construction activities at various coastal fortifications were limited to the repair of damage from the war and general maintenance activities. The introduction of rifled ordnance came as a sudden shock to fortification planners within the Corps of Engineers and time would be required to absorb the new coastal defense lessons from the war. Ingrained with the responsibilities of providing stewardship for a system of fortification not experiencing any conceptual design transformations for over fifty years, engineers were unprepared to immediately present an alternative system capable of countering the advances of rifled

artillery. Traditional theories and methods of coastal defense required extensive review and modification. The obsolete Third System would soldier on for another twenty years with a few minor alterations, as the Corps of Engineers embarked on a prolonged period of experimentation and study to devise a new fortification system.[3]

The tradition bound Corps of Engineers were blinded by their loyalty to the system of forts it had created over the years. To salvage and preserve the utility of the old system by some means in the immediate post-war years, many engineers returning from field duty with the general army did not use the practical experience gained from constructing temporary earthen or sand fortifications. Both armies made extensive use of emplacements constructed of earth or sandbags, often backed by timber to defend inland rivers, cities, and to supplement the permanent fortifications. Damage to earthen works caused by cannon fire could be more rapidly repaired then a shot hole in a masonry wall. Although several Third System forts were completed to guard the most vital northern harbors in accordance with their original plans, fortifications initiated after the start of the war were exclusively constructed of earth.[4] The answers to all of the engineer's problems were at their fingertips in the pages of the history documenting the campaigns of the American Civil War or by observing the efforts of several European powers in the process of planning and constructing a new system of forts incorporating massive amounts of armor plating. The forward development of American coastal defenses would be delayed for almost twenty years as the Corps of Engineer broke their allegiance to the old order.

Emerging from the Third System

Efforts to move beyond the defensive limitations of the Third System began in January 1864 when a Board of Engineers realized the future potential of earthen fortifications and recommended to the Secretary of War the replacement of masonry fortifications with earthen structures in locations where land batteries could be employed against them. This recommendation reflected the lessons presented from the Federal efforts to reduce Forts Pulaski and Sumter. Another board convened by Secretary of War Edwin Stanton in September 1864 echoed its predecessor and went one step further by calling for the elimination of further expenditures to continue construction efforts on incomplete Third System installations until a new design concept emerged. These bodies only took the preliminary step of recognizing the need for change and did not present an alternative plan to the leadership of the army to chart a course for the future.[5]

As a result, appropriations for fortification work in the immediate post-war years were limited to adding new measures of protection from rifled cannons to existing forts or funding experiments with armor plating to determine the feasibility of attaching armor plating to the scarp wall of existing forts. The work of the engineers would become further constrained by the beginning of twenty-five years of minimal military appropriations for fortification construction from Congress. The financial priorities of the nation shifted to reconstruction of the South, while the lack of a perceptible military threat to the United States and a prevailing opinion that the engineers did not know how to contend with the military technological advancements of the Civil War further limited funding for military fortifications.[6]

Limited funding could only support the problematic experimentation of attaching armored plates to the scarp walls of existing works in the years immediately following the Civil War. Chief Engineer Totten first proposed the use of armored shutters over the openings of embrasures to protect crews as cannons were being loaded in casemates in the 1850s. After extensive testing, only inconclusive results were achieved using this method to counter rifled artillery shells. The engineers were forced to concede that the use of armored plating on existing forts walls would become prohibitively expensive and would be only a stopgap measure to extend the service life of the Third System for a few more years. The United States was in no position to fund extensive modifications to existing forts, let alone a whole new system that might quickly be outmoded by a coming period of artillery advances, as events would soon demonstrate. While Congress adopted a wait and see attitude towards future developments and provided paltry allocations for maintenance of existing forts, the Ordnance Department continued to develop the potential of larger and more powerful rifled guns in the early 1870s. This would force the planning engineers to make an important decision to design a new system of fortifications around these new seacoast artillery guns that would abandon the practices of the past and forge into uncharted territory.[7]

A new picture of the future fortification requirement began to emerge in 1869 after prolonged study of the technological issues. Engineers believed very large rifled cannons mounted en barbette in earthen batteries along with supporting magazines and bombproofs were required. These cannons would be mounted on newly developed carriages capable of depressing ordnance over the top of a parapet. The engineers also began to take the systematic approach to fortification by realizing forts would consist of a

large number of individual batteries widely separated from each other with explosive torpedoes, physical obstructions, floating batteries, torpedo boats, and searchlights serving in equal capacities. Mortar batteries were to be developed to provide large volumes of plunging fire to defeat the thinly armored horizontal decks of warships. The traditional concept of a single masonry fortification mounting large numbers of cannons as the only means of defending a particular location was beginning to fall out of favor.[8] Most of these innovations would remain key elements in the systematic design and construction of fortifications until the end of World War II.

Post-Civil War Building Program

Beginning in 1870, a large number of such works commenced at various points around the country under a new fortification program; however, this program was ahead of its time and would become the most short-lived. Many of the new concepts only existed on paper or were under testing and development. Earthen battery construction commenced at a rapid rate, but the new works had to be armed with old 15-inch Rodman cannons due to the slow development of the new weaponry. No system of torpedo defense or physical obstruction presently existed and would require further study before implementation. Even the development of new carriages to mount the new ordnance could not be started without an idea of the dimensions of the new guns. Questions remained to be answered from Congressional critics, if these new defenses would stand up to future developments still being produced in the ordnance development programs of potential European rivals. While these new developments in heavy artillery continued to be produced at a rapid rate, the engineers simply could not implement the system they were trying to develop.[9]

Within five years, Congressional appropriations for the new system was non-existent. Construction efforts for most of the new batteries remained unfinished and the small number of batteries completed would remain unarmed. Congress remained unconvinced throughout the 1870s this system would remain a viable system of coastal defense, especially when the continued development of ordnance could make the entire network obsolete overnight. To prevent a demise similar to that of the Third System, Congress would authorize limited funds to continue the development of the new seacoast weapons and proceed with the study of several methods to conduct submarine mining and physical obstructions. Even if these new fortifications could of been completed and funding committed to speed the development of new ordnance and carriages, the army would of been hard pressed to garrison these new works in face of the man power constraints to garrison western outposts and supervise reconstruction efforts in the south. The entire Corps of Engineers continued to demonstrate a commitment to inflexible defense planning by advocating a new system of fortifications possibly incapable of withstanding future technological developments and not possessing sufficient resources and funding to complete it.[10]

Until fortification engineers could devise a system of forts capable of not proving itself useless in a future war, outdated Third System structures armed with Civil War era ordnance would have to soldier on well into the 1890s. Congress would only provide paltry sums of money to conduct limited maintenance on existing works and a few new developmental efforts. For the next twenty years an effective system of coastal defense did not exist within the United States. Arguments from the Corps of Engineers to fund the building of new works would find little support throughout the country until the

technical and tactical concepts within the aborted post-Civil War plan, could be fully developed and implemented within funding constraints. The perceived doctrinal use of coastal fortifications would remain unchanged from their predecessors of the Third System, therefore, continuing the traditional use of American fortification well into the twentieth century when a new system of forts would eventually be constructed. Instead of delaying an enemy naval attack and subsequent landing to provide the necessary time for the rest of the armed forces to be massed to defeat the enemy in the field, any new fortifications would continue to be a deterrent measure to defend principal coastal cities from attack, prevent blockade of interior waterways, provide refuge for merchant shipping, and protect naval bases.[11]

The arguments from the engineers to built a new fortification system, mainly in the form of official reports to Congress and articles within fledging service journals, continued to fall on deaf ears until 1885. With growing concern regarding the weakness of the seacoast defenses of this country, Congress directed President Grover Cleveland to appoint a board headed by the Secretary of War, William C. Endicott, to study the present condition of coastal defenses and devise a prioritized plan for the type of installations and weaponry needed to defend them. This board, soon to be known as the Endicott Board, would be responsible developing the technical and tactical concepts needed to support the implementation of American heavy ordnance developed over the previous twenty years and for shaping the coastal defense policy of the United States until the end of World War II.[12]

Parallel Development of American Seacoast Ordnance

The stagnant development of new seacoast defense weaponry would be the critical element leading to the termination of the new harbor defense construction program in the mid-1870s and would greatly impact the approval of appropriations to implement the recommendations of the Endicott Board. Congress was more then willing to wait for several critical advances in the design and production of heavy ordnance to occur before they would be willing to fund the introduction of a new fortification program. Until this occurred, insufficient armament resources would remain the primary reason for limiting the ability of fortification engineers to develop a coherent coastal defense strategy. Improvements in the design and performance of American heavy ordnance continued at a rapid pace for the remainder of the nineteenth century. Substantial progress would also be made during this time period in developing a system of defense using electrically controlled submerged mines. These artillery developments involved the use of steel as the primary material for gun manufacturing, the introduction of more effective propellants, and the perfection of breech loading weaponry.[13]

Cast iron used to manufacture the 15-inch Rodman cannons still in service was not durable enough to be used to manufacture the new high-powered rifled ordnance under development. Steel became the material of choice for the next generation of seacoast armament that would eventually be incorporated into the batteries of the Endicott system. The large-scale availability of steel and the maturing of a capacity within American industry to produce increasingly massive forging would take several decades to fully develop. New methods of forging cannons had to be adopted as well. Following the lead of European ordnance manufacturers, America began to perfect the

use of the "build-up" method of construction in the late 1880s. This involved the fabrication of a cannon, by building up the barrel by shrinking on successive layers of steel concentric tubes around a central core instead of machining a cannon from a single casting of iron.[14]

The new propellants being developed for these new weapons would also replace the traditional types of gunpowder that had been in use for the last several centuries. The characteristics of this propellant would substantially increase muzzle velocities while reducing the amount of mechanical stresses within the weapon after ignition. The burn rate of this new propellant could be regulated to such a degree as to allow the exertion of a continuous accelerative force upon the projectile along the entire length of the barrel. To fully exploit the new propellant characteristics, the next family of seacoast artillery weapons required a substantial lengthening of their gun barrels. The metallurgical and technological advances in gun construction noted above would make this increase a reality.[15]

After observing the effects of muzzle-loading rifled artillery on the masonry forts of the Third System during the course of the American Civil War, one of the next technological progressions artillery would experience would be the conversion from muzzle-loading to breech-loading artillery. Contrary to the British experience of initially converting from muzzle-loading to breech-loading artillery, reverting back to muzzle-loading, and then a return to breech-loading artillery using a different system, the American Army fully embraced the introduction of breech-loading cannons in the 1890s.[16] Muzzle-loading artillery from the Civil War could still be found emplaced

within American fortifications until the completion of the construction of the first series of Endicott batteries at the end of the Spanish-American War.[17]

In comparing the two types of artillery systems, muzzle-loading cannons were less accurate than their breech-loading counterparts. In a breech-loading gun the projectile is more perfectly centered and the driving band of the projectile functioned more uniformly on the rifling, giving the weapon a more uniformed range. The rifling on most breech-loading cannons were more shallow than the rifling found in muzzle-loading weapons, therefore, reducing the overall strain on the barrel. Another important factor in favor of breech-loading weapons was a substantial increase in firepower. The power of an artillery system is relative to the size of the propelling charge. Muzzle-loading cannons could not be constructed with chambers appreciably larger in diameter than the bore, resulting in excessively long cartridges and dangerous wave pressures. Breech-loading systems could be made with larger chambers to facilitate the loading of larger propelling charges. Eventually with continued improvements in the construction of the breech block, the risk of accidents with breech-loading cannons would see a dramatic reduction in comparison with muzzle-loading systems. Premature ignition of the propelling charge during the loading process was still the primary source of accidents in the use of muzzle-loading cannons.[18]

From a durability standpoint, a muzzle-loading artillery piece could withstand a greater number of firings over its lifespan, but the increased firepower found within the new breech-loading systems meant that over the entire life of the gun they delivered a greater total amount of power at greater ranges. Although the initial cost of breech-loading weapons was greater, the ease of relining the new steel barrels assisted to offset

the high initial cost. In addition, the new breech-loading systems were constructed with longer barrels allowing an increase in accuracy and power. The introduction of breech-loading also eased the loading of ammunition. The need to ram ammunition and propelling charges down the entire length of the barrel of muzzle-loading cannons could be eliminated. Overall the new weapons were expensive, but their greater efficiency more then compensated for the increased cost.[19] These new weapons could be mounted on several new types of carriages and within emplacements designed in such a way to allow the recoil energy of the weapon to lower it behind protective parapets. In the lowered position, the crew could service and reload the weapon in relative safety, at accelerated rates of operation, and out of direct observation from the enemy. When these ordnance advances were fully developed into the family of seacoast weapons making up the armament of the batteries within the new Endicott system around 1890, cannons would be capable of firing, caliber for caliber, projectiles four times the weight of older projectiles, increasing the effective range of artillery by a factor of two or three, and with a greater accuracy and armor penetration capability when compared with the capabilities of their Civil War predecessors.[20]

Engineers also made substantial progress in developing submarine torpedoes as a system of defense to assist gun batteries to close important estuaries and harbors to enemy naval vessels. The more modern term submersible mine began to be adopted for this important weapon after 1870 when the term torpedo started to be applied exclusively to the mobile, self-propelled devices known by the same name. By the mid-1870s, a limited stockpile of mines and the necessary shore apparatus needed to control their detonations under enemy vessels were available for use during war. Congress would

continue to provide large portions of the limited funding available for defensive fortifications to further the development of defensive mining until the mid-1880s, but no funding would be committed to built installations to support defensive mining in wartime. Although a plan to create a system of controlled minefields existed on paper, the limitation of this defensive capability by the Congress and the engineers serves as another example of insufficient resource planning to include defensive mining within the coastal defense strategy of the United States. The Endicott Board made defensive minefields a key element in their systematic approach to fortifications when they advocated within their findings, shore batteries and defensive minefields need to operate in support of one another.[21]

The Endicott Period, 1885-1905

Congressional intentions for the Endicott Board was to put an end to over two decades of confusion and short sighted, inflexible coastal defense planning by developing a comprehensive system of fortification resources capable of meeting the needs of the country and able to absorb future technological advances with minimal impact to the overall system. After ten months of effort, the report of the board would be far reaching and would shape the conduct of future American coastal fortification endeavors well into the next century. Beginning with an evaluation of the current state of coastal defenses throughout the entire country, the board reexamined the rationale need for coastal defenses and in the end proposed the construction of an entirely new system of fortifications including elements not traditionally incorporated into defenses of the past. The board's report, when published in January 1886, fulfilled its Congressional mandate by advocating the types of defenses needed to defend the important harbors of the nation

on a prioritized basis incorporating the characteristics of the ordnance advances developed over the last twenty years.[22]

Despite the noble intentions of Congress to diversify the traditional dominance of the engineers in solely defining the parameters and purposes of the nation's coastal forts by opening the membership of the board to naval officers and civilians, the final report of the board contained most of the arguments supporting the engineers traditional functions of coast defense since the War of 1812. According to the Endicott Board, the purposes of American coastal defenses were to protect important ports from attack or bombardment, merchant shipping within sight of the coast, and intercoastal trading vessels using inland waterways. No mention was made of using fortifications to delay or prevent an invasion, but noted the capture of a coastal port was possible. The report looked at the economic dimension of future wars by arguing that coastal fortifications could limit the economic damage done by the enemy.[23]

The Endicott Board became the vehicle of preserving an American fortification tradition dating back more than seventy years. This tradition often begins with a cycle of ambitious planning containing concepts for fortifications that would take decades to construct due to funding constraints within the military budget. Once the foundation of a fortification plan had been executed, overtime it would become inflexible in nature and would eventually be subjected to insufficient resources in material, funding, or manpower from either the army or Congress. Eventually it would become static in nature, incapable of absorbing or countering new technological advances introduced into warfare. The far-reaching plan of the Endicott Board became America's chance to break the mold. For all intents and purposes, the report of the board continued to echo the traditions of the past

by clearly outlining coastal defense plans very similar or identical in most respects to the proposals advocated by the various Boards of Engineers over the last century. Unfortunately, it marked the beginning of another cycle of coastal fortification planning responsible for developing a system that would become obsolete before it was even completed. This system of defense continued to serve the nation until well after the end of World War II and would see its shortcomings during the siege of Corregidor and Bataan by the Japanese in the invasion of the Philippine Islands.

