

FROM CIVIL WAR TO COLD WAR: A HISTORY OF SAN FRANCISCO BAY COASTAL DEFENSES

PAUL A. PHILLIPS

IN ADDITION TO NEW THEORIES, METHODOLOGIES, DEFINITIONS, AND ENEMIES, the Cold War inspired new technologies, especially related to warfare. These new weapons were primarily centered around strategic arms, i.e. nuclear devices and their delivery systems. Indeed, the Cold War was synonymous with issues relating to nuclear conflict. The dawning of one age, however, signals the end of another. This statement is especially true in the study of military technology, strategy and fortification.

From the birth of American civilization to the end of World War II, the people of North America sought to defend its coasts from unwanted invaders. Before the American Revolution, British engineers fortified important harbors, such as Boston and New York. After the Revolution, coastal defense became the primary focus of the United States armed forces for the next one hundred eighty years. The basic goal was to protect harbors from foreign raids or invasion.¹ The process by which this task was carried out, as well as the materiel and equipment utilized, is complex and demands attention.

The first system of fortifications was erected in response to the 1807 *Chesapeake* Affair,² and consisted of hastily built, open works with earthen parapets. A second system emerged in 1807 from the impending conflict with Britain, and consisted of more open works and some masonry forts. “Thus,” one historian states, “by 1815 practically every seaport of any consequence in the United States had at least one or two fortifications as part of a moderately respectable, though necessarily mixed assemblage of roughly sixty separate First and Second System defenses of varying size, style, and strength.”³ It was not until 1817, however, that the United States organized and built its first permanent defense with unified construction and materiel.

Several decades later the city of San Francisco was founded and grew into the country’s most important West Coast possession. It was by far

the most heavily fortified port on the Pacific Coast. By studying the coastal defenses of San Francisco Bay, therefore, we are able to see the development and practical implementation of American coastal defense policy. The policy was directly related to the technology available and the perceived threat at the time. Later, technology negated coastal defensive works as a viable method of military and national defense. The current effort is a brief history of the development, implementation, emplacement, and ultimate decline of seacoast fortifications at San Francisco Bay. It will primarily focus on the advancement of military technology, especially in the areas of coastal gunnery and seacoast fortification, and its relation to coastal defense policy.

The first permanent fortification in the San Francisco Bay area was built in 1776 under the direction of Lt. Jose Joaquin Moraga. He had traveled from Monterey to assure that the dominance of Spain would stretch northwards to San Francisco Bay. The walled quadrangle style fort was built a mile inland, on what is now the Main Post of the Presidio of San Francisco, in order to shelter it from the harsh weather at the coast. It was never adequately armed, however, and when Captain Vancouver visited the Presidio in 1792, only one sixteenth-century brass 13-pounder was operable.⁴

Moraga quickly realized that the Presidio could never keep an enemy fleet from sailing into San Francisco Bay, so the soldiers began work on a seacoast defense on the site of what is now Fort Point. The *Castillo de San Joaquin*, as it was called, was made of adobe brick and built upon sand, causing all of the walls to crack whenever a cannon was fired. Problems persisted, for the heavy rains of winter demolished the unstable adobe on a yearly basis. When fully armed, the *Castillo de San Joaquin* boasted three iron 24-pounders, one iron 12-pounder, and eight brass 8-pounders. Though inaccurate, they did command the entrance of the Bay and could reach the shores of the Marin headlands. This harbor defense was complemented by a battery of up to five iron 12-pounders at Point San Jose, well inland at what is now Fort Mason.⁵ Point San Jose, the *Castillo*, and the Presidio were never fully staffed, and after the Mexican Revolution of 1821, the Spanish abandoned the fortifications. The Mexican government tried to maintain the forts, but could not. All forts were abandoned by 1835.

U.S. Army Captain John C. Fremont took control of the old Spanish forts in 1846 when he led a group that attacked and spiked the guns of the now-deserted *Castillo de San Joaquin*. This “Big Bear Revolt” was fol-

lowed a month later by the occupation of San Francisco by the U.S. Navy. It was not until 1854, however, that the Federal Government officially moved to protect California. The Gold Rush had propelled San Francisco Bay into the national spotlight, and the Army sought to fortify its newfound treasure.