Elements of the Endicott Board Plan

The plan of the Endicott Board generally condemned the present state of the coastal defenses throughout the entire country and proposed a plan incorporating all the elements of modern defense technology available to be built at twenty-six coastal locations and three sites along the Great Lakes. In an extremely detailed, prioritized plan with an estimated to cost in excess of $126 million, the new fortification plan would include floating batteries, armored-turret shore batteries, submarine mines with batteries to defend them, movable torpedoes and torpedo boats and support facilities, and heavy rapid fire guns. The board discouraged the use of iron for armor and proposed steel in its place. Eight appropriation proposals were sent to Congress to procure steel, a federal gun factory, emplacement construction, armor, gun carriages, mines, floating batteries, searchlights, and torpedo boats. An initial appropriation of $21.5 million was requested in the first year, with an annual requirement of $9 million every year thereafter until completion of construction. The enormous overall cost of the project stunned Congress and it would be years before they would act on the proposal.[24]

Congress reaction to the overall plan was justified. The cost for the entire project was enormously excessive and in some cases unrealistic. If all the works called for in the system where eventually constructed, over 80,000 troops would be required to man the static defenses after the outbreak of war, from an army whose peacetime establishment hovered around 25,000 throughout the period of its construction. Even with the augmentation of the reserves and National Guard formations, the army would be hard pressed to find enough trained manpower to meet all of its wartime commitments. Costs estimates for the entire system also underwent tremendous revisions after the required number gun emplacements were changed and several defensive elements originally outlined in the overall plan were eliminated. After implementation of the plan, the new weapons outperformed the predictions contained within the report further reducing the required number of weapons. The report in its original form called for a total of over 1,300 weapons of 8-inch caliber or greater to be emplaced, but fewer than 700 cannons and mortars would actually be installed. The Achilles heel of the entire Endicott System was its fascination with the new technologies coming out of development at the end the 1880s.[25] "The Third System had been designed according to principals thought to be timeless. . . . similarly, the Endicott Board failed to take sufficient account of the prospect of change in technologies. The board proposed to make an enormous investment in the current state of the art without, evidently, considering what would happen if new advances made the current wisdom obsolete."[26] The Endicott Board set into motion a fortification framework around which an entirely new and modern system of fortification would be constructed preserving most of the elements of a flawed American tradition of coastal defense planning well into the next century.[27]

Characteristics of the Endicott Fortification System

Despite the traditional premises underlining the construction of the fortifications of the Endicott System, the types of batteries and weapons emplaced in them were markedly different from their predecessors within the Third System. Endicott batteries were dispersed from one another over a wide area and used the local terrain as much as possible to further to assist in concealing their location from the enemy. The dispersion of weapons required huge additional tracts of lands that would add to the overall cost of the entire system. The increased firepower of the new weapons pushed the locations of the new batteries further out towards the mouths of the harbors and estuaries they were tasked to defend. Older fortifications already constructed in these locations would be converted to hold the new weapons in an effort to hold down overall costs or would be relegated to a secondary line of defense or outright abandonment. Although massive in nature, the new batteries were actually simpler in construction in comparison to Third System examples. Instead of the massive masonry vertical walls of the old system, the new batteries were dispersed horizontally from one another and constructed with reinforced concrete up to twenty feet thick fronted by an additional thirty feet of earth to provide additional protection. This type of emplacement was nearly invisible from the sea and immune (for the moment) to the flat trajectory firing of the weapons mounted on the naval vessels of the period. To take full advantage of this amount of protection, several types of disappearing carriages would be introduced allowing the weapon to be raised above the concrete and earthen parapet to fire and would be lowered to its original position by the recoil energy of the weapon after firing behind the parapet for servicing and loading by the crew.[28]

The protection provided by these new carriages and the increased firepower of the new weapons mounted within them would be one of the most expensive items of the entire system. Armament costs of traditional fortifications built before the Civil War never amounted to more than one-sixth of the total cost of the installation while the weapons and carriages needed to arm a single Endicott battery would amount to almost one-half to three-quarters of the total construction costs.[29] While some weapons systems, such as the dynamite gun, shallow-draft seacoast defense vessels, and groups of torpedo boats manned by army personnel did not receive funding to include them into the system, a greater variety of different weapons would emerge to arm the forts. Besides the use of heavy rifles on disappearing carriages, large numbers of heavy mortars designed to arc heavy, large-caliber shells through the thinly armored decks of capital ships and batteries of small-caliber rapid-fire cannons designed to protect large fields of electrically controlled submerged mines would become the primary elements to emerge from the planning efforts of the Endicott Board. One of the primary limiting factors that would have grave consequences during the service life of the whole system, was limiting the firing trajectory of a majority of the heavy ordnance rifles to a maximum elevation of fifteen degrees, therefore, greatly restricting their maximum effective range to approximately 15,000 yards.[30] Naval vessels of the period initially possessed the same firing restrictions, but the guns would eventually be mounted in turrets allowing greater elevation and a corresponding increase in maximum range obtained with the same caliber of weapon. This development would eventually allow ships to outrange the new fortifications while negating the protection of the concrete and earthen parapets with the use of plunging fire.[31]

Emplacements for heavy ordnance rifles, not vulnerable to the flat trajectory of naval fire, would be constructed on terrain features several hundred feet above the surf line using newly designed barbette carriages and would normally be capable of firing at a greater range than comparable weapons mounted on disappearing carriages. Only a few major caliber weapons were mounted using this method. Most installations would be located as far to seaward as possible and would normally be concealed along the beaches at ground level close to the harbor or river entrance they were tasked to defend. The mainstay armaments of the Endicott era batteries were the 8-inch, 10-inch, and 12-inch caliber rifles mounted in either disappearing or barbette carriages. The largest of these flat trajectory weapons were capable of firing a 1,000-pound shell out to a range of approximately 15,000 yards. Approximately 300 of these weapons would be mounted in emplacements in batteries from two to four weapons each. Ammunition storage for each battery was located in vaulted magazines located one level below the gun platforms protected by a layer of concrete up to twelve feet thick. Shell and powder were sent to the weapons using a mechanical hoist system and loaded onto hand trucks for direct loading into the gun. Individual emplacements were connected by telephone landlines to the various fire control support systems and command posts located throughout the entire installation. As the period progressed, the optical fire control systems for each battery would dramatically improve and batteries would eventually be upgraded with electrical systems and supporting gasoline generators.[32]

Large caliber seacoast mortars would be installed in large numbers in almost every installation. Most of the armor of naval vessels in 1890 was located on belts along the side of ships to prevent penetration of shells fired from naval rifles. These weapons

were designed to fire heavy projectiles to penetrate the thin deck armor of warships.[33] Mortars were emplaced in groups of four within installations resembling a pit, open only along the back wall and top to allow the weapons to fire. Organized to fire in batteries of eight to sixteen weapons, these 12-inch weapons threw a 700-pound projectile in a high trajectory arc designed to descend vertically on a slow moving warship in a shotgun like pattern. Less expensive to install than traditional rifled ordnance, almost 400 of these weapons would be mounted within fortifications throughout the United States. A critical planning assumption made by fortification planners when solving the difficult problem of hitting naval targets with vertical fire, would be the target would almost be stationary when bombarding the opposing fort.[34]

As the naval fire control systems continued to improve towards the end of the century, this assumption was not proven invalid. The use of large batteries of mortars became obsolete once again before all of the planned batteries had been constructed. Mortars batteries now constituted a significant portion of the planned armament of most Endicott installations and it was to late to turn back. Engineers would continue to commit limited funding resources well into the next century to install mortars while the seacoast artillerists would continue to devise new methods of vertical fire in a vain attempt to overcome the technical advances of naval vessels. The total number of mortars within a battery would be cut in half when experimentation determined the rate of fire could actually be increased without a corresponding loss of effectiveness. The history of the use of mortar batteries serves as an indication of inflexible defense planning and the inability of the entire system to overcome critical technological advances that outdated the entire system before construction could be completed.[35]

To provide protection for the extensive field of electrically controlled submerged mines planted within harbors and rivers against minesweeping vessels, the fortification planners installed a series of batteries containing small caliber guns capable of being fired and loaded fairly rapidly. These cannons, ranging from 3-inch to 6-inch in size, were arranged in batteries containing two to six weapons and mounted on simple pedestal mounts equipped with gun shields instead of the more complex installations used for larger weapons. Using ammunition capable of being handled manually by the crew serving each weapon, these guns could achieve a sustained rate of fire of five to fifteen rounds depending on the level of training and the size of the weapon being served. This type of ordnance did not receive much consideration during the planning deliberations of the Endicott Board, but would eventually be mounted in large numbers throughout the service life of the system in place of some of the larger pieces of ordnance to counter a large number of threats to the physical obstacles or naval bases they were designed to protect.[36]

The last major element of the Endicott defenses were the provisions made to install enormous fields of electrically controlled submerged mines denoted from facilities located ashore designed to track the paths of enemy warships through the field. These mines were not permanently installed during peacetime, but were stored ashore in special mining casemates designed to facilitate the rapid planting of the minefield in event of hostilities. After these minefields were emplaced, friendly shipping were not in danger when individual mines were electrically detonated from firing stations located on shore. Each major harbor defense command would be assigned one or more mine laying vessels (called mine planters) and supporting small craft to quickly implement the defensive

mining plan for each specific harbor and be responsible for conducting routine maintenance when the need arose. Specific coast artillery units would be responsible for maintaining the fire control circuitry equipment ashore and would conduct periodic mine laying practices.[37]

Implementation of the Endicott Plan

After the Endicott Board sent their final report to Congress in January 1886, initial appropriations to implement the plan were slow in gaining approval because of the severe reaction to the total cost of the system. Finally convinced of the defenseless condition of the nation's seaports and the use of fortifications as a cheaper alternative to a large standing army to repel an invasion, Congress initially provided funding to establish Watervliet Arsenal in 1888, the national gun factory outlined in one of the eight appropriation plans initially sent to Congress by the board.[38] The completion of the development of the new heavy ordnance became the key for unlocking funding resources from Congress. When the Ordnance Department demonstrated its ability to contract or directly manufacture the weapons to be installed in the planned system, approval for funding the battery emplacements soon followed with little debate. Initial outlays of $1.2 million were approved in August 1890 to begin construction of installations to defend Boston, New York, and San Francisco, quickly followed up by a further $1,250,000 over the following two years.[39]

Funding for the system was much lower than anticipated by the members of the Endicott Board. The engineers would continue to press Congress without success over the next fifteen years to drastically increase the amount of funding provided to prevent the project from being subjected to the delays experienced in the construction of the

Third System. Endicott Board members projected to have spent almost $98 million on battery construction by 1895, but Congress only approved about $10.6 million during the same time period with the engineers receiving an average allocation of $1.5 million annually. At this rate the engineers would require another twenty-two years to complete the plan. Work progressed slowly but at a steady pace with the available funds. Deterioration of diplomatic relations with Spain in 1896 served as a catalyst to prompt Congress to approve an additional $2.5 million to shore-up the defenses of the eastern seaboard and the gulf coast. However, fortification engineers would never be able to persuade Congress to appropriate the level of funding required to complete the entire project, forcing the conversion of a number of old Third System installations to hold the new ordnance and a reduction in the total number of weapons evidentially included in the system. By the beginning of 1897, the Chief of Engineers reported the completion of the emplacement of fourteen 12-inch, eighteen 10-inch, and five 8-inch rifles supported by seventy-three 12-inch mortars and two 5-inch rapid-fire guns. This total would be increased further by an additional ten 12-inch, sixty-four 10-inch, and twenty-eight 8-inch rifles with an additional 159 12-inch seacoast mortars and ten 5-inch rapid fire guns by 1 July 1898. This sharp increase primarily would result from the injection of additional funding given by Congress to speed the completion of fortifications in time for the commencement of hostilities with Spain over the fate of Cuba. The speedy completion of the new fortifications became the only means of calming the fears of the coastal cities of the Eastern seaboard from being attacked by Spanish raiding squadrons, therefore, allowing the navy to be transformed into an offensive force instead being tied defensively to the coast for the duration of the war.[40]

Although the tremendously under strength, the Spanish Fleet wisely chose not to expend its weak combat power by attacking American seaports for extremely limited gains, the threat it posed continued to reinforce almost one hundred years of conceptual thinking for the need of static, inflexible coastal defenses. The beginning of the new century saw an exponential increase in the amount of protection provided by the incomplete Endicott system in comparison to the limited defensive potential provided by the derelicts of the Third System. Fifty-seven 12-inch, 105 10-inch, and seventy-five 8-inch guns were emplaced in over thirty locales supported by an additional fifty-three 5-inch rapid-fire cannon and 242 12-inch seacoast mortars. Despite these impressive figures, the engineers went to great lengths to state the defenses were only fifty percent complete and only a limited number of cities were capable of fending off a determined naval attack. The large number of weapons to be mounted within the system became an indication the engineers were again embarking on a prolonged construction program resulting from an inflexible coastal defense plan being further delayed by not having a sufficient amount of funding resources.[41]

Continually revised plans for the entire Endicott System were calling for the installation of a total of 661 large caliber guns and over 1,000 seacoast mortars in 1896. These large numbers indicate a lack of understanding within the engineering establishment of the capabilities of the new ordnance technology. One large caliber cannon by itself could replace the firepower of dozens of the older models of artillery, yet plans for individual installations still called for the emplacement of several hundred weapons to defend the same locale. In the case of Boston, San Francisco, and New York, it seemed as if the engineers were simply determined to emplace almost the same number

of guns within the new works as could be found in the older generation of forts. The notion of over planning on the part of the engineers further limited the level of future Congressional appropriations.[42] Given the enormous ambitions of the plan, constructing defenses of this nature took an enormous amount of time and vast commitments of manpower and resources. The competing priorities of the Corps of Engineers to build fortifications as well as improve the waterways and harbors of the nation limited the number of available officers. Despite the continued calls for more funding to accelerate the rate of construction, the engineers probably only had enough personnel available to supervise the current level of construction.[43]

Additional obstacles to accelerating the rate and scope of fortification construction were the continuous differences and agendas of various internal factions within the army. The artillerists, engineers, and military and civilian representatives of the Ordnance Departments were more committed to maintaining three individual spheres of influence instead of creating the atmosphere of harmony required to see the completion of the system in a timely manner. Besides claiming the engineers did not always know what was best for the entire army, the artillerists would claim the engineers built sighting stations and command posts to dangerous to use and gun emplacements not constructed in accordance with the specifications of the new ordnance. The Ordnance Department would be hard pressed during the early years of the Endicott System to maintain ammunition stockpiles at acceptable levels and would face criticism of not being able to manufacture the new weaponry to arm the newly completed emplacements in a timely manner. The engineers charged the artillery did not have enough expertise to adequately man the new works being turned over to them. Numerous bureaucratic battles

between the artillery and engineers resulted over the next several years to control the emplacement of submerged minefields and the design of optical fire control systems.[44]

In addition to the bureaucratic issues pertaining to the development of the Endicott System, technical difficulties also began to arise. Concrete had never before been used in massive quantities and the use of this new technology before it could be fully proven would become an issue destined to consume vast amounts of scarce maintenance and preservation funds in the next several decades.[46] A five-gun Endicott style emplacement required the removal of 26,000 cubic yards of earth and the pouring of 25,000 cubic yards of concrete and the installation of an additional 12,000 cubic yards of earth to the build-up of a protective, concealing slope in front of the battery.[47] Portland cement concrete became the building material of choice. Although it was easy to work and shape and ultimately would be hard and strong when it fully set, the engineers did not realize it generated heat and shrank when drying. It was also not waterproof and would crack during setting due to the massive structures required to mount the new weaponry. Dampness and seepage would be a problem never fully solved over the service life of the installations. The development of drainage systems and the use of reinforcing steel bars during the construction of later installations greatly assisted in maintaining their structural integrity.[48]

Inherit problems aside, implementation of the Endicott plan pushed the defensive capabilities of American coastal defenses forward. Although the Corps of Engineers would continue to blame Congress for the slow rate of construction, the army found itself without the trained manpower and manufacturing resources to push the system forward at a faster pace even if additional money had been made available. Seepage within

completed works began to consume large amounts of maintenance funds over the next few years to such an extent, new battery construction stopped, so designs of the fortifications could be reviewed to find the source of the problems and develop solutions to literally plug the leaks. Feuding within the service continued between the engineers and artillery over the development of modern position and range finding apparatus.[49] Politically speaking, the new empire the United States inherited as a result of the Spanish-American War needed defending. The Endicott fortification plan was limited to the continental United States and did not take the defense of new overseas possessions into account. Fate intervened in the form of President Theodore Roosevelt. He directed Secretary of War William H. Taft to convene another board of experts in 1905 to determine if the installations constructed over the last fifteen years would continue to be viable in the face of the rapid pace of technological innovation still being seen in all areas of warfare. The Taft Board would be the last chance America would have to reverse the trends shaping the development of American fortifications since the War of 1812.[50]

Reaffirmation of the Taft Board

When the Taft Board convened in 1905 (officially known as the National Coast Defense Board) the Endicott System was only fifteen years old. During its construction, however, naval and ordnance technological advances continued to outpace the assumptions used by the engineers to convince Congress to fund construction efforts. Some of the fortification elements devised under the Endicott plan were found to be either erroneous or still under development at the turn of the century. Most of the completed installations were immediately placed under a caretaker status in readiness for a future war. The limited peacetime establishment of the army did not have the

manpower available to provide permanent garrisons for most of the installations. The task of the Taft Board was to reconsider the methodology and policy used to conduct coastal defense in light of the new technological advances seen in naval construction and ordnance since the turn of the century to determine if fundamental changes needed to be instituted before committing additional funding to continue construction. The fortification of the new insular territories also received consideration during the deliberations of the board.[51]

An argument could be made historically from the beginning of the Endicott era, that the slow pace of budget appropriations and the rapid continuing advance of naval and ordnance technologies already doomed the Endicott System to obsolescence even before the Taft Board started their deliberations. Ignoring earlier recommendations to press forward with the development of armored turrets, the cost effective adaptation of the disappearing carriage would eventually be overtaken within the next decade by the development of the airplane and range extensions to existing naval weaponry achieved from increasing the elevation of turrets aboard warships. Much of the construction work for the Endicott system had already been completed, so the Taft Board felt compelled to concentrate its efforts on enhancing the ability of existing fortifications to continue to defend the coast and extend the protection of this type of fortifications to locations overseas.[52]

By not directly challenging the existing coastal defense principals and the resulting fortification designs, the Taft Board essentially rubber-stamped the Endicott Board report. By reiterating the need for the type of defenses already under construction, most of the work of the Taft Board would be limited to refining the plans of the existing

system by updating cost estimates and proposing additional technological developments that could be incorporated into the existing forts or new structures constructed overseas.[53] America therefore lost its last chance to significantly alter a culture within the army hierarchy responsible for developing systems of fortification traditionally insufficiently resourced to fight a major conflict or inflexible in nature to meet the changing defensive needs of the nation.

In addition to reaffirming the continued defensive potential of heavy weaponry mounted on disappearing carriages, the report of the Taft Board would recommend the installation of a number of technical devices having the potential to extend the service life of the fortifications for several more years. Among these were the uses of searchlights to assist with illuminating targets at night, electrically powered ammunition hoists to rapidly move projectiles and powder to gun platforms, and telephone communications to enhance command and control throughout the fortification reservation. Recommendations would also be made urging the prompt installation of new aiming systems using optical range and position finders, precision instruments to calculate target data, and the electrical transmission of firing data directly to the batteries. These efforts would continue to ensure the continued superiority of shore-based weapons over their naval counterparts until the end of World War I when developments in naval ordnance would finally overcome the defensive capabilities of the new system.[54]

The Taft Board also recommended the elimination of efforts to develop floating defenses, such as torpedo boats and shallow draft monitors as essential elements of the nation's coastal defenses. These elements were more expensive to build and maintain than fortifications and efforts to build coastal defense vessels would have an adverse

effect on the amount of funding available to develop other types of vessels for the navy. While the final report of the Taft Board did not attempt to alter the Endicott fortification plan for the continental United States, its conclusions concentrated on providing recommendations for new fortifications of similar design to defend ten locales within the insular possessions and the Panama Canal.[55] It also recommended the installation of a new 14-inch weapon in place of the traditional 12-inch model on disappearing carriages, wider spacing between individual battery emplacements, and a revision of the battery design of 12-inch seacoast mortar batteries. The adoption of a new 12-inch mortar, having a greater range and accuracy over previous models, would allow fortification planners to build future mortar emplacements containing fewer weapons without a corresponding loss of firepower effectiveness. Despite these improvements, the use of seacoast mortars would continue to be limited in the future by the efforts of shipbuilders to enhance the horizontal armor protection of future ship designs.[56]

Cost projections for the new recommendations of the Taft Board added an additional $11 million to the price tag of the Endicott system. Once again Congressional indifference limited the immediate appropriation of funds to implement the board's recommendations or increase the maintenance and preservation funds needed to shore up the drainage systems of earlier Endicott structures. Initial funding efforts were limited to the installation of searchlight batteries and the electrification of communications and ammunition hoists. When funding for the construction of new batteries was finally restored in 1908, the modernization of older emplacements would continue to receive priority over the initiation of new fortifications over the next several years. When economic depression struck the nation in 1911, further funds for finally completing the

entire modern system of fortifications would have to wait until America initiated its final preparations to enter World War I.[57]

World War I

On the eve of World War I, the Chief of Coast Artillery finally announced most of the approved projects outlined in the combined Endicott and Taft plans were completed. The United States had spent $143.7 million since 1888 to emplace a total of 1,182 seacoast defense weapons along the perimeter of the continental United States, to guard our most strategic overseas bases in the Philippines and Hawaii, and to protect the flow of commerce in and out of the Panama Canal.[58] In reality the vast array of fortifications outlined in the Endicott plan and later supplemented and expanded by the Taft Board were never fully completed. Once again the American tradition of building a system of fortifications had come full circle twice in the short military history of the Untied States. The efforts of the engineers to finish the ever expanding and revised plan for the modern system over the last twenty-five years mirrored our previous experiences during the nineteenth century to complete the Third System before the start of the American Civil War. Just like the Third System before it, the new modern system of fortification became inflexible in the planning of defensive strategies for the country, became incapable of adjusting to technological advances, and would become insufficiently resourced to the point it would only serve as a hallow shield in time of war.

As American fortification engineers continued to struggle to obtain the necessary funding to complete installations, several technological advances in naval ordnance finally overcame the defensive capabilities of the fortifications designed to keep naval threats at arms length from important coastal cities. From this point forward, American

fortifications would never be able to overcome the ever-widening technological gap and any attempts to modify existing installations would become reactionary in nature. Advances in naval fire control systems enabled capital ships to accurately engage coastal fortifications and enemy warships at greater distances than previously experienced. The usable ranges of naval gunfire were beginning to approach the maximum range these guns were already capable of firing. During World War I, the turrets of most battleships would be redesigned to increase the firing angle of naval weaponry. This led to extended maximum ranges and allowed ships for the first time to have the ability to arc shells through horizontal decks of enemy vessels and behind the earthen and concrete parapets of coastal fortifications. The increasing use of the airplane by naval forces to spot and adjust the effects of naval gunfire during World War I would also limit the effectiveness of coastal fortifications in the future.[59]

The protective features of disappearing carriages were eliminated by these technological advantages and for the most part obsolete. Although new types of mountings and protective features would be introduced over the next several decades, disappearing carriages would continue to mount the majority of American seacoast weaponry until well after our entry into World War II. Efforts by fortification engineers to devise new mountings were just beginning when America entered World War I in April 1917. Assessing the naval threats to the coastline of the United States at this point in the war, only the submarine forces of Germany were capable of causing harm to the flow of troops and supplies from America to the battlefields of Europe. Since static coastal defenses could not influence the prosecution of the war at sea, efforts to

modernize the coastal defenses would receive a very low priority. Only a limited amount of new battery construction would be commenced during the entire war.[60]

Since the wartime activities of garrisons manning the static coastal defenses would be extremely limited, Major General Erasmus M. Weaver, the Chief of Coast Artillery, proposed to the War Department to send the majority of the Coast Artillery troops (numbering 200,000 men) to France to man the railway and heavy artillery trains supporting the American Expeditionary Forces (AEF). Ordnance "barrowed" from the Endicott fortifications and from surplus navy stocks would be mounted in various configurations on railway mountings and sent to the front to fire in support of ground forces. Several models of tractor drawn heavy artillery and trench mortars from Allied countries were also utilized by American units during the course of the war The Coast Artillery also became responsible for developing the techniques, tactics, and procedures for the use of antiaircraft artillery in support of ground forces due to their historical expertise of engaging moving targets. A permanent division of resources emerged within the Coast Artillery for the next thirty years from the assumption of these two additional types of artillery material in competition with its traditional role of resourcing the permanent seacoast defenses.[61]

The Interwar Years

Indications of the insufficient level of resourcing of American coastal defenses would emerge during the postwar years when the limited amount of funding and manpower had to be divided equally between the permanent seacoast batteries, mobile seacoast artillery, and antiaircraft units. With virtually no lessons on the use of American seacoast fortifications from World War I to lean on, the engineering and artillery

establishments advocated for the continued modernization of the Endicott fortifications. They continued to be the cornerstone of the coastal defenses of the nation for the next two decades with additional support provided by railway and mobile artillery units. Some arguments were advanced to shield the system from aerial observation and supplement their firepower with mobile and fixed antiaircraft artillery batteries. Downsizing of the military establishment at the end of the war would severely limit the amount of funding available to continue to upgrade the fixed fortifications and develop the new artillery functions given to the Coast Artillery. Development continued on more powerful armament, but the funding to emplace them with the system would be non-existent for the next several years due to the realignment of postwar economic priorities after World War I.[62]

As a new function within in the army, antiaircraft artillery would continue to advance from its primitive beginnings on the battlefields of Europe into fixed and mobile components. Development continued on the development of accessory equipment such as searchlights, aircraft sound locators and mechanical fire direction systems. Fixed antiaircraft batteries armed with varying numbers of 3-inch weapons were installed among the other seacoast defense batteries over the next twenty years to provide some form of defense against aerial attack and observation. The effectiveness of the batteries continued to increase as advanced electronic and optical fire control and improved types of ammunition were introduced in the years prior to World War II.[63] The entire problem of coast defense acquired another dimension when naval aviation could bypass the traditional coastal defenses to attack cities they were designed to protect from naval bombardment. As the military potential of military aviation continued to expand during

the inter-war years, the Coast Artillery continued to expand the number of units dedicated to antiaircraft defense to such a point this type of artillery would be its sole function by the end of World War II.[64]

In the years before World War II, mobile seacoast armament would emerge in the form of railway and tractor-drawn units. Several Coast Artillery officers believed this type of artillery would eventually replace static coastal fortifications when a new doctrine began to emerge within the army emphasizing more mobility. The availability of surplus material from World War I gave these officers the opportunity to test their theories. Manufactured in limited numbers during and after the war, three primary models were standardized for use in Coast Artillery railway gun units: an 8-inch and 14-inch rifle and 12-inch mortar. Tractor-drawn seacoast artillery also emerged during this time period after redesigning the carriage of a 155-millimeter howitzer of French design. These weapons were to be used against lightly armored vessels and landing craft conducting amphibious landings from specially designed concrete hardstands called "Panama mounts" positioned along the beachfronts of fortification reservations. The philosophy behind the use of mobile weaponry derived from the fact they would be harder to attack with aircraft or naval bombardment because their exact position would not be known ahead of time and were easier to camouflage from aerial observation.[65]

The development of mobile seacoast artillery within the army during the inter-war period became a matter of economics. After the traditional downsizing of the military establishment at the conclusion of World War I, large military appropriations to continue construction of static fortifications were out of the question as funding sources shifted to other priorities ignored during the conflict. The priorities of the army shift to sources of

surplus weaponry and adapt them to defend vital locations for which the construction of permanent fortifications were either awaiting funds or were not completed throughout the 1920s and 1930s. Although easier to economically resource, the defensive use of mobile seacoast artillery had several technical drawbacks. The most significant of these would be the lack of accuracy in comparison to weaponry installed in fixed fortifications. Mobile weaponry could not be linked to the communications infrastructure and the extensive fire-control networks throughout a military reservation. The carriages used to mount mobile and railway cannons were incapable of rapidly swiveling horizontally to engage high-speed naval targets. Artillerists would attempt to overcome these limitations by having the engineers construct a number of horizontal concrete firing bases at several locations within potential areas of operation to increase the weapon's stability and traversing speeds at the expense of their mobility and vulnerability to aerial observation. Although the army committed large amounts of its limited monetary and manning resources towards the development and deployment of this type of seacoast artillery, its use fell out of favor by the beginning of the 1940s and would never overcome the predominance of permanent fortifications in the minds of military planners.[66]

While artillerists were expending valuable, yet extremely limited fiscal resources attempting to develop a mobile alternative to the system of fortifications developed under the Endicott and Taft plans, military engineers continued their own efforts to develop emplacements flexible enough to counter the naval technological advances of World War I. The disappearing carriage with its flat trajectory fire and limited range began to give way to a series of batteries mounted on high-angle barbette carriages capable of traversing the weapon a full 360 degrees and firing a 12-inch projectile nearly twice the

range of similar weapons mounted on disappearing carriages. Limited funding became available during World War I to construct a limited number of batteries. This effort would be continued after the war when a completely new 16-inch model capable of firing one-ton projectiles almost thirty miles would be emplaced at locales in severely limited numbers. To cut down on manufacturing costs with only a slight degradation in range capabilities, the army would capitalize on the availability of navy 16-inch gun barrels from ships being scrapped under the provisions of the Washington Naval Treaty.[67]