Congress appropriated \$500,000 in March of 1853 to fortify San Francisco Bay.⁶ These new coastal defenses were based upon the so-called American Third System of coastal fortifications. The system was born out of lessons learned in the War of 1812, and were characterized by masonry or stone forts that were casemated with Totten Embrasures (iron throat and doors on casemates that protected both the gun and crew during reloading, thus allowing engineers to make the openings smaller), and were typically larger and taller than previous forts.⁷ Begun in 1853, Fort Point was the only Third System structure built on the Pacific Coast. Joseph Hagwood, Historian for the U.S. Army Corps of Engineers, calls it “the most important defense project of the Pre-Civil War period.”⁸

The traditional method for constructing Third System fortifications began with selecting a strategic site, lowering it nearly to sea level, and then building a multi-tiered masonry fort. The Army chose the site of the old *Castillo de San Joaquin*, and promptly lowered the entire bluff from 97 feet to 10 feet above sea level.⁹ By the time of its completion in 1861, Fort Point was 250 feet long, 150 feet wide, and 45 feet high. The entire structure was built upon a foundation of granite imported from China, and its masonry walls were 12 feet thick.¹⁰ The original plan for the armament of Fort Point called for 30 guns each on the first, second, and third tiers, and 37 on the barbette tier. In addition, the perimeter could hold an additional ten cannon and five flank howitzers, thus bringing the total number to 142 heavy caliber weapons.¹¹

The weapons were low trajectory weapons of various sizes including 42-pounder, 32-pounder and 24-pounder smoothbores, 8-inch and 10-inch Columbiads, and 24-pounder flank howitzers. The main reason that these Third System fortifications were built at sea level was due to these low trajectories; most heavy weapons could be raised to a maximum elevation of 10 degrees.¹² The tactics of the casemated forts were to concentrate a large amount of firepower at the wooden ships attempting to pass by the coastal defenses. The idea was to point and shoot at the enemy vessel at the water line, so that the cannon ball could land short of the target, skip along the surface of the water, and slam into the sides of the ship. The howitzers were utilized to throw heated shot upon the decks

of the wooden ships to start fires. Emanuel Lewis, prominent historian of seacoast fortifications and current archivist at the National Archives, describes the process, "With great velocity, the ball sinks deep into the wood, is deprived of air by the closing of the hole, and chars instead of burning the surrounding wood. ... Red-hot balls do not set fire to the wood until some time after their penetration. They retain sufficient heat to ignite wood after having made several ricochets upon water."¹³

Alcatraz was always second to Fort Point in dollar allocation, but was nonetheless indispensable in the plan for the overall defense of San Francisco Bay. Construction began in 1854. Alcatraz eventually mounted up to 155 cannon and howitzers of all types, including the new 15-inch Rodmans that were shipped in the 1860s. Instead of a casemated masonry fort, the plans called for barbette mounted guns behind earthen scarps or masonry retaining walls. The island, at first, was thought to be a perfect defensive structure, rising straight out of the sea with high cliffs as a barrier to any attacking force. These open battery platforms were supplemented by a two-story brick tower, or caponier, that measured 50 by 25 feet. Each battery had one of these bastions at the mid point, and housed both cannon and infantry to repel invaders.¹⁴ A status report presented to the Army in March of 1860 indicated that Fort Point was ready to mount 90 heavy caliber weapons, and Alcatraz already had 75 guns emplaced.¹⁵

By the end of the Civil War, the entire perimeter of Alcatraz was encased with heavy weapons.¹⁶ Indeed, apart from the Citadel, the lighthouse, and the barracks, the entire island was bristling with armament. At least two-thirds of the perimeter of the island was composed of batteries. Battery Prime and Battery McClellan were located on the southern tip of the island. Battery McPherson, Battery Tower, Battery Stevens, and Battery Mansfield stretched along the entire western portion of the island. Battery Rosencrans and Battery Halleck comprised the northern defenses of the island.

The final fortifications of the Civil War Era were located on the northern portion of the Golden Gate. Two batteries were built on Angel Island. Upon completion in February of 1864, Point Knox boasted seven 32-pounder smoothbores, one 8-inch Rodman, and two 10-inch Rodmans.¹⁷ Point Stewart was completed in June of 1864 and was armed with three 32-pounders and one 10-inch Columbiad emplaced upon a 250-degree spindle carriage. On the mainland, Point San Jose was updated with six 10-inch Rodmans at Battery East, and six 42-pounder Banded Rifles at

Battery West.¹⁸

When the construction of the San Francisco Bay coastal defenses began in 1853, the United States did not anticipate any imminent conflict. It was simply following its pattern of standard military defense of an important harbor, regardless of the threat. By 1860, however, the threat was identifiable, and it wasn't foreign. Southern sympathizers in San Francisco were clamoring about the impending cessation of the Confederacy and threatened to storm the arsenal at Benicia and take arms and ammunition. The military heard of this, as well as a plan to create a separate "Confederate Republic of the Pacific." Arms and ammunition were moved to Alcatraz, and there were no incidents of revolt. This did speed up the construction of the forts and batteries in the region for fear of Confederate ships operating in the Pacific.¹⁹ Rumors continued throughout the war spreading word of Confederate ships sailing towards San Francisco, but the hearsay never materialized.²⁰

A floating battery was ordered to supplement the fixed coastal defenses. The *USS Camanche*, a *Passaic*-class monitor was shipped from New Jersey to San Francisco. However, the ship transporting the disassembled *Camanche* sank at its moorings upon arriving at San Francisco in November 1863. It was salvaged and rebuilt, but was not recommissioned till months after the end of the war. Its two 15-inch Dahlgren guns never saw action. The *Camanche* was eventually converted into a coal barge, and finally scrapped at Mare Island in 1899.²¹

Thus, by the end of the Civil War, San Francisco Bay was one of the most heavily defended harbors in the nation. Fort Point protected the entrance to the bay, and was the most powerful fortification on the west coast. If an enemy vessel were able to escape the guns at Fort Point, it would surely meet destruction when the guns of Angel Island to the north, Point San Jose to the south, and Alcatraz Island in the center unleashed their fury of a combined 182 heavy caliber weapons. The 15-inch Rodmans could throw a 434-pound projectile up to 7,730 yards.²² Each of the four main defensive works could easily reach the opposite sides of the Bay, thereby creating a four-way crossfire.

The Marin side of the Golden Gate was scheduled to become the final component of the San Francisco Harbor defense. In 1853 Colonel Joseph K.F. Mansfield advised a fort be built to complement Fort Point. A multi-level, casemated, masonry fort was on the drawing board, but the Army was unable to secure the land from its owner, Samuel Throckmorton. Not until 1864 did Throckmorton finally sell the land, and work did not begin

until three years following the Civil War.²³ By the time the Federal Government bought Throckmorton's land, the technology of the fort was out-of-date.²⁴

At the end of the Civil War, masonry fortification such as Fort Point were rendered obsolete. The war, according to Chief Engineer of the Army DelaField, taught three valuable lessons: America needed a larger standing army, mines were imperative for harbor defense, and fort architecture must be revised in light of the new, rifled guns.²⁵ New propellants, new steel manufacturing processes, and rifled guns hastened the death of masonry forts. These new weapons, such as the 15-inch Rodman or the 200-pounder Parrot Rifle, at first favored the forts for they could smash the enemy's wooden ships at will. The larger guns could hurl a solid shell weighing 440 pounds over three miles.²⁶ Ships also improved, however, becoming steel skinned and steam powered. Fixed fortifications could no longer match an adequately equipped warship. The ship's steel armor could repel a cannonball, the steam powered engines could dash past the fixed gun positions, and, if equipped with rifled guns, the ship could mercilessly destroy any masonry fort. The Army concluded that "the damage done to the masonry scarps by the armored monitors ... showed conclusively that the masonry scarp on sea fronts must in the future be dispensed with"²⁷

Fortification architecture significantly changed after the lessons of the Civil War. Europe abandoned the casemated fortification in favor of massive iron fortifications, some resembling shore-mounted battleship turrets.²⁸ After such a long and devastating war, the United States had neither the money nor the desire to construct such fortifications, but the military did realize that certain changes were necessary. In San Francisco, two additional batteries flanking both sides of Fort Point were erected. They were called Battery West and Battery East, with twelve and five cannons emplaced, respectively. Improvements were made on Point San Jose, but the guns were scrapped by the turn of the century.²⁹

The 1870 project began fortifying the northern shores of the Golden Gate. After the 11-year battle to acquire the land, and another two years and 50,650 pounds of TNT to blast away Lime Point in preparation for the new casemated fort, construction abruptly halted, and it was never built. Instead, an "architecturally handsome battery at Point Cavallo" was erected.³⁰ It was a symmetrical, earthen triangle designed to hold up to 20 heavy weapons. Construction stopped in June of 1876 without one gun being mounted. Three Rodmans were emplaced at the turn of the century,

but were scrapped after 1905. One gun was emplaced at Battery Gravelly Beach, and four guns were mounted at Battery Ridge, which became the highest fortified seacoast location in the United States.³¹ Additional plans were made to fortify Point Diablo and Point Bonita, but they never materialized.

Work on seacoast fortifications nationwide stopped in 1872 due to lack of funding from Congress. By the mid 1880s, the once-mighty fortifications were in serious disarray. Not only did Congress fail to allocate money for new coastal defense works, it also failed to give the Army enough money to maintain current defenses. A board of inquiry was commissioned in 1885 to assess the status of seacoast defenses. Referred to as the Endicott Board (after the Secretary of War, William C. Endicott), it stated the obvious: The current coastal defenses were in sad condition, and immediate improvements are necessary.³² The Board recommended the strengthening of 27 harbors nationwide, including three on the Great Lakes.³³ Cities and harbors were listed in order of importance, and San Francisco was second only to New York in priority of fortification. Congress, after years of neglect, appropriated \$21.5 million in fiscal year 1885, with \$9 million allocated annually until the work was finished.³⁴ San Francisco was scheduled to receive a complete overhaul of the harbor defenses.