Although these weapons were now capable of firing projectiles out to ranges comparable to the weapons mounted on naval warships, the engineers built the emplacements concealed only from enemy warships. Besides not having the budgetary resources needed to emplace these new weapons in large quantities in the early 1920s, no overhead protection from aerial attack was provided for either the weapon or the crew. While engineers recognized the need to continue to laterally disperse and increase the protection of critical elements of the batteries such as the fire control stations and ammunition storage sites, the most important part of the works, the cannons and personnel would continue to suffer from the effects of enemy direct artillery fire or aerial bombardment. The vast circular concrete firing platforms required to give these barbette-mounted weapons a 360-degree traversing capability resembled huge bull's-eyes when viewed from above. This striking example reinforces the army's inflexibility in planning defensive fortifications in austere fiscal environments. By ignoring the emerging capabilities of military aviation, the army continued to be very reactionary when attempting to counter technological advances being realized within several areas of warfare.[68]

The two-dozen new 12-inch and 16-inch weapon emplacements to emerge from World War I only provided half the answer to the continuing stream of technological advances. While the new weapons now equaled their naval counterparts and could be constructed economically in a timely manner, the War Department stopped construction efforts in 1922 to once again reconsider coast defense methods in light of the capabilities of modern aircraft and naval vessels. A 1923 War Department study finally conceded a large navy and air force could provide better protection than fixed coastal fortifications. However, the most economical form of defense would continue to be provided by the cannons and submerged mine fields. This study became the foundation of coastal defense policy within the United States until the outbreak of World War II. Regardless of the threat to the country, the military would continue to use static coastal defenses of limited utility and ever narrowing capacities as they have traditionally done over the preceding century and a half as the primary means of defense.[69]

After determining that the present system of fortifications would continue to provide the primary means of defense for coastal cities from enemy naval attack, several events in the 1920s and 1930s would prevent further modifications to obsolete installations and continuing efforts to construct new emplacements. The passage of the Washington Naval Treaty of 1922 greatly reduced the perceived threat from naval attack. This treaty also specifically prohibited the modernization of the fortification located in the insular possessions west of Hawaii as a concession to the Japanese to sign the final pact. Huge numbers of capitals ships mounting powerful armament would be scraped around the world as a result of this treaty. Naval disarmament would be responsible for reducing enthusiasm within Congress to approve funding for future fortification

construction projects. This treaty also assisted with fostering the establishment of the isolationism movement during the interwar years. Isolationism became a matter of defense policy and would drastically reduce the amount of money being received by the army to continue modernize the entire force. Numerous installations across the country were placed back into caretaker status shortly after the conclusion of World War I. Firing practices for the crews manning the remaining fortifications and requests for construction appropriations virtually ceased to exist after the start of the Great Depression. As the country spent the next decade struggling to recover economically, plans for future fortifications would remain on the shelf until the late 1930s.[70]

After several years of design work, army engineers in 1937 began to build new fortifications within the harbor defenses of the San Francisco Bay area designed to directly protect gun crews and emplaced weapons from aerial attack. Two concrete casemates housing the new 16-inch cannon developed after World War I were protected from bombs and projectiles by a roof consisting of eight to ten feet of reinforced concrete and twenty feet of earth. Only the muzzles of the cannons were visible. All supporting command structures, ammunition storage area, and electrical generation systems were located underground in close proximity to the weapons they served. Serving as the pattern of all future weapon emplacements to be constructed in the future, only enough funding could be found to complete these initial two emplacements, despite the start of limited mobilization during 1938. Fortification engineers had finally devised a method to close the technology gap, but were unable to implement the solution on a grand scale due to the greater emergent requirements to rebuild the entire army on the eve of World War II.[71]

World War II

Facing the vulnerabilities of the majority of America's coastal fortifications in the summer of 1940, the Chief of Coast Artillery warned the Army Chief of Staff the entire system was inadequate and could be outranged by naval gunfire and was vulnerable to air attack due to the lack of overhead protection. As war erupted in Europe and as part of the full mobilization of the nation for war, the new Harbor Defense Board recommended the immediate construction of a new, fully standardized system to be erected at thirty-three sites within the continental United States, Alaska, Panama, and strategic bases in the Caribbean and Atlantic. These fortifications consisted of a series of casemated 16-inch gun batteries and shielded gun emplacements equipped with a brand new 6-inch weapon capable of firing out to fifteen miles. The high-angle firing 12-inch weapons emplaced immediately after World War I were also retained. Instead of a mixture of over two-dozen models consisting of six different calibers, the standardization of armament and construction of these new batteries greatly eased the development of tactics, procedures, training, manufacturing, and maintenance within a nation hastily preparing for war. More significantly these new batteries provided a range of coverage never before seen within past coastal fortification systems by the addition of radar ranging devices in addition to the standard optical systems in use.[73]

Until this new system of works could be completed, the nation would be forced to rely on the ever-increasing limitations found within the Endicott and Taft fortifications in existence since the early 1890s. Battery construction proceeded at a rapid pace through 1942, when the overall military situation turned in favor of the Allies until the end of the war. Like all the previous systems, the entire construction program for this system would

never be completed. The government spent almost a quarter of a billion dollars on its construction before the end of the war. Many of the projects were cancelled outright or were never armed after the concrete structures were completed. While these fortification designs contained new concepts to increase their potential defensive value by preserving combat power from existing vulnerabilities, they were still throwbacks to an earlier time. They were designed to defend the same inflexible coastal defense doctrine conceptualized right after the War of 1812. Military planners of the period still could not grasp that the time for permanent seacoast fortifications had passed and aircraft, ships, and mobile ground forces were more capable of successfully completing the same tasks these fortifications have traditionally conducted for the last one hundred and fifty years. Once again military planners never realized that forts were only one part of the nation's defense instead of being at times the only defense of the nation. The entire modern system of fortification would only be fully tested once in battle. Like their predecessors during the Civil War, the army will have a complete demonstration illuminating the faults of inflexible defense planning, insufficient resourcing, and a lack of awareness of warfare's technological advances across several generations of flawed decision making.[73]

The Siege of Corregidor

After the fall of the Bataan Peninsula to advancing Japanese forces in April 1942, the subsequent siege of the island of Corregidor fully tested the defensive capabilities and design principals underlying the modern system of coastal fortifications. Ironically, the fortifications constructed within the United States over the preceding one hundred and fifty years were designed to prevent the type of scenario illustrated by Commodore George Dewey's squadron of warships entering Manila Bay at the beginning of the

Spanish-American War to destroy the entire Spanish Pacific Squadron at their moorings and force the garrison of the city to cower under the power of their guns. After the Philippine Islands were ceded to the United States at the conclusion of the war, an elaborate system of fortifications were constructed on Corregidor and several other islands to seal off Manila Harbor from naval attack. Construction efforts began in 1904 to build a series of heavy rifles mounted on disappearing carriages supported by additional batteries of 12-inch seacoast mortars, large fields of electrically controlled submerged mines, and several batteries of light rapid-fire guns. The first gun emplacement completed test firings in 1909 while the balance of the defenses were completed by the beginning of World War I.[74]

The most modern seacoast weaponry on Corregidor was two 12-inch cannons mounted on high-angle firing barbette carriages installed just after the end of World War I. These heavy rifles were capable of firing a 700-pound projectile out to a range of 29,500 yards and were considered the most powerful weapons mounted on the island. Corregidor's other seacoast defenses were organized in twenty-three different batteries totaling fifty-six guns ranging in caliber from 3-inch to 12-inch. An additional six 12-inch rifles mounted on disappearing carriages had a range of 17,000 yards while the most modern 12-inch seacoast mortars could range a target out to 15,200 yards. Nineteen 155-millimeter GPF mobile guns capable of hitting light naval targets at ranges out to 17,000 yards made up the balance of the direct fire weaponry. Since the inception of military aviation during World War I, the antiaircraft defenses of the island were steadily increased to fend off attacks against the vulnerable seacoast batteries. By the beginning of World War II, these defenses would total seventy-six .50 caliber machine guns and 3-

inch antiaircraft guns organized into eleven batteries augmented by ten 60-inch searchlights for target illumination. Coastal defenses were also installed on three of the adjoining islands to complete the harbor defenses of Manila Bay. An additional twenty-seven seacoast and antiaircraft batteries mounting a total of forty-nine guns were mounted on these islands in Endicott and Taft period fortifications. The most novel of all the harbor defenses would be the installation of two twin 14-inch armored gun turrets on the reinforced concrete superstructure of Fort Drum, commonly referred to as the "concrete battleship," because of its tall steel sighting tower and the mounting of its weapons in resemblance of a contemporary capital ship. A total of 5,700 men were assigned to the harbor defenses organized in three seacoast and one antiaircraft artillery regiments with support provided by additional headquarters and service troops.[75]

While limited funds were made available to improve the seacoast defenses of the Philippines prior to America's entry into the war, the basic weaknesses of the defenses were never corrected. The entire fortification system designed to protect Manila Bay from naval attack remained vulnerable to attack from the air and from artillery fire along its flanks after enemy forces seized the mountains and hills along the shores of Bataan to the north and Cavite providence to the south. With a few exceptions, the bulk of the seacoast weaponry on Corregidor and the adjoining islands were only designed to counter a naval attack, therefore a majority of the weaponry were emplaced in positions pointing out to seaward and were not capable of supporting the land battle on the nearby Bataan Peninsula. Only the two 14-inch gun turrets of Fort Drum and a couple of the 12-inch seacoast mortars batteries were in position to fire on Japanese positions. To make matters worse, the majority of the ammunition in use within the fortification system was

only capable of damaging armored naval targets. Approximately ten percent of the total ammunition in the islands was of the high explosive variety and most of it would be rapidly consumed during the course of the land battle for Bataan. Antiaircraft ammunition was also in short supply throughout most of the battle, requiring the use of submarines to conduct numerous resupply runs to alleviate a critical shortage of mechanically fuzed 3-inch high explosive shells.[76]

Subjected to Japanese aerial bombardment since the beginning of war on 8 December, their efforts intensified in the coming months as the battle to seize Bataan progressed. Although aerial bombardment and limited artillery fire from the southern shores of Cavite Province would destroyed most of the aboveground living quarters and supply warehouses over the next few months, the defenders simply dug in underground and dispersed supplies to underground sites and the caverns of Malinta Tunnel. Most of the early aerial and artillery bombardments did not significantly damage the ability of the defenses to keep elements of the Japanese Navy at arms length. Vital installations such as the power generation plant and water storage sites remained untouched and only minor, repairable damage was sustainable by individual weapons within the seacoast or antiaircraft batteries. Since the artillery troops could not be spared to man the beach defenses of the island, the 4th Marine Regiment was transferred from duty on Bataan to fulfill this vital role. Other groups of soldiers and sailors were eventually pressed into service as infantry as the battle for the peninsula was winding down to allow the coast artillery units to continuously man the guns of the defending batteries.[77]

The majority of the American defenses were incapable of conducting counter-battery fire due to the flat trajectory fire of the cannons mounted on disappearing

carriages and their inability to locate the Japanese batteries. Few aerial reconnaissance assets were available over the course of the battle and the Japanese were skilled in locating their own artillery units within the deep ravines of the surrounding hills and mountains as well as camouflaging their positions. The very limited supply of high explosive shells available for counterfire had to be husbanded for critical targets and experimentation to adapt armor-piercing shells for this use mostly failed to produce the desired effect. After the fall of Bataan on 9 April 1942, the end for Corregidor came very quickly. The majority of the heavy Japanese artillery batteries repositioned to concealed defilade positions among the mountainous terrain of Bataan over the course of the next week. While a renewed aerial bombardment of the island quickly commenced, most of the damage to the islands defenses would be done by the accurate prolonged bombardment conducted over the next few weeks prior to the Japanese landings occurring on the night of 5 and 6 May. Using months of aerial reconnaissance data to pinpoint the exact positions of the defending batteries and using observation balloons to adjust the fall of shot of their immense 240-millimeter howitzers, it was only a matter of time before the defenses were systematically destroyed.[78]

Most of the seacoast defense weapons were being continuously put out of action from damage sustained during the course of the pre-assault bombardment and it was a constant struggle for the defenders to keep repairing individual weapons in the open under prolonged shelling. Only the two 14-inch gun turrets located at Fort Drum were immune to the effects of the Japanese artillery fire. The most spectacular example of the vulnerability of the entire system of fortifications came, when a Japanese 240-millimeter howitzer shell struck the 12-inch seacoast mortar ammunition magazine of Battery Geary

on 2 May ruining all eight mortars within the pits and reducing the entire battery to rubble. Ironically, the 12-inch seacoast mortars located throughout the defenses although technologically inferior to provide effective bombardment against armored naval targets, they would be responsible for providing the most effective counter-battery fire of the campaign with its limited stock of high explosive shells. By the time the Japanese amphibious landing occurred on the night of 5 and 6 May, most of the seacoast defenses were out of action and were not capable of preventing the landing of Japanese troops or no longer capable of firing back at naval targets. Most of the vital installations, such as the water reservoir pumps and the central electrical generation plant, were no longer capable of operating for long periods of time due to shell damage. The lack of a capability to distribute water during the hot tropical summer weather to the majority of the defenders and an ever-dwindling supply of food had a prolonged effect of their ability to offer continuing resistance to the Japanese invaders.[79]

The Japanese only required four weeks of sustained artillery bombardment to systematically render the complete array of American seacoast fortifications on Corregidor ineffective. After the initial Japanese landings gained a toehold on the island and continued to make steady advances after being reinforced, further resistance on the part of the American defenders became a jester of futility. When the commitment of the coast artillery units manning the seacoast batteries, as reinforcing infantry did not alter the course of the battle, General Wainwright negotiated the complete surrender of the remaining forces in the Philippines to prevent further bloodshed. Elements of the Japanese Navy were never required to come within the range of the defending batteries to pommel them into submission. The Japanese fully understood the vulnerabilities of the

American positions defending Manila Bay. After generations of prolonged use without the benefit of modernization, the Japanese knew how to exploit the weaknesses of an inflexible defensive system not sufficiently resourced to counter the technological advances of warfare. Using the advances of military aviation and the mobility of large, long-ranging artillery systems, the Japanese did not need to risk valuable naval assets to quickly isolate and destroy a system of fortifications constructed only to prevent a naval attack against the city of Manila.[80]

Summary

The destruction of the fortifications of Corregidor, like its predecessors during the American Civil War, clearly demonstrates the limited tactical and operational utility of a system of fortifications that have been in existence in one form or another for over one hundred and fifty years. Military planners continued to rely on their strategic deterrent value to prevent an attack on American coastal cities or overseas possessions and always assumed they would be able to prevent an enemy naval attack without significant assistance during time of war. Twice over the military history of the United States, strategists have misunderstood the proper role of fortifications. Instead of making a fortification system part of the defense of the nation they depended on it to constitute the entire defensive structure of the nation. This line of thinking and reasoning gave birth to an American fortification tradition responsible for constructing a system of works only capable of acting as a hollow shield for the majority of its service life. Once constructed, military planners erroneously assumed they would always be in a state of continuous readiness to defend America's shores. This inflexible methodology of defense planning

became responsible for creating fortifications insufficiently resourced and not technologically capable of countering the offensive capabilities of potential foes.