The new technological developments of the Endicott Period transferred the focus from fortifications to armament. The Endicott Period's most conspicuous feature was guns.³⁵ The days of the smoothbore cannon were past. Breachloading rifles (BLR) replaced the old muzzleloading smoothbores, and could lob a heavier shell farther, faster, and more accurately. San Francisco was slated to receive ten 16-inch, four 14-inch, twenty 12-inch, seventy-one 10-inch, and five 8-inch BLR's. These new mammoth guns were supplemented with one hundred twenty-eight 12-inch rifled mortars, three floating batteries with 10-inch guns, eighteen torpedo (mine) boats, and 1050 mines.³⁶ The largest of the guns emplaced during this period, the 12-inch BL Rifle (the 14-inch was never used), dramatically increased firepower and range. At only 10 degrees in elevation, the 12-inch guns could hurl a 1,070 pound projectile eight miles.³⁷

The Endicott shore defenses were intended to shelter and withstand low-angle gunfire.³⁸ Open, reinforced concrete emplacements were built at ground level, concealing the guns from the sea. The batteries were spread out, compromising concentrated firepower in favor of better defensive positioning. The concrete emplacements were twenty feet thick,

with an additional thirty feet of earth in front of the concrete. Contemporary battleships could only fire at a maximum 6 degrees in elevation, which not only limited the range, but prevented them from achieving the elevation necessary to lob a shell on top of the battery. Only a direct hit at the ground level of the emplacement could knock the battery out of commission.³⁹ The open emplacements not only protected the guns from a seaborne attack, but they were also easier and cheaper to build than massive, enclosed fortifications. Emanuel Lewis states that separating the batteries, though it “sacrificed the tremendous concentration of weapons presented by casemate forts it nevertheless offered genuine tactical benefits, for defensive armament could be grouped in any number of comparatively inexpensive works distributed among sites of maximum advantage along harbor entrances where concealment and protection from attacking ships could be easily secured.”⁴⁰

Advancements in seacoast gun carriages greatly increased the range, safety, and accuracy of the new behemoth guns. An ingenious disappearing carriage was fashioned in the 1880s that complemented the open, concrete emplacements perfectly. The gun, in the reloading position, was hidden behind the concrete and earth parapets. This allowed the gunners to reload in complete safety and concealment from enemy shells. Upon reloading, the gun was raised above the parapet by a countersink weight located directly beneath the gun and carriage. After the gun was aimed and fired, the recoil of the gun would send it hydraulically to its reloading position.⁴¹

The organizational structure of the defenses at San Francisco also developed at this time. On the southern portion of the Golden Gate, the Presidio maintained its status as the headquarters for the entire Bay Area, but the coastal batteries from Fort Point south to Baker Beach were renamed Fort Winfield Scott. Land was purchased near Land’s End after the Civil War to thwart land attacks and was named Fort Miley. In the interior Bay, the location of Point San Jose became Fort Mason. Alcatraz Island was dubbed Fort Alcatraz, and Angel Island became Fort McDowell. The most significant changes during the Endicott period occurred north of the Golden Gate. The batteries on the north shore comprised Fort Baker. Finally, the area from Fort Baker west, continuing to Point Bonita, was called Fort Barry.

The Endicott Board’s recommendations were put into action in what became known as the 1890 Project. Fort Winfield Scott increased its batteries from three to sixteen, including an experimental “Dynamite Gun”

armed in 1895. New York Harbor is the only other location that saw these contraptions. According to Erwin Thompson, historian for the Golden Gate National Recreation Area, “three pneumatic 15-inch dynamite guns were not part of the defenses of San Francisco and were mounted by the manufacturer for firing tests.”⁴² The Army never adopted the guns, and they were dismantled by 1905. They were never considered an integral part of the overall defense works, but these mammoth, 50-foot-long guns were “blown” every week, and they provided interesting test results.⁴³ The guns were the first to be electronically fired. They were also the first guns designed to carry varying sizes of projectiles. They could propel dynamite shells at the enemy, said to be able to explode near a ship by a manually timed, internal fuse. Projectiles could carry up to 500 pounds of TNT.⁴⁴

Mortars became increasingly important in the 1890s. Though warships’ sides had been strengthened with iron and steel, the decks remained solid wood. According to the U.S. Army Engineering School, “... mortars had come to be one of the principal elements of Seacoast Defense.”⁴⁵ Rapid-fire guns also played an important role in coastal defense. The *Coast Artillery Manual* explicitly stated that “the importance of rapid-fire and machine guns cannot be over estimated. A large number of them is absolutely necessary.”⁴⁶

The wide array of armament bristling at the Golden Gate embodied the contemporary seacoast defense thinking of the age. In theory, long-range seacoast armament could destroy enemy ships before they reached a harbor.⁴⁷ The U.S. Army’s assessment was that contemporary “seacoast fortifications were designed to combat battleships having turrets armed with 12-inch guns.”⁴⁸ Though the guns afloat were similar to the guns ashore, they were still on moving, rocking, pitching, and therefore unstable platforms. The large-caliber seacoast guns (10- or 12-inch) were designed to sink the larger, capital ships. The smaller caliber weapons were assigned to match the firepower of the faster cruisers. Rapid-fire guns supplemented the larger guns and had a shorter range. They were employed to keep up a fast, continuous volume of fire to prevent smaller, faster vessels from quickly sailing past the coast defenses into the harbor itself. Mortars were short-range, high-velocity weapons built to rain fire and explosives on the wooden decks of the ships. Mines, floating batteries, and even “the old smoothbore guns may be utilized in the defense ... but shouldn’t conflict with rapid-fire guns.”⁴⁹

The following is a list of batteries emplaced during the 1890 Project at

Fort Winfield Scott:

<u>Battery Name</u>	<u>Battery Armament</u>
Lancaster	Three 12-inch BLR's on disappearing carriages
Cranston	Two 10-inch BLR's on disappearing carriages
Marcus Miller	Three 10-inch BLR's on disappearing carriages
Boutelle	Three 5-inch rapid-fire guns on balanced pillar mounts
Godfrey	Three 12-inch BLR's on non-disappearing carriages
Dynamite	Three pneumatic 15-inch dynamite guns
Saffold	Two 12-inch BLR's on non-disappearing carriages
Crosby	Two 6-inch BLR's on disappearing carriages
Chamberlin	Four 6-inch BLR's on disappearing carriages
Baldwin	Two 3-inch, 15-pounder rapid-fire guns on masking parapet, balanced pillar mounts
Sherwood	Two 5-inch guns on barbette carriages, pedestal mounts.
Slaughter	Three 8-inch BLR's on disappearing carriages
Blaney	Four 15-pounder rapid-fire guns on balanced pillar mounts
Howe	Two mortar pits having eight 12-inch BL mortars
Wagner	Two mortar pits having eight 12-inch BL mortars (Also known collectively as Battery Howe-Wagner)
Stotsenburg	Two mortar pits having eight 12-inch BL mortars
McKinnon	Two mortar pits having eight 12-inch BL mortars (Also known collectively as Battery Stotsenburg-McKinnon)

Throughout the entire Bay Area, the entire construction process began in 1895 and was completed by 1905.⁵⁰

The north side of the Golden Gate came of age during this period. Fort Baker saw Battery Spencer replace the old Cliff Battery, and held three 12-inch BL Rifles on non-disappearing carriages. Battery Ridge was re-

tired by 1901. Battery Kirby replaced Battery Gravelly Beach and held two 12-inch rifles on disappearing carriages. In between both the Kirby and Spencer batteries sat Battery Wagner, which held two 5-inch rapid-fire guns on balanced pillar mounts. Two 8-inch BLR's on non-disappearing carriages were emplaced at Battery Duncan, a few hundred yards north of Battery Cavallo. The final portion of Fort Baker was Battery Yates, located at the tip of Horseshoe Cove, consisting of six 3-inch, 15-pounder guns on barbette carriages on pedestal mounts.⁵¹

Fort Barry was created during this phase of construction. Located on the outer edges of the Golden Gate at Point Bonita, Fort Barry was the first line of defense. Battery Mendell boasted two 12-inch BLR's on disappearing carriages. Battery Alexander hosted eight 12-inch BL mortars. Battery Guthrie originally consisted of four 6-inch rapid-fire guns on barbette carriages, but later, for better management of weaponry, the two were dubbed Battery Smith. The entire fortification of the four guns is known as Battery Smith-Guthrie. The same situation occurred at Battery Rathbone, which held four 6-inch rapid-fire guns on barbette carriages. Two were later dubbed Battery McIndoe, and collectively the fortification was called Battery Rathbone-McIndoe. Battery O'Rorke completed Fort Barry, and hosted four 15-pounder 3-inch guns on barbette carriages, pedestal mounts.⁵²

Fort Miley saw three new batteries erected. Battery Chester consisted of two 12-inch BL Rifles on disappearing carriages, and one 12-inch BLR on a non-disappearing carriage. Battery Livingston initially had sixteen 12-inch BL mortars in four pits, but was later reduced to two pits of four mortars each. Battery Springer was created when Battery Livingston was split in half, and was comprised of the remaining eight 12-inch BL mortars in two pits. They are also known together as Battery Livingston-Springer.⁵³

Fort McDowell had long abandoned its Civil War smoothbores in favor of new, breach-loading armament. Battery Drew boasted one 8-inch BLR on a non-disappearing carriage. Battery Wallace also had one 8-inch BLR, but it had a disappearing carriage. The final emplacement on the island was Battery Ledyard, consisting of two 5-inch rapid-fire guns on barbette carriages, pedestal mounts.⁵⁴

Fort Mason and Fort Alcatraz saw few improvements during this period. Point San Jose was renamed Battery Burnham, and was furnished with a single 8-inch BLR on a disappearing carriage.⁵⁵ Fort Alcatraz, by the end of the 19th century, was slowly becoming less of a strategic artil-

lery position, and more of a military prison. A report in 1893 of the status of ordnance on the island indicated that only nine cannon—seven 15-inch Rodmans and two old smoothbores that were subsequently rifled—were fit for duty. No additional cannons were emplaced at Fort Alcatraz, and all were removed by 1909.⁵⁶

In 1905, President Theodore Roosevelt convened a commission, under the leadership of Secretary of War William Howard Taft, to evaluate the Endicott Board plan. By 1900, the Endicott system was 50 percent completed, with twenty-five harbors deemed adequately prepared for defense. This Taft Period of coastal defense sought to rethink the Endicott ideals in an era of new technology, new naval doctrine, and a pressing need to fortify new overseas possessions.⁵⁷ Most construction during this period did not occur in North America, but was located overseas at Hawaii, Panama, Manila Bay and other United States possessions.