This study has demonstrated America's failure to use several systems of permanent seacoast fortifications to most economically shield the nation's vital harbors and estuaries and meet its long-range defensive needs between the War of 1812 and World War II. Throughout history the means of conducting coastal defense operations have radically changed over time. However, twice within the military history of this country, these fortifications systems would eventually resemble a hollow shield over time, unable to adequately defend America when called upon. Individually, the development of rifled ordnance before the Civil War and the increasing use of the airplane and continuing advances in naval gunnery made two succeeding generations coastal fortification systems obsolete in a matter of a few years.

The building of a coastal defense system properly resourced to meet any perceived threat within imposed fiscal restraints became the army's primary challenge. Over the years, the ambitions of the engineers to build several systems of large, complex coastal fortifications were never realized. Planning considerations would always exceed the ability of the nation to finance construction costs and provide adequate amounts of trained manpower and advanced armament. Modernization of a coastal defense system throughout its service life often did not keep pace with the technological developments being introduced to warfare. Economic limitations forced defense planners to continually resource, maintain, and expand obsolete coastal fortification systems for several decades until engineers could design and obtain the financial resources to build and equip a more modern version capable of countering existing technology. Funding to finance

improvements and install new types of seacoast artillery to keep pace with emerging threats was a recurring problem never adequately solved.

Once the use of forts became the cornerstone of American coastal defense policy, the army consistently experienced difficulties incorporating the lessons from previous conflicts into the design and development of the succeeding generation of fortifications. American coastal fortifications, as illustrated by the fortifications constructed on the island of Corregidor, were only capable of countering a naval threat to the areas they were tasked to defend. Never designed to counter a land threat, American coastal fortifications throughout their existence were always vulnerable to massed artillery fire and aerial bombardment once an enemy force became established ashore. Instead of integrating the use of coastal fortifications into the entire defensive structure, our coastal fortifications were fully expected to defeat the enemy without any assistance from other elements of the army. Competition and bureaucratic infighting between the engineers, artillery, and the ordnance department for control of fortification operation and standardization prevented further efforts by the army to fully integrate the potential defensive uses of fortifications.

This methodology of the use of coastal fortifications continued to dominant the planning of American defensive strategy and coastal defense doctrine for over one hundred and fifty years. Ultimately, decades of insufficient resource allocation and flawed coastal defense policy decision making during the generational development of the fortification system would lead to its systematic failure to adequately defend the United States during the Civil War and World War II.

CHAPTER 5

THE AMERICAN FORTIFICATION SYSTEM IN RETROSPECT

The record shows that American military organizations have often failed to anticipate and adapt to changes in the nature of warfare. The United States Army's experience with its coastal fortification system is a case in point. The army's peacetime failure to recognize the need for change led to the loss of individual installations in time of war. An institutional pattern of insufficient resource allocation and flawed coastal defense policy decision made during the generational development of the fortification system was mainly responsible for its systematic failure. The reduction of Forts Pulaski and Sumter by Federal forces during the Civil War and the Japanese Army's destruction of the seacoast artillery batteries fortifying the island of Corregidor in early 1942 are examples of defeats resulting from the inability of the military to make sufficient change over time. The American fortification system became the victim of a repeating cycle of inflexible defense planning, insufficient resourcing, and a general lack of awareness of the emerging technological advances in other areas of warfare having the potential to influence future methods of coastal fortification.

Some of those same patterns exist within the military today. Similar to the experiences of past generations of engineers and artillerists responsible for economically designing a viable system of coastal fortifications, the present day leadership of the army is faced with some of the same factors when attempting to create a force structure capable of operating within the entire spectrum of warfare. In an environment of limited defense budgets and continuously changing international commitments, force developers and integrators are presently attempting to overcome fifty years of organizational and

doctrinal concepts used to train and equip the army to fight large-scale, combined arms maneuver battles against potential opponents during the Cold War. They are initiating a time consuming process to shape a new force structure capable of quickly deploying to the far reaches of the world to perform the emerging types of non-traditional missions such as humanitarian relief, peacekeeping, and nation building. While military engineers were unable to consistently convince Congress to appropriate the necessary financial resources to construct new fortifications in a timely manner, today's military leaders face similar challenges when attempting to generate Congressional support for needed force structure modernization.

Rather than repeating historical mistakes, modern military leaders need to learn the lessons from our past experiences and appropriately apply them to the military force structure responding to the contingencies of future conflicts. When exploring the historical use of coastal fortifications within the United States one sees some very striking parallels with efforts to restructure today's army. The army has had limited success in using heavy, mechanized units developed and structured over the course of five decades to meet the requirements for light, mobile forces capable of performing the emerging non-traditional missions. The military's attempt to use the same force structure to perform two very diverse missions has been difficult at best and it has taken almost a full decade to realize a significant change was required within the force structure of the army.

Modern force developers and integrators must use the examples provided by the historical use of coastal fortifications to prevent repeating mistakes of the past. Military engineers originally responsible for devising plans for future fortifications systems did

not recognize or apply the correct lessons from the use of coastal defenses. Each succeeding system of coastal fortification was inflexibly planned and designed to support the original and traditional functions of coastal defense in practice since the War of 1812. These defenses were conceived to protect important ports and naval bases from attack or bombardment, merchant shipping within sight of the coast, and intercoastal trading vessels using inland waterways. The coastal fortification systems in use in the United States from 1812-1950 were designed to defend against a naval attack. However, American defensive strategy never incorporated the use of coastal fortifications to delay an invasion until the rest of the army could be mobilized to contain and defeat the enemy. Fortifications were designed to stand alone against an opposing naval force and consequently American harbor defenses were quickly overwhelmed when subjected to artillery fire from an enemy force operating on land.

The Endicott Board recognized the need to change the traditional means of coastal defense used by Third System installations, but the board did not recognize the correct lessons brought to light from the reduction of Forts Pulaski and Sumter. The failure of these installations to protect the coastal environs they were tasked to defend demonstrated a need for future coastal fortifications to be incorporated into a strategy involving the entire military in the defense of American coastal cities from foreign invasion. Instead the installations to emerge from the deliberations of the Endicott Board preserved an American fortification tradition dating back more than seventy years. This cycle of ambitious planning contained concepts for fortifications that would take decades to construct and accelerating costs due to funding constraints within the military budget. Once the foundation of a fortification plan was adopted and executed, it became

inflexible in nature and would suffer from insufficient resources in material, funding, and manpower from either the army or Congress. These fortifications would eventually become static in nature and incapable of absorbing or countering new technological advances introduced into warfare.

For all intents and purposes, the construction of the Endicott fortifications within the United States and the efforts of the succeeding Taft Board to extend the protection of the system to our overseas possessions only preserved methods of coastal defenses already out of date. Instead of enhancing the ability to continue defending vital coastal cities from an attack by combined enemy land and naval, and eventually air forces, the entire Endicott system only upheld the traditions of the past. Several naval technological advances in ordnance, construction, and propulsion systems would finally overcome the defensive capabilities of the fortifications designed to keep naval threats at arms length from important coastal cities. American fortifications were never able to overcome the ever-widening naval technological gap and attempts to modify existing installations became reactionary in nature. The increasing use of the airplane would further limit the effectiveness of coastal fortifications in the future. The new system was clearly similar or identical in most respects to the coastal defense systems proposed by various Boards of Engineers over the last century. Unfortunately, it marked the beginning of another cycle of coastal fortification planning responsible for developing a system that would become obsolete before it was completed. This system of defense continued to serve until the end of World War II. Its shortcomings became evident and were exposed during the Japanese siege of Corregidor.

At the end of World War II, military planners discontinued the use of coastal fortifications when they finally realized their limitations to continue to defend the United States when airplanes, naval forces, mechanized ground formations, and emerging missile technology could more economically conduct the same mission. Some of the elements of inflexible defense planning and a lack of technological awareness responsible for the development of a model of insufficient resource allocation and flawed coastal defense policy decision making during the generational development of the fortification system are also present in today's military environment. To prevent the systematic failure of future defensive strategies and systems to adequately defend the United States during a future war, modern force developers and integrators as well as military strategists need to absorb the historical lessons of coastal fortifications when more modern parallels such as Homeland Defense, National Missile Defense, and the expanding proliferation of Weapons of Mass Destruction are starting to emerge. Military planners of today also need to consider the historic parallels of the past when attempting to implement viable solutions and field defensive systems to counter modern military problems in the same political and economical environment seen during the development of America's coastal defenses. Many of these new modern concepts will be responsible for defending the same traditional principals responsible for the construction of coastal fortifications systems over a period of one hundred and fifty years. As the United States Army continues to create and shape the environment needed to change its organizational and doctrinal base, absorbing the lessons from its previous experiences in developing America's coastal defense fortifications will be of tremendous assistance in enhancing its ability to fight and win future conflicts.

ENDNOTES

Chapter 1

[1] Robert Leckie, foreword to *Corregidor: The Saga of a Fortress*, by James H. Belote and William M. Belote (New York: Harper and Row, 1967), vii.

Chapter 2

[1] Homer R. Oldfield, "The Passing of Permanently Emplaced Artillery," *Journal of the United States Artillery* 52, no. 4 (April 1920): 316. This prize-winning article from the *Journal of the United States Artillery* Essay Competition of 1919 advocates the conversion of American Seacoast Artillery to Railway mounted guns due to the evolutionary obsolescence of seacoast batteries permanently mounted in fixed fortifications.

[2] Ibid., 316.

[3] Ibid., 316.

[4] Graham A. Cosmas, "San Juan Hill and El Caney, 1-2 July 1898," in *America's First Battles, 1776-1965*, ed. Charles E. Heller and William A. Stofft, Modern War Studies Series, ed. Theodore A. Wilson (Lawrence, KS: University Press of Kansas, 1986), 109.

[5] Marguerita Z. Herman, *Ramparts: Fortification from the Renaissance to West Point* (Garden Park City, NY: Avery Publishing Group, 1992), 156.

[6] Emanuel R. Lewis, *Seacoast Fortifications of the United States: An Introductory History* (Annapolis: Naval Institute Press, 1970), 37.

[7] Ibid., 37.

[8] Ibid., 21-22; and Harold L. Peterson, *Round Shot and Rammers: An Introduction to Muzzle-Loading Artillery in the United States* (South Bend, IN: South Bend Replicas, 1969), 74-8.

[9] Ibid., 25.

[10] Ibid., 37.

[11] Herman, 134.

[12] Lewis, 31.

[13] Ibid., 32.

[14] Herman, 136.

[15] Lewis, 32-3; Peterson, 74-8; and Warren Ripley, *Artillery and Ammunition of the Civil War* (Charleston, SC: The Battery Press, 1984), 17-44.

[16] Herman, 140-1.

[17] Ibid., 156.

[18] Lewis, 36-7.

[19] Herman, 141.

[20] Lewis, 37.

[21] Herman, 156-7. Totten, the army's Chief Engineer from 1838 to 1864, exerted considerable influence on the construction of military fortification for most of his military career. He was directly involved with the planning, design, and construction of seacoast fortifications for the twenty-six years he served as the Chief Engineer. He spends a considerable amount of his professional career refining the design of casemate embrasures. His design configurations were revolutionary in comparison to examples found in European fortifications. See Lewis, *Seacoast Fortifications of the United States*, pp. 43-5. The Third System has been referred to as the Totten System because of his influence on the completion of the coastal defense system that guarded the country up the time of the Civil War.

[22] Lewis, 38. Board members conducted an extensive survey of the coast and land and water routes in the interior of the country. Extensive on site surveys were conducted as well as consultation with individual engineers. The American State Papers, vol. 2, contains extensive details concerning the activities and reports of the Bernard Board.

[23] Herman, 157; and Lewis, 38.

[24] David A. Clary, *Fortress America: The Corps of Engineers, Hampton Roads, and United States Coastal Defense* (Charlottesville, VA: University Press of Virginia, 1990), 39.

[25] Lewis, 39, 43.

[26] Ibid., 42-3.

[27] Herman, 158, 160.

[28] Lewis, 45, 52-3.

[29] Clary, 39.

[30] Ibid., 39-40.

[31] Ibid., 40.

[32] Ibid., 39.

[33] Herman, 158.

[34] Lewis, 39.

[35] Herman, 158. These batteries consisted of about twenty gun positions on average constructed in a linear fashion but a few were of a circular, semicircular, or crescent shape. Guns could be barbette or casemate mounted depending on the importance of the battery and the amount of funds available for construction. Another design form used mostly in the southern states, was the construction of tower batteries, known as Martello towers. Normally of circular design, these towers would mount only a few guns to provide all-round fire.

[36] Clary, 37, 40-2. The Bernard Board is also referred to as the Board of Engineers. See Clary, *Fortress America*, pp. 37-47 for a more detailed discussion concerning the mission of the original Board of Engineers and Chief Engineer Totten's struggle to gain financial support from Congress to complete construction of the Third System of Fortifications.

[37] Ibid., 42.

[38] Ibid., 43.

[39] Ibid., 44.

[40] Ibid., 44-5. A major issue that complicated the fortification program during the 1830s and 1840s was the provision of adequate housing for soldiers to garrison the fortification after construction was completed. Chief Engineer Totten believed that casemates were adequate enough to provide for all of the accommodations requirements for troops assigned to defend each work. The Corps of Engineers thought that the construction of barracks was beyond their concern and would interfere with the fields of fire of gun emplacements. Opponents argued that troops living in casemates would be

cramped and unhealthy. The issue was further complicated, by the assignment of barracks construction to the Quartermaster Department beginning in the mid-1820s. Army leaders continued to argue over the issue for the next thirty years. Housing for troops was finally incorporated in the design on new fortifications being built in the 1850s. See Clary, *Fortress America*, pp. 44-5 for a more detailed discussion. Many articles written by medical professionals concerning the overall health of troops living in fortifications and the development of field sanitation appeared in professional army journals, such as the *Journal of the United States Artillery* beginning in the late 1870s.

[41] Ibid., 45-6. Fortification construction competed against funding requirements to fight the Mexican War in 1847. Secretary Marcy continue to advocate continued funding to complete projects underway, while Chief Engineer Totten warned that completion of the program was several years away. The impact of extending the fortification system to the West Coast started to impact on the completion of the system currently under construction as the country continued to expand westward.

[42] Ibid., 46. Chief Engineer Totten continue to press forward with completing all the aspects of the original Board of Engineers plan. He also began to make plans for new works as well. The Corps of Engineers continued to be plagued by shortages of trained engineers to supervise the completion of construction. Harbor and river improvement projects continued to compete for qualified engineers. Most of the fighting strength of the army was stationed in the West or in Florida. Many of the permanent stations in the east did not have garrisons assigned to them. Also the lessons observed from the Crimean War concerning the use of fortifications and the development of steam-powered ships and larger guns were beginning to have an impact on the development and design of fortifications in the 1850s. See Clary, *Fortress America*, pp. 45-47 for a more detailed discussion.