Significant improvements to the Endicott fortifications were implemented during this period. Seacoast searchlights swept the seas at night to locate enemy ships. Ammunition delivery was motorized within the batteries. Gun crews no longer had to carry shells by hand or by wheelbarrow. Some ammunition bunkers were built underneath the batteries, and the ammunition was hauled up to ground level by a motorized chain and pulley system. Electronic communication was introduced, allowing better fire control and coordination of fire between batteries.

A dramatic shift in policy, however, dominated this period. President Roosevelt, an ardent navalist, insisted on a strong navy, and coastal defenses were seen as subordinate to the needs of the navy. A strong navy negated the need for passive coastal defense. According to Lewis, Roosevelt's "Mahanistic Navalism" led to the "elimination for all time of the passive coast defense doctrine as a basic element of American naval policy."⁵⁸

Though this was dubbed a new era, it was essentially the continuation of the Endicott Plan. No new gun or carriage improvements appeared, except for a new 14-inch gun, but they were all emplaced overseas. No new construction was planned or implemented in the United States. The most significant improvement of this era was a modern system of aiming and sighting for the heavy guns. Two separate sighting posts for each battery were set up, usually camouflaged in the surrounding landscape on opposite ends of the battery. These Base End Stations could find the range, speed, and location of the enemy by sight. Each Base End Station would then call up a Central Battery Computing Room and give its findings on

the specific movements of the enemy. This Central Computing Room would take the information from both Base End Stations, combine, recompute by using triangulation methodology, add in variables such as wind or weather, and then give fire control coordinates to the guns. Additional improvements were made in optical instrumentation, target data processing, and electrical transmission of sighting and gun pointing.⁵⁹

The only noteworthy construction around the Bay in the years preceding World War I was construction of the Laguna Merced Military Reservation in 1917. This created Battery Bluff which was designed to hold two 5-inch rapid-fire guns on pedestal mounts, and Battery Howe which would hold twelve 12-inch BL mortars. The weapons were never mounted, but were shipped to France instead.

World War I was an ironic time during the history of the Bay's defenses. Instead of preparing for war, the Army felt that the West Coast was relatively secure from attack. The war was in Europe, not the Pacific, and the military thought that the West Coast could spare the armament. They, therefore, sent a good portion of the guns emplaced at the Golden Gate to Europe.⁶⁰ A new searchlight was emplaced at Bird Rock Overlook at Fort Barry in 1912, as well as at Fort Mason. A new mine depot was built at the Presidio, and a mine casemate was constructed at Baker Beach, near Battery Chamberlin. Apart from a mine casemate that remained at Mortar Hill on Angel Island, all guns were removed from Fort McDowell by 1915. This left both interior islands devoid of guns, as well as the interior defenses at Fort Mason. It is reasonable to suggest that there was actually more destruction than construction during World War I around San Francisco Bay.

In 1914, the Chief of the Coast Artillery Corps announced that most seacoast defense projects were completed.⁶¹ Since 1888, at the beginning of the Endicott constructions, \$143.7 million had been spent on coastal fortifications within the United States. Unlike the Civil War, "after the [1918] armistice, the Chief of Engineers declared that there were no lessons from the War that would justify fundamental changes."⁶² There were some changes afoot, however, whether the Army perceived them or not. After the war, some batteries were permanently scrapped, either by obsolescence or because the guns never returned from Europe. By 1920 Fort Point, the Dynamite guns, Battery West, Battery East, Battery Howe-Wagner, Battery Boutelle, Battery Miller, Battery Lancaster, Battery Sherwood, and Battery Blaney were retired at Fort Winfield Scott. This left Fort Winfield Scott with only five operable batteries. Battery Grav-

elly Beach, Battery Ridge, Battery Cavallo, Battery Duncan, and Battery Wagner were also retired at Fort Baker, leaving it with only two operable batteries by 1920. Fort McDowell was completely empty, as were Fort Alcatraz and Fort Mason. All other military posts in the area retained their full complement of arms. However, none of the remaining posts were adequately staffed, if at all. Fort Funston (Laguna Merced Military Reservation) was completely abandoned in 1920, and only skeleton caretaker crews were stationed elsewhere in the Bay. No upkeep on the facilities was assured, except to see that the guns did not rust.⁶³

The invention of the airplane dramatically altered coastal defense policy. Not only could open barbette emplacements now be attacked from the air, but the airplane could also direct naval fire from a safe distance. Furthermore, new battleships that emerged during the war allowed higher firing trajectories, thereby further negating the effectiveness of an open defensive position.⁶⁴ An assessment of Bay Area defenses in the 1920s concluded that airplanes were dependent on good weather, and submarines were not fast enough to keep up with ships. One coastal artillery officer observed, “the fixed gun, with sound ranging devices that even fogs cannot blind, is still the most dependable weapon — if it has the range.”⁶⁵

The truth was, however, that contemporary battleships could outgun any coastal fortification. San Francisco’s largest guns were the 12-inch BL Rifles, but they had been emplaced as early as the 1890s, and the carriages only allowed a maximum elevation of 10 degrees. Modern battleships could now reach height elevations of 30 degrees. Ships mounted with new 16-inch guns had a firing range of 34,000 yards. At best, San Francisco’s 12-inch seacoast guns had a maximum range of 27,000 yards. The 12-inch mortars could only reach 15,000 yards. A coastal emplacement with the naval 16-inch gun, however, could reach a range of over 50,000 yards. “This is the ideal gun for San Francisco,” said a former Lt. Commander stationed at Fort Winfield Scott.⁶⁶

The 1930s brought Japanese aggression in the Pacific as well as tensions in Europe. Between 1933 and 1938 most money for harbor defense went to the Pacific Coast because of Japanese aggression in the Far East.⁶⁷ In addition, the large capital ships of the Japanese Navy posed a new threat to seacoast defenses. A new type of coastal fortification, the first major change since the Endicott emplacements, began in San Francisco in 1937, and became the model for all coastal defense construction worldwide. At Battery Davis, Fort Funston, two 16-inch BL Rifles were mounted

in huge casemates 600 feet apart. In between was a series of galleries with ammunition dumps, generators, storage rooms, and operations centers. The entire structure was roofed with 8-10 feet of reinforced concrete, covered with an additional 20 feet of earth. A blast shield, composed of a two-foot-thick slab of concrete a few feet under the surface of the earth, was also used. This shield was designed to explode any shell penetrating the fortification from above; this small slab of concrete would bear the brunt of the explosion, thereby keeping the devastation well away from the interior structure.⁶⁸ Almost all heavy gun emplacements henceforth were built following this pattern.⁶⁹ They were the largest coastal guns ever mounted anywhere in the world.

Tests were conducted on July 1, 1940, to find the range of each gun. Battery Townsley was selected to perform the examination. Each 16-inch gun fired five rounds. Muzzle velocity was measured at over thirty-nine thousand pounds per square inch. When 1st Lt. Kramer, Ordnance Officer at Fort Cronkhite, ordered the maximum range test, the results were astonishing. July 1st was a clear day and Kramer spotted the optical azimuths to a location five miles past the Farallon Islands, a total of 30.11 miles. Kramer ordered a standard charge of 660 pounds of powder, plus an additional fifteen percent, and had the guns raised to maximum elevation. The gun fired flawlessly, and no one saw far enough to view the splashes.⁷⁰

Penetration tests on the new guns were held in 1941. Test blocks of reinforced concrete and reinforced steel were fabricated for the tests, and placed 620 feet from the end of the barrel. Once again, Battery Townsley performed the examination. Four of these blocks, measuring 42 feet wide, 27 feet high, and 23 feet thick were created for the test. Two smaller blocks more densely girded with steel to simulate a battleship were also created. These smaller blocks were 16 feet and 13 feet thick, respectively. The test blocks were rated as ranging from 3,000 to 5,000 pounds per square inch in density. The idea was to measure how far the projectiles penetrated the blocks, and do calculations to assess total amount of fire-power. In each case, for each block, the guns penetrated the entire length of the test block.⁷¹ The Army concluded that these new massive guns were stronger, and could fire farther than they ever could have hoped. "And," states one historian, "until the development of nuclear weapons, the batteries were thought to be virtually impervious to air bombardment and high angle gunfire."⁷²

This period was the least varied of all of the coastal fortification

projects. Only 16-inch casemated defenses were planned worldwide, twenty-seven of which were located within the United States. In addition to the 16-inch guns, fifty 6-inch sites were also planned for the coasts. The plan, known as the 1940 Modernization Project, called for these fifty-seven new batteries, retention of sixty-three existing batteries, and elimination of the rest. This was extensive, but practical, for the projected cost of \$82 million was still less than the cost of one battleship.⁷³ The timing was perfect for new construction, for “in response to the need to put people to work during the depression year, and to protect our shores against attack, the Federal Government began pouring millions of dollars into fortification rehabilitation projects.”⁷⁴ The neglect was over.

This era saw increased dependency on searchlights, Base End Stations, mines, and submarine nets. After Pearl Harbor, mobile 155mm sea-coast artillery regiments were also stationed in the Bay Area. Fort Cronkhite was created north of Fort Barry. Battery Townsley, one of the new 16-inch casemated batteries, was created in 1939. An anti-aircraft battery was also built, and dubbed Anti-aircraft Battery No. 1. Each Anti-aircraft battery consisted of a pair of 37mm automatic guns.⁷⁵

Fort Barry began construction of a new 16-inch battery, but lessons learned by 1943 rendered it obsolete, and it was never finished. Today it is known simply as Construction No. 129. Anti-aircraft Battery No. 2 is also located here, as well as a Balloon Hanger that was built before the war. At Fort Baker, Battery Gravelly and Battery Kirby Beach were built to house two 6-inch rapid-fire guns on pedestal mounts. A mine depot was built on the main post of Fort Baker as well. Apart from a new mine casemate built at Baker Beach, no new fortifications were constructed at Fort Winfield Scott, Fort Mason, Fort McDowell or Alcatraz. Fort Miley, on the other hand, saw a significant increase in construction during World War II. Battery Lobos held two 6-inch rapid-fire barbette-mounted guns. Battery Land boasted four of the same. Another 16-inch casemated battery at Fort Miley was never named, was armed for less than a year in 1948, and is known only as Construction No. 243. Fort Funston hosted Battery Davis, the blueprint for all 16-inch batteries. It also consisted of Anti-aircraft Battery No. 3 and Battery Bluff, a collection of four 6-inch rapid-fire guns.⁷⁶ More than 60 Base End Stations were built from Drake’s Bay to Half Moon Bay to provide fire control information.⁷⁷ Between 1940 and 1945, more than \$220 million dollars were spent on coastal defense, emplacing nearly two hundred modern and modernized guns.⁷⁸

The end of World War II coincided with the end of harbor fortifica-

tions as a feasible method of coastal defense. The lessons of the war made the fortifications obsolete once and for all. Historically, harbors and ports were absolutely essential for a successful invasion. D-Day (June 6, 1944) taught military strategists several things about amphibious warfare. The elaborate network of seacoast fortifications were negated by massive aerial bombardment and a few well placed commando or airborne groups in the rear areas (seacoast fortifications only faced towards the sea). Also, large amphibious operations no longer required existing port facilities. Ports were still necessary, however, and the Allied forces at Normandy brought their own, towed from England and emplaced at the landing beaches.⁷⁹ Submarines negated landbased guns, and could slip into harbors undetected. Airplanes could pummel fixed fortifications and render them useless. David Clary, historian of the seacoast fortification at Hampton Roads, Virginia, calls the attack on Pearl Harbor “the airplane’s supreme insult to conventional harbor defense thinking”⁸⁰ Attacks on nations were no longer confined to seacoasts. V-1 and V-2 rockets, long-range bombers, and atomic weapons made destruction available to those who lived inland.

“Today,” states Emanuel Lewis, “the coastal fort is a relic.”⁸¹ Since 1812, the only coastal defense fortification in the United States that has fired in anger at a foreign enemy was Battery David Russell, Oregon, at a Japanese submarine. The entire concept of harbor defense by long-range artillery was abandoned in 1948. The last of the great seacoast guns were scrapped by 1949, and the Coast Artillery Branch of the Army was abolished in 1950. Obsolescence was complete. The long strip of land on the verge of the sea had lost its defensive importance. In fact, scrapping of the great guns was so thorough, that today we have more Rodmans and Civil War era smoothbores than post-1890 ordinance.⁸²

The obsolescences of seacoast fortifications did not end the defense of San Francisco Bay. The threat had once again changed. No longer were large capital ships in danger of invading the West Coast, but rather long-range Russian bombers (equipped with nuclear weapons) were now the enemy. Missile bases around the Bay Area sprang up at the end of the War in Korea. The Nike-Ajax system protected the San Francisco Bay Area from 1954-1959. There were several sites around the Bay, including one at Fort Cronkhite (SF-87), one at Fort Barry (SF-88), one at Fort Winfield Scott (SF-80), one at Fort Funston (SF-59), one at Milagra Ridge Military Reservation (SF-51), and one at Fort McDowell (SF-91). These Nike-Ajax missiles were designed to shoot down a single aircraft within

25 miles and flying up to speeds of Mach 2. They were 34 feet long, traveled at Mach 2.25, and carried a high explosive warhead. In 1959, technological advancements made the Ajax system obsolete, and the Army developed the Nike-Hercules system to replace it. They used the same launch sites as the Ajax series, but the missiles were entirely different. The Hercules missile was 7 feet longer, 8,000 pounds heavier, had a range of 87 miles, a speed of Mach 3.65, and, above all, could carry a nuclear warhead. The purpose of the Nike-Hercules missile was, with a nuclear warhead, to destroy an entire squadron of enemy long-range bombers.⁸³ Like its predecessors, the guided missile defenses were soon seen as ineffective, and the entire project was halted and scrapped in 1974. Long-range bombers were no longer seen as a viable threat