[43] Ibid., 46. The Board of Engineers established for the Atlantic Coast warned that steam-powered warships would make enemy fleets more maneuverable and more difficult for coastal fortifications to defeat.

[44] Ibid., 46.

[45] Ibid., 47.

[46] Herman, 162. Herman argues that the overall encompassing fortifications schemes proposed by the various Boards of Engineers was never achieved, but were significant for several reasons. First, was the establishment of a distinct form of American military architecture that understood the theoretical basis of all the best systems of fortifications and then adapted what was most useful to the American landscape. Second, these forts were designed to be durable and expensive, and despite the ravages of the Civil War, many remain standing to the present day. Their obsolescence could not be foreseen, so their design could not be criticized.

Chapter 3

[1] Jon Stephenson, "Deterrence In Stone: Seacoast Fortresses of the 19th Century," *Periodical: Journal of America's Military Past* 20, no. 2 (Summer 1993): 10.

[2] Robert S. Browning, *Two If By Sea: The Development of American Coastal Defense Policy* (Westport, Conn.: Greenwood Press, 1983), 106.

[3] Stephenson, 10. The author uses the following quote from Emanuel Lewis to summarize this principal, "Fortifications of the sea-coast type were to a large measure intended to make the coast of any invasion so unattractive logistically as, hopefully, to discourage the undertaking altogether; or, failing that, to render the invasion as difficult and onerous as possible."

[4] Ripley, 13-43; Peterson, 74-80; Browning, 106; and Lewis, 53-8.

[5] Stephenson, 11-3; and Browning, 106.

[6] Browning, 107.

[7] Stephenson, 13. Brick and stone were very resistant to natural erosion and their use as construction material for a fort justified the expense when engineers were looking for the most durable material available. Casemate construction was also enhanced when brick and stone were used. This allowed the Bernard Board to design fortifications consisting of several tiers of cannons in order to concentrate the maximum amount of firepower along a particular face of the bastion.

[8] Browning, 107. Most of the large first-rate warships found within Napoleonic fleets were called Ships-of- the-Line. These vessels were armed with anywhere from 64-120 guns arranged along two or three separate gun decks similar to the tiers of casemates founds within masonry fortifications. Thirty-two pound guns would be found on the lover decks while twenty-four pound guns were the main armament of the main deck. Each warship of this type would required up to 800 men to properly man all the armament. In comparison, American coastal fortifications of the period were normally armed with 42-pounder cannons capable of firing a shot with greater accuracy and range.

[9] Lewis, 53-8.

[10] Stephenson, 15.

[11] Ripley, 13-43; Lewis, 53-8; and Stephenson, 15. The development of American ordnance began anew in 1819 when model numbers first appeared in the United States Army. Older models of ordnance continued to serve within American

fortifications, but were often below the new standards being set for ordnance and would be phased out as soon as replacement became fiscally feasible and practicable.

[12] Ripley, 13-43; Peterson, 74-80; Browning, 107; Lewis, 58; and Stephenson, 15.

[13] Lewis, 58; and Stephenson, 15.

[14] Lewis, 58. Foreign manufacturers spent much of this time period trying to develop innovations to artillery beyond the current capabilities of metallurgy and manufacturing.

[15] Stephenson, 15-6.

[16] Lewis, 59. The new Columbiads could also be mounted in several different areas of a fortification. They would be found mounted in low-level casemates, upper level barbette tiers, and elevated earthen batteries throughout the American Civil War.

[17] Stephenson, 16.

[18] Lewis, 59-60.

[19] Stephenson, 16; and Lewis, 60. See Ripley, *Artillery and Ammunition of the Civil War*, pp. 87-107 for a more detailed discussion concerning the types of weapons manufactured, and photographic examples of cannons developed by John Dahlgren.

[20] Ripley, 78-82; Peterson, 101-4; Lewis, 60-1; and Stephenson, 16. See Ripley, *Artillery and Ammunition of the Civil War*, pp. 78-82 for a more detailed discussion concerning the manufacturing process and photographic examples of cannons developed by Thomas Rodman.

[21] Stephenson, 16. See Ripley, *Artillery and Ammunition of the Civil War*, pp. 109-26, and pp. 127-36 for a more detailed discussion concerning the types of weapons manufactured and photographic examples of cannons developed by Robert Parrott and John Mercer Brooke, respectfully.

[22] Ibid., 17.

[23] Browning, 113-4.

[24] Ibid., 114.

[25] Stephenson, 17.

[26] Browning, 110. Although not very effective against masonry fortifications, the development of the Paixhan shell gun by the French would assist to alter the traditional shore battery's domination over naval vessels. Paixhan's himself pointed out that the only way to negate the effects of a shell gun during a naval engagement would be to armor the hull of a ship. This rational would help drive the introduction of armored warship in Europe and the United States during the course of the American Civil War.

[27] E. B. Potter, ed., *Sea Power – A Naval History*, 2nd ed. (Annapolis: Naval Institute Press, 1984), 126-9.

[28] Browning, 110.

[29] Ibid, 115.

[30] David Page, *Ships Versus Shore: Civil War Engagements Along Southern Shores and Rivers* (Nashville, Tenn.: Rutledge Hill Press, 1994), 157. This will not be Robert E. Lee's only association with Fort Pulaski. He will revisit the island fortress as a Confederate General and will make a critical decision that will have an enormous impact on how quickly Fort Pulaski will survive Union efforts to subdue it. He also had a tremendous impact on the early construction efforts of the fort. As an assistant to Major Samuel Babcock, the engineer in charge of constructing the huge coastal fortification, he was responsible for designing the series of dikes used to drain the excess water from the marshy island. When his superior became ill, he also surveyed the entire island and selected the final site of the main work.

[31] Robert B. Roberts, *Encyclopedia of Historic Forts: The Military, Pioneer, and Trading Posts of the United States* (New York: Macmillan Publishing Company, 1988), 233.

[32] Walter J. Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," *Journal of the United States Artillery* 40, no. 2 (March-April 1913): 206. Communication with batteries located outside the walls would be through the gorge wall into the demilune over a drawbridge and then through another drawbridge located in one of the faces of the demilune. The scarp of the demilune and the entire counterscarp of the main work were faced with masonry. The walls were constructed to a height of twenty-five feet.

[33] Warren Laing, "The Rise and Fall of Fort Pulaski," *CDSG Journal: The Quarterly Publication of the Coast Defense Study Group Journal* 10 (May 1996): 80. Bernard originally designed Fort Pulaski to hold two casemate tiers and one barbette tier. The marshy ground of Cockspur Island forced the planners to reduce the number casemate tiers by one. Liang's article contains an excellent description of the geometric layout of the installation. Fort Pulaski resembles a truncated hexagon with two side removed and replaced with a gorge wall. The three salient angles (east, northwest, and

southeast) between the four primary faces are cut-off at thirty-degree angles to form pan coupes. At the northwest and southwest angles, demibastions reconstructed to provide protection to the rear facing gorge wall, in addition to the protection provided by the demilune outwork. The casemate tier embrasured twelve guns in each primary face and one in each pan coupe. Each demibastion housed two howitzers, one to cover the gorge moat and drawbridge and one to defend the drawbridge across the demilune moat. Musket ports were also cut into the gorge wall and demibastions to aid in defending the demilune. Definitions of French fortification terms are provided in the glossary.

[34] Roberts, 233.

[35] Liang, 80.

[36] Page, 157.

[37] Roberts, 233.

[38] Peggy Robbins, "Storm Over Fort Pulaski," *America's Civil War* 3 (September 1990): 26-31.

[39] Page, 157.

[40] Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 206-7. At the time of the siege, the fort contained forty-eight Confederate guns of the following types: five 10-inch Columbiads, five 8-inch Columbiads, four 32-pounders, four 24-pounder Blakely Rifle, two 12-inch Seacoast Mortar, and three 10-inch Seacoast Mortars. See Buttgenbach and Schiller, *Fort Pulaski and the Defense of Savannah* for a more detailed discussion concerning the positioning of artillery within Fort Pulaski. See Ripley, *Artillery and Ammunition of the Civil War* concerning the capabilities of certain weapons used during the siege.

[41] Robbins, 26-31; and Liang, 81.

[42] Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 207.

[43] Robbins, 26-31; and Roberts, 233.

[44] Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 210.

[45] Liang, 81.

[46] Liang, 82. Federal artillery aimed at Fort Pulaski from Big Tybee island consisted of the following types: Four 10-inch and twelve 13-inch Seacoast Mortars, four 8-inch and six 10-inch Columbiads, five 30-pounder Parrott Rifles, and James Rifles

described as one 48-pounder, two 64-pounders and two 84-pounders. See Buttgenbach and Schiller, *Fort Pulaski and the Defense of Savannah* for a more detailed discussion concerning the positioning of the artillery batteries arrayed against Fort Pulaski. See Ripley, *Artillery and Ammunition of the Civil War* concerning the capabilities of certain weapons used during the Federal reduction of Fort Pulaski.

[47] Liang, 82.

[48] Page, 158.

[49] Liang, 82-3; Robbins, 26-31; and Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 211-2.

[50] Liang, 83; and Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 213. A total of 3,543 shells were fired from the guns and 1,732 shell from the mortars. See Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 213 for more details concerning the use of ordnance material by the Federal batteries during the siege

[51] Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 213.

[52] Liang, 84.

[53] Ibid., 83.

[54] Ibid., 84.

[55] Buttgenbach, "Coast Defense in the Civil War: Fort Pulaski, Georgia," 215.

[56] C. D. Edmondson, "The Bombardment of Fort Sumter, August 17-23, 1863," *The Quartermaster Review* 15, no. 1 (July-August 1935): 17.

[57] Roberts, 723.

[58] U.S. National Park Service, *Fort Sumter: Anvil of War* (Washington D.C.: The Government Printing Office, 1984), 10-1. The nature of the land dispute responsible for halting construction between 1834-41 was the bestowing by the state of South Carolina of a vague land grant in Charleston Harbor to William Laval. As a local resident of Charleston, Laval promptly claimed the site where the Federal government was constructing Fort Sumter. The State Attorney General would invalidate Laval's claim in 1837. The government of South Carolina would also question, "whether the creation of an Island on a shoal in the channel, may not injuriously affect the navigation and commerce of the Harbor." Another issue was raised as to what authority the Government had to begin construction on the site without it being formally deeded to the Federal

government. The Federal government was acting under the assumption that a formal deed of cession to "land" ordinarily covered with water was not required. Construction operations were started at the harbor mouth without state approval. The Federal Government would not receive clear title to the land until November 1841.

[59] Roberts, 723. Brigadier General Thomas Sumter was known as the "Carolina Gamecock" during the American Revolution.

[60] Edmondson, 17.

[61] U.S. National Park Service, *Fort Sumter: Anvil of War*, 11-3; Roberts, 723. Two tiers of casemates extended along four of the walls. The gorge wall was occupied by the three story officer quarters and only mounted cannons on the terreplein. Barracks for the enlisted personnel of the garrison were constructed in parallel to the gunrooms on each flank wall. The sally port in the gorge wall opened on to a wharf and a twenty-five and a half foot-wide esplanade extending the length of the wall.

[62] Roberts, 723.

[63] U.S. National Park Service, *Fort Sumter: Anvil of War*, 13.

[64] Page, 122-3.

[65] J. L. Holcombe and W. J. Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (First Attack)," *Journal of the United States Artillery* 37, no. 2 (March-April 1912): 169-71. The *Star of the West* departed New York on 5 January 1861 and arrived off the Charleston bar on 9 January. The firing by shore batteries on the ship could be looked at as the first hostile action against the federal Government by a seceding state by denying the government an opportunity to land store and reinforcements for the garrison. See U.S. National Park Service, *Fort Sumter: Anvil of War* and Castel, "Fort Sumter – 1861." *Civil War Times Illustrated* 15, no. 6 (October 1976) for a detailed narrative of the events concerning the events and activities leading up to the first attack on Fort Sumter.

[66] U.S. National Park Service, *Fort Sumter: Anvil of War*, 23-4. The total of 3,700 Confederate troops would eventually garrison Charleston, with approximately 800 of them being responsible for manning all fortifications, shore batteries, and ironclad batteries ringing Fort Sumter.

[67] Ibid., 18.

[68] Holcombe, 173-5. To man Fort Sumter's 135 guns, a wartime garrison of 650 men was envisioned. Major Anderson's command consisted of nine officers and seventy-six enlisted men, with an additional forty-three loyal civilian employees of the

Engineering Department remaining to assist the garrison. The work to manufacture cartridge bags progressed slowly. Only six sewing needles were available within the entire garrison for this effort. Any obtainable material, including sheets, blankets, and articles of clothing was used. Despite these shortages about 700 cartridge bags were available for use by 12 April. Additional measures of defense included bricking up unused embrasures, mining the wharf, and building defenses in various locations to prevent an infantry assault.

[69] Ibid., 175-8. This constitutes the total number of weapons capable of firing on Fort Sumter directly. Confederate fortifications also existed to defend other avenues of approach into the harbor

[70] U.S. National Park Service, *Fort Sumter: Anvil of War*, 24.

[71] Holcombe, 175-9. In its new configuration, solid shot often failed to penetrate the walls of Fort Moultrie due to the addition of earthen protection and the use of cotton bales to close off cannon embrasure. Federal gunners considerably overestimated the amount of damage they caused to this fortification. If the shells were used against the embrasures of Fort Moultrie's guns, they may have destroyed the cannons within the embrasures, but the amount of shells available to the garrison within Fort Sumter was extremely limited.

[72] Ibid., 179-83. The use of hot shot by the Confederates caused considerable damage and ultimately limited the volume of return fire from Federal gunners. Once the wooden barracks and officer's quarters were burning, the fires were impossible to extinguish without exposing personnel to the effects of the vertical fire of Confederate mortar shelling. After attempting to remove as much powder from the magazines as possible, the doors had to be closed and covered with earth by the garrison to prevent the flames from consuming the contents. About fifty barrels were moved to the casemates for storage. When the Confederate gunners saw all the smoke and flames from the fires, they redoubled their efforts to increase the amount of hot shot being fired at the fort. Eventually, hot embers flew into the casemates, making it dangerous to store powder within them, causing Major Anderson to order his men to throw the barrels out of the embrasures into the water. The barrels collected on the stone riprap surrounding the walls where it would be exploded by enemy fire.

[73] Ibid., 184.

[74] Ibid., 185-6. See U.S. National Park Service, *Fort Sumter: Anvil of War* and Marvel, *Five Flags Over Fort Sumter* for a detailed narrative concerning the events and activities leading up to the first attack on Fort Sumter and photographs demonstrating the amount of progressive damage sustained by Fort Sumter during the entire American Civil War.

[75] Page, 126-7.

[76] Holcombe, 186.

[77] Ibid., 182; and U.S. National Park Service, *Fort Sumter: Anvil of War*, 24.

[78] Edmondson, 18. Batteries Bee, Beauregard, and Marshall were erected on Sullivan's Island across the channel from Fort Sumter. Fort Wagner (Battery Wagner to Federal forces) and Battery Gregg secured the northern end of Morris Island. Several other smaller and less notable batteries and forts were also placed at critical points surrounding the harbor. Fort Johnson and Castle Pinckney as well as the Battery constructed along the Charleston waterfront provided defense to the inner harbor area. See Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," for more details concerning the location and types of earthen fortifications constructed inside the harbor defenses along with a listing of the ordnance material mounted within them during the course of the war.

[79] Walter J. Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," *Journal of the United States Artillery* 42, no. 2 (March-April 1914): 185-6.

[80] Ibid., 186-7. Other important construction efforts undertaken by the Confederate's consisted of the following: the filling in of the embrasures on the second casemate tier; mounting howitzers to defend the quay and pier from infantry assault; restoring the hot shot furnaces; and rebuilding the cisterns and installing a distilling plant.

[81] Ibid., 189-91. Originally thirty-seven guns and the seven seacoast mortars could be brought to bear on the channel of the harbor, but thirteen ancient smoothbore 32-pounder cannons were counted among this total and would be of little value in the upcoming campaign. Due to the limited amount of facilities within the industrial base of the Confederacy to manufacture large amounts of heavy armament, almost any piece of ordnance was pressed into service no matter the utility it would have to assist in the defense of important locales throughout the south. The actual effective armament of Fort Sumter to defend Charleston against a Federal naval attack consisted of the following: four 10-in Columbiads; two 9-in Dahlgren guns; two 7-in Brooks rifles; eight 8-in Columbiads and navy shell guns; seven 42-pounders, rifled and banded; and one 32-pounder, rifled and banded.

[82] Raimondo Luraghi, *A History of the Confederate Navy* (Annapolis, Md.: Naval Institute Press, 1996), 209-10; and Walter J. Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 187-92. Buttgenbach contains an extensive chronological documentation concerning the types of fortifications constructed by the Confederates and corresponding changes in levels on manning and armament. The *Palmetto State* and *Chicora* were constructed in 1862 and would be part

of the defenses of Charleston until the evacuation of the city in February 1865. The armament of the *Palmetto State* consisted of a battery of one 80-pounder forward, one 60-pounder aft, and one 8-inch shell gun on each broadside protected by four inches of armor plate. The *Chicora* had six guns, two 9-inch smoothbores and four 60-pounder rifles. Neither of these vessels contributed to the defense of the city, but was available to contest the Federal ironclads surviving the gauntlet of fire from the coastal fortifications.

[83] Ibid., 193; and Edmondson, 18.

[84] Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 193.

[85] Jack Greene and Alessandro Massignani, *Ironclads at War: The Origin and Development of the Armored Warship, 1854-1891* (Conshohocken, Pa.: Combined Publishing, 1998), 134-44; Henry F. Church, "The Harbor Defenses of Charleston," *The Military Engineer* 23 (January-February 1931): 14; Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 193-9; Page, 132-4; Edmondson, 18-9; and John Johnson, *The Defense of Charleston Harbor, Including Fort Sumter and the Adjacent Islands, 1863-1865* (Charleston, S.C.: Walker, Evans and Cogswell Company, 1889), 40-75. The attacking Federal fleet mounted a total of thirty-two guns and consisted of the following vessels: *Weehawken*, *Catskill*, *Montauk*, *Nantucket*, *Passaic*, *Nahant*, and *Patapsco*, single-turreted monitors mounting two guns; the *Keokuk*, with two turrets mounting one gun each; and the armored frigate *New Ironsides* mounting 16 guns in broadside. Of the thirty-two guns in the attacking Federal squadron, twenty-two were 11-inch smoothbores, seven 15-inch smoothbores, and only three 8-inch Parrott rifles. Ranges during the engagement varied between 500 to 2,000 yards. The two 11-inch Dahlgren guns of the *Keokuk* would later be recovered by the Confederates in one of the most daring salvage operations of the war. Most of the damage to the Federal vessels resulted from the loosening of rivets from the prolonged battering of the armor plate and causing machinery knocked out of alignment.

[86] Edmondson, 19; Greene, 143-4; and Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 195.

[87] Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 198, 202. Additional damage corrected included remounting of several guns and filling shot holes with fresh masonry. Several damaged embrasures and portions of the parapet and scarp wall required repair as well. Two embrasures were reported destroyed in the attack. Although most of the damage up to this point was cosmetic in nature, the accumulated damage to the fortress was starting to add up. The combat efficiency of the fortification was still near 100 percent.

[88] Church, 14; Edmondson, 19; Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 200; E. Milby Burton, *The Siege of*

Charleston, 1861-1865 (Columbia, S.C.: University of South Carolina Press, 1970): 157-71; Stephen R. Wise, *Gate of Hell: Campaign for Charleston Harbor, 1863* (Columbia, S.C.: University of South Carolina Press, 1994): 75-118; and Johnson, 76-114; Page 135-7.

[89] U.S. National Park Service, *Fort Sumter: Anvil of War*, 36-8; Edmondson, 19; Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 200-4; and Page, 137. The armament in General Gillmore's breaching batteries consisted of two 80-pounder Whitworth Rifles, nine 100-pounder Parrott Rifles, six 200-pounder Parrott Rifles, and one 300-pounder Parrott Rifles. A total of eighteen rifled guns capable of firing a ton of metal at Fort Sumter at each discharge.

[90] Page 137-8; Church, 14; Edmondson, 19-20; Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 205-6; U.S. National Park Service, *Fort Sumter: Anvil of War*, 38-9; Johnson, 115-44; Wise, 154-79; and Burton, 183-210. Johnson refers to this chronology as the "First Great Bombardment of Fort Sumter." He further breaks up each bombardment into periods to focus on particular aspects of the battle. He divides the entire Federal 1864-64 campaign to reduce Fort Sumter into three separate bombardments. Gillmore also mounted a 300-pounder Parrott Rifle in a battery designed to shell the city of Charleston in conjunction with the Federal bombardment to reduce Fort Sumter. Nicknamed the "Swamp Angel," this battery would begin shelling the city on the night of 22 August after General Beauregard refused General Gillmore's demand for the Confederates to evacuate Fort Sumter and Morris Island. After firing on the city over the course of two days, the "Swamp Angel" burst when firing its 36th shell. Blowing the breech out of its jacket, the cannon tube was catapulted forward onto the parapet of the battery landing in a position to deceive the Confederates it was still capable of firing on the city. A huge expenditure of ammunition and powder would be consumed as a result. See Goldy, "The Swamp Angel" for a more detailed discussion surrounding the influence this weapon had on the course of operations to reduce Fort Sumter and force the surrender of Charleston.

[91] Church, 14; Edmondson, 20-1; and Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 206-7.

[92] Church, 14; Edmondson, 21; and Buttgenbach, "Coast Defense in the Civil War: Fort Sumter, Charleston, S.C. (Subsequent Attacks)," 212.

[93] Roberts, 234, 723.

[94] Clary, 104-5.

[95] Ibid., 98.

[96] Ibid., 66.

[97] Ibid., 66-8.

[98] Chester G. Hearn, *Admiral David Glasgow Farragut: The Civil War Years* (Annapolis, Md.: Naval Institute Press, 1998), 71-113, 248-303; Chester G. Hearn, *The Capture of New Orleans, 1862* (Annapolis, Md.: Naval Institute Press, 1995), 197-236; Browning, 115-7; Greene, 94-107,157-75; and Luraghi, 155-63, 322-9.

[99] Clary, 69.

[100] Browning, 121-2. Using a spar mounted torpedo, the *David* attacked the *New Ironsides* outside of Charleston harbor in October 1863. The *New Ironsides* would be put out of action for a year due to the damage caused by this attack. The *Hunley* sank the warship *Housatonic*, outside of Charleston, while it was part of the Federal blockading squadron. The *Hunley* would also be lost during the course of its attack.

[101] Ibid., 123.

[102] Stephenson, 18.

Chapter 4

[1] Leckie, vii.

[2] Ibid., viii. The perceived use of the Maginot Line by the French and the fortress mentality reasoning used by the British to defend the city of Singapore serve as additional examples by popular democracies to develop static fortification systems at the expense of modern armies.

[3] Browning, 128; and Clary, 108.

[4] Lewis, 67-8.

[5] Browning, 128-9; and Clary, 108-9.

[6] Lewis, 68; Clary, 110; and Browning, 133-4.

[7] Lewis, 68; Clary, 109-11; and Browning, 131-3, 135.

[8] Clary, 110; and Browning, 131. The primary assumptions made by engineers concerning the design of future fortifications would be artillery fire alone could not prevent the passage of a fleet through a channel and a series of physical obstructions and supporting auxiliary systems would also be required fortifications.

[9] Lewis, 69-70; and Browning ,134.

[10] Lewis, 70; and Browning 134-6, 141-2.

[11] Lewis, 70; and Browning 141, 143-4; Clary, 113-4.

[12] Browning 148-51. Concern for the overall condition of the seacoast defenses of the United States started increasing in 1881 when Congress substantially raised the amounts of funds committed to the development and manufacture of the new seacoast artillery. The Naval Appropriations Bill for 1883 authorized a joint board of army and navy officers to recommend the location of a National Gun Foundry and to study suitable methods of manufacture. Congress mandated the Endicott Board to include two civilians in addition to the Secretary of War, two naval line officers (rather than staff) officers, two army ordnance officers, and only two members of the Corps of Engineers. The intent of Congress was to develop a board free from the existing methods of determining the construction of fortifications by allowing a larger range of opinions among the membership of the board. This departure from the normal Boards of Engineers, signaled the erosion of the span of control traditionally exercised by the Corps of Engineers to influence the building of entire systems of fortification.

[13] Lewis, 75-7, 88; and Browning, 136, 139-41.

[14] Browning, 138-40; and Lewis, 75. Not until after the publishing of the findings of the Endicott Board in the late 1880s would American industry and the national gun factories have the capability to produce the heavy forgings and develop the machining techniques required to meet the standards to produce substantial numbers of these lighter, stronger, and more powerful weapons. When this industrial capacity fully matured, it would become the key to unlocking the Congressional appropriations required to fund the fortification system envisioned by the Endicott Board.

[15] Lewis, 76. With these new propellants, it will be possible to control the burning rate of powder by varying the size of the individual grains to maintain the controlled production of gases within the bore of the weapon for a predicted time period to assist in accelerating the projectile along the length of the barrel. Older gunpowder regardless of the size of the grains is instantly consumed while the projectile is still in the bore of the weapon.

[16] Bolling W. Smith, "An 1886 British Perspective on Muzzleloading and Breeechloading Artillery," *CDSG Journal: The Quarterly Publication of the Coast Defense Study Group* 14, no. 1 (February 2000): 71. The author based his analysis of both types of weapons on the British experience documented in *Treatise on the Manufacture of Guns and Text-Book of Service Ordnance*, Third Edition, Printed for Her Majesty's Stationary Office by Harrison and Sons, London, 1886. This edition was

printed the same year the report from the Endicott Board was published. Similar conclusions can be made when comparing American muzzle-loading and breech-loading artillery systems.

[17] Lewis, 64-5. Only fractions of the projected number of Endicott batteries were completed in time for the start of the Spanish-American War in 1898. Some emergency fortifications were erected at the start of the war to temporarily guard cities of the US Eastern Seaboard and Gulf Coast using old muzzle-loading 10-in Rodman Cannons until the projected Endicott batteries were completed.

[18] Smith, "An 1886 British Perspective on Muzzleloading and Breeechloading Artillery," 71-2.

[19] Ibid., 72.

[20] Lewis, 76. Initial American efforts to develop a disappearing carriage began in 1870 and will take several attempts over a period of twenty years to fully develop this method of mounting ordnance. This type of carriage and several types of barbette carriages will be used to mount the weapons found in most of the batteries constructed during the Endicott era.

[21] Browning, 140-1; and Lewis, 88.

[22] Browning, 158.

[23] Ibid., 159-60.

[24] Clary, 129-30; Browning, 160-1, 167; and Lewis, 77. The total estimate of the entire system was $126,377,800 in 1885 dollars. Construction of permanent batteries and armament would cost $93 million, while the rest of the systems was estimated to cost an additional $19 million for floating batteries, $10 million for torpedo boats, and $4 million for submarine mines.

[25] Clary, 130-1; and Lewis, 77.

[26] Clary, 131.

[27] Lewis, 77-8.

[28] Browning, 173-5; Lewis, 78; and Clary, 132. Although barbette carriage would still be used to mount the new family of weapons in some cases, the Buffington-Crozier carriage would eventually be adopted in various models to mount the majority of 8-inch, 10-inch, and 12-inch heavy rifle within most of the Endicott batteries. Developed and named after the two Ordnance Department officers, this carriage operated by means of a

counterweight sinking into a well beneath the gun to raise and lower it behind the parapet of the battery.

[29] Lewis, 78. Lewis calculated a new Endicott battery structure for two 12-inch heavy rifle would cost roughly $100,000 in 1900 while the guns and carriages by themselves would amount to approximately $180,000 without the addition cost of ammunition and propellant needed to fire the weapon. In comparison, Lewis further calculated the total cost of seventeen Third System forts to amount to $14 million while the cost of the installed armament (to include 100 rounds of ammunition per weapon) amounted to $2.33 million. Prior to 1890 the cost of a carriage was approximately one-third of the cost of the weapon to be mounted. From this time forward the costs would be approximately equal between the two items.

[30] Clary, 130; and Lewis 78-9.

[31] Norman Friedman, *U.S. Battleships: An Illustrated Design History* (Annapolis, Md.: Naval Institute Press, 1985), 189-91. Most navies of the world will not start to increase the elevation capabilities of gun turrets until after World War I. The new restrictive environment of the Washington Naval Treaty of 1922, will make the installation of this new capability an interpretive issue, delaying conversions within the U.S. Navy for several years.

[32] Clary, 130; and Lewis 79.

[33] Potter, 158. As the size and firepower potential of naval rifles increased at the end of the nineteenth century, ship designers began to concentrate the weapons in the central portion of the ship where thicker armor protection could be concentrated. Ships no longer need to have armor installed everywhere to protect the traditional broadside locations of guns. The barbette wall located beneath the gun turrets gave further armor protection to the ship's weapons. Eventually, only reasonable protection could be provided to gun turrets, magazines, machinery spaces, and the waterline as naval guns continued to increase in size and firepower throughout the Endicott period. Initial battleship designs would sacrifice armor protection along the horizontal decks to reinforce armor protection along the side of the ship. American fortifications planners used seacoast mortar installations to provide plunging fire to take advantage of this weakness. Ship designers would eventually counter this capability by reinforcing the horizontal armor protection of vital spaces to negate this advantage of seacoast fortifications and when the elevation capabilities of gun turrets were improved to such an extent to increase the trajectories of shells fired by traditional naval ordnance.

[34] Lewis, 79.

[35] Browning, 175-7; Lewis, 79, 83; and Clary, 131. The Endicott Board would recommend a total of 726 12-inch mortars to be installed, but only 376 would eventually be installed in various fortifications within the United States and overseas.

[36] Browning, 175; and Lewis, 83. Lewis and Browning calculate over 500 of these cannons were installed in batteries beginning in 1896. Depending on the time period considered, the actual number of weapons installed for these purposes was probably much higher when guns were being installed in Endicott installations to counter Motor Torpedo Boats, Aircraft, and for beach defense against amphibious landings later in the twentieth century.

[37] Lewis, 88. These were stored ashore to prevent deterioration of the miles of control cables needed to control the detonations of individual mines. Other equipment requiring extensive maintenance were the fire control stations, mine and cable storage facilities, and the wharves used to load mines onto mine planters.

[38] Clary, 133. Watervliet Arsenal is located in New York state. Another federal facility will also be established to manufacture similar weapons exclusively for the navy.

[39] Browning, 170. Browning argues the amount of funding being approved for coastal defense construction would be influenced by the political party controlling the majority within Congress. Funds for fortifications would sharply fall off when the Democrat party controlled while a Republican controlled Congress would correspondingly increase potential funding for the building of Endicott defenses.

[40] Clary, 135; Browning 170; Cosmas, 109; Potter, 176-8; and G. J. A. O'Toole, *The Spanish War: An American Epic 1898* (New York: W. W. Norton and Company, 1984), 194-5, 209, 210. Word of the sortie of the Spanish Fleet to the Caribbean caused a war scare along the entire eastern seaboard. Americans were convinced the Spanish fleet would cruise up and down the entire coast laying waste to their homes by naval bombardment and merchants feared the total destruction of merchant commerce. The army and the navy received tremendous pressure from concerned groups of citizens to provide each locale with the highest level of protection possible in the limited time available. Most of the American battle fleet would be tied to the coast for much of the early part of the conflict until Cervera's squadron was located. Old 15-inch Civil-War era Rodman cannons would be used in temporary emergency fortifications for the duration of the war to augment the uncompleted Endicott fortifications.

[41] Browning, 170-1.

[42] Ibid., 171-2. Planning for the defenses of New York included an array of twenty-one 12-inch, fifteen 10-inch, and nine 8-inch heavy rifles supported by 176 12-inch mortars and vast fields of controlled submerged mines and additional floating

defenses. Similar numbers of weapons were envisioned for the harbor defenses of Boston and San Francisco.

[43] Ibid., 173.

[44] Clary, 135-7. In the end the engineers would loose most of the power they traditional held within the army hierarchy to determine the course of fortification planning. The artillery would eventually gain control over devices needed to accurately control the fire of the new weaponry and would oversee the incorporation of electricity and advanced communications devices within the emplacements. They would also win the contest with the engineers to be the branch responsible for the technical maintenance and the tactical planning for the emplacement of electrically controlled submerged minefields within the defenses. The Ordnance Department will eventually use civilian manufacturing facilities to a greater extent to augment the production capabilities of the federal gun factories to ensure the demand of gun barrels for the new emplacements could be meet on a timely basis.

[46] Ibid., 136.

[47] Browning, 173.

[48] Clary, 136.

[49] Ibid., 137-8.

[50] Browning, 178.

[51] Lewis, 89; Clary 138, 148-9; and Browning, 183. Another way to summarize the intentions of the Taft Board would be to determine if the expense undertaken by the government to build the incomplete Endicott System still provided an effective method of coast defense for the United States and to determine the necessary changes for the entire system while extending its coverage to the new overseas possessions.

[52] Clary, 149-50.

[53] Browning, 183.

[54] Lewis, 89, 93; Clary 149-51; and Browning, 184. The base end station method of fire control would emerge as the most precise method of optically firing weapons within the Endicott system until the end of World War II. Two or more widely separated sighting stations known, as base-end stations would use optical instrumentation to provide a stream of continuous bearings to the target to the central plotting room within each individual battery. The bearings would be plotted to determine the future predicted position of the target. Additional factors such as the meteorological factors influencing

the ballistic flight of the projectile, changes in target position during the time of flight of the shell, and the necessary time delay in transmitting the data to the gun battery would be included in the gun-laying calculations sent electrically to the gun crews.

[55] Lewis, 94. The recommended locations included Manila and Subic Bay in the Philippines; Guam; Pearl Harbor and Honolulu in Hawaii; Kiska Island in Alaska; Guantanamo, Cuba; San Juan, Puerto Rico; and both entrances to the Panama Canal.

[56] Clary, 150-1; and Lewis, 94. Prior to World War I, fortification engineers would redesign mortar batteries by first reducing the number of pits per battery and then the total number of weapons contained in each pit. The early four pit batteries containing sixteen weapons were divided in half beginning in 1906 into batteries containing two pits housing a total of eight weapons. A few years later, each individual pit would be reduced from four weapons to a total of two mortars per pit. Weapons were actually removed from the emplacements of existing installations while designs for new installations being constructed overseas were designed as with pits originally containing two weapons each.

[57] Clary, 151-2.

[58] Joseph Russo, *Continental Defense of the United States: A Summary History From the 1700s through 1990* (N. p., n.d.), 16; and Clary, 154.

[59] Lewis, 100-1. Seven out eight seacoast weapons were mounted on disappearing carriages during World War I.

[60] Russo, 17-8; Clary, 154-5; and Lewis, 101.

[61] Russo, 17-8; and Lewis, 101.

[62] Clary, 155; and Lewis, 101. Factions would emerge within the peacetime army after World War I dismissing the future potential of military aviation to inflict damage on the existing fortifications as well as the viability of railroad and mobile artillery weapons within the structure of the Coast Artillery to contribute to repelling a naval threat from the coast.

[63] Lewis, 101-2.

[64] Clary, 158. Antiaircraft artillery continued to be developed at the Coast Artillery school at Fort Monroe as the army's answer to counter the proponents of strategic airpower, lead by General Billy Mitchell. In essence, they claimed future wars would be fought in the air and the industrial infrastructure of potential opponents would be vulnerable to air attack.

[65] Lewis, 102-3; and Clary, 159.

[66] Lewis, 103, 110; and Clary, 159-60.

[67] Lewis, 110-1; and Clary, 160-1.

[68] Lewis, 111, 115; and Clary, 160-1. The new weapons within the same battery were separated by as much as one thousand feet instead of the traditional two hundred feet. Railways would be constructed to connect gun emplacements with widely separated ammunition storage points. Magazines were also dug-in underground to provide additional protection. Although the engineers believed greater laterally dispersion of critical elements of gun batteries was the key to counter advancing naval and aerial technology, the entire emplacement was still very vulnerable t attack by not protecting the actual weapons and key personnel servicing it.

[69] Clary, 162.

[70] Ibid., 160, 162.

[71] Lewis, 115; and Clary, 162-3.

[73] Lewis, 115-6, 118; and Clary, 163. Overseas locations under consideration for the new armament on the eve of America's entry into World War II would be Dutch Harbor in Alaska, Hawaii, The Panama Canal zone, Trinidad, Bermuda, and Canadian bases in Newfoundland. The new 6-inch guns would not be casemated. A gun shield manufactured from four to six inches of steel would enclose them. It would be able to provide the crew with protection from machine gun bullets and light cannon fire. New carriages with similar heavy gun shields would also be designed for mounting a stock of surplus navy 8-inch cannons within the new systems as well. Regardless of the caliber of the battery, all supporting structures such as magazines, electrical generators, communications, and plotting rooms would be constructed under earth enclosed concrete structure located next to the weapons. Despite the introduction of radar guided firing, the use of this new technology in its infancy would require the retention and expansion of the traditional optical fire control systems in use over the preceding thirty years. Base-end stations either constructed underground or camouflaged to look like farm silos or farmhouses would extend up to 50,000 to 60,000 yards north and south of the batteries they supported. Until the completion of standardized structures in the Hawaiian island, army engineers would adopt a surplus stock of navy gun turrets from the battleship *Arizona* and the aircraft carriers *Lexington* and *Saratoga* on concrete foundations similar in construction to Fort Drum in the Philippines.

[73] Leckie, viii; Clary, 163-4; and Lewis, 119, 125.

[74] Louis Morton, *The Fall of the Philippines*, Volume in the United States Army in World War II (Washington, DC: Department of the Army, 1953), 471; and James H.

Belote and William M. Belote, *Corregidor: The Saga of a Fortress* (New York: Harper and Row, 1967), 10.

[75] Morton, 474-8.

[76] Ibid., 476-9; Robert L. Underbrink, *Destination Corregidor* (Annapolis: Naval Institute Press, 1971), 45; and Belote, 10-29.

[77] Morton,479-89, 493-7, 528-37; Belote, 49-57, 84-95; and J. Michael Miller, *From Shanghai to Corregidor: Marines in the Defense of the Philippines*, Volume in the Marines in World War II Series (Washington, DC: Marine Corps Historical Center, 1997).

[78] Morton, 479-89, 493-7, 536-41, 546-53; and Belote, 49-57, 84-95, 108-23, 132-44.

[79] Morton, 479-89, 493-7, 536-41, 546-53; and Belote, 49-57, 84-95, 108-23, 132-44.

[80] Morton, 552-61, 564-74; and Belote, 145-91.

GLOSSARY

Barbette. A platform inside a fortification weapons were mounted on to permit the firing either over the rampart wall or within a protected firing enclosure instead through embrasures located inside the fortification wall.

Breach. A gap in the wall of a fortification caused by enemy bombardment.

Breech. Mass of solid metal behind the bottom of the bore extending to the cascabel.

Breech Block. A moveable piece, which closes the breech of a cannon. Development of the breechblock altered the method of loading ammunition into cannon at the end of the nineteenth century.

Caliber. A measurement used to describe the diameter of the bore of a cannon. It is expressed in inches or in the weight of its spherical shot.

Canister or Case Shot. A bagged or cased round loaded with small bullets or scraps of metal, loaded into a cannon on top of a charge of gunpowder. This type of round was very effective against enemy personnel at close range.

Casemate. A bomb proofed vault used to enclose the firing area of a weapon built into the wall of a fortification. Cannons housed within casemates were designed to fire through *embrasures* built within the wall. Casemates were designed to provide overhead protection to gun crews during the course of an engagement. The garrison often used casemates without mounted weapons as barracks and to store supplies.

Columbiad. A general classification given to large-caliber, long pieces of artillery that combine certain features found in normal cannons, howitzers, and mortars. They were capable of firing shot and shell with heavy charges of powder at high angles of elevation. Most of these weapons were smoothbore in nature. Columbiads were ideally suited for defending narrow channels into strategic harbors; therefore, they were the main Post-Civil War seacoast weapons in the United States until the introduction of heavy artillery rifles on disappearing carriages at the beginning of the 20th Century. The name came about from the title of a poem written by Joel Barlow, entitled *The Columbiad.* The name was supposedly given to the 50-punder weapon introduced prior to the start of the War of 1812. Emanuel Lewis documents evidence to suggest the name originated from a different source and usage. The name was given to any cannon manufactured by Henry Foxall's Columbian Foundry located at Georgetown, D.C. The name was not used to designate any other types of cannons.

Counterscarp. The outer wall or slope of the *ditch* surrounding the ramparts and outer works of a fortification.

Curtain. The main wall of a fortification located between bastions.

Demibastion. A bastion consisting of only one face and one flank built into the wall of a fortification to assist in protecting vulnerable approaches to rear-facing gorge walls. These positions within a fortification would often have musket loopholes and howitzer built into the structure.

Demilune. In early fortifications, an outwork shaped by two faces and a crescent- shaped *gorge* could be used to protect a portion of the fortification wall. Demilunes were used to protect the main entrance or *sallyport* into the main work. *Ravelins* replaced demilunes in later works.

Ditch. A wide, deep trench similar in appearance to a castle moat built around the entire fortification and important outer works. Material excavated to fill the walls of the ramparts often came from the digging of the ditch. When filled with water, the term wet ditch was used to describe the obstacle.

Embrasure. An opening or slot in a rampart with its sides slanted or flared outward to increase the angle of fire of an emplaced weapon.

En Barbette. A term used to describe the practice of mounting cannons on barbettes within a fortification. Artillery is said to be firing "en barbette" when the piece is positioned so they are fired over the *parapet* instead of through *embrasures*. Cannons mounted in casemates or barbette mountings could be found within the same fortification.

Endicott-Period Battery. A seacoast fortification designed and built as a result of the deliberations of the Endicott Board. The Endicott Board, under the leadership of the Secretary of War William Endicott, conducted a study of the coastal defense requirements of the United States in 1885 to determine the necessary recommendations to develop a new system of seacoast defenses based on earthen batteries mounting heavy artillery rifles on disappearing carriages.

Esplanade. A flat, open stretch of stone built along the base of a fortification wall to act as a breakwater for a work built on a shoal to protect the base of the wall from erosion.

Fort. An enclosed seacoast defensive work, with walls and bastions built at a strategic location to defend vital estuaries and harbors from enemy attack. Manned by soldiers, it was armed with artillery such as cannons and howitzers.

Glacis. A sloping earthwork extending away from the wall of the fortification designed to protect the rampart from enemy shelling.

Gorge. The rear face of a fortification. An outwork called a *demilune* or *ravelin* would often cover and protect the gorge wall of a fortification.

Hotshot. Cannonballs heated in a hotshot furnace and utilized for setting fire to wooden fortifications or ships.

Howitzer. A short-barreled weapon capable of firing shells at a high angle of fire. Effective against targets located within fortified works or entrenchments. Able to reach targets in greater defilade than could normal cannons.

Magazine. A bombproof storage facility built deep inside fortifications to protect ammunition, armaments, or ordnance stores from enemy fire.

Martello Tower. A freestanding masonry tower armed with a small garrison and limited amount of cannons, usually erected along a vital point of the coastline in place of a more extensive fortification.

Merlon. A section of a fortification wall constructed between two embrasures.

Mortar. A short-barreled weapon with a large caliber bore, able to propel massive shells at a high angle into a fortification.

Muzzle. The mouth or opening of the bore of a cannon. Ammunition would be loaded through the muzzle of cannons until the end of the nineteenth century. The development of the breechblocks such as the wedge system or the interrupted-screw system allowed ammunition to be loaded into cannons through the breech.

Pan Coupe. A salient angle between two vertical walls of a fortification; French military term to describe an angular deviation within a fortification wall or the structure constructed at the junction of two vertical walls.

Parade. A level area located within the enclosed, interior portion of a fortification used by the garrison to drill or assemble. A parade was often used as a storage yard for material and cannons during construction. Hotshot furnaces or latrines were often positioned within these central locations.

Parapet. A low, protective wall on the top of wall or curtain of a fortification used to protect soldiers from enemy fire. Cannons mounted *en barbette* were mounted on carriages or platforms designed to fire at the enemy over the top of the parapet structure.

Pound. Term applied to guns that fired solid balls of a certain weight (four-pound cannon is a weapon capable of firing a solid cannon ball weighing four pounds).

Ravelin. A V-shaped outwork outside the ditch used to protect a portion of the fortification wall. Ravelins were often used to protect the main entrance or *sallyport* into the main work.

Redan. A V-shaped outwork projecting its point towards the enemy.

Salient Angle. A projecting angle, the opposite of a recessed angle or reentrant.

Sallyport. The fortified gateway or covered main entrance into a fortification.

Scarp. The inner wall of the *ditch* surrounding the ramparts and outer works of a fortification.

Shell. An explosive round or bomb fired from a cannon or mortar.

Star Fort. A term used to describe the configuration of the outer curtain walls of a fortification. All of the bastions of the fortification would take the outward appearance of a five-point star. French trained engineers introduced this design into the construction of American fortifications within the Second and Third Systems.

Terreplein. A horizontal platform for cannons behind a *parapet* where heavy guns are mounted. In a fortification mounting several tiers of cannons, terreplein would be found on the upper most tier serving as platforms for cannons mounted *en barbette*.

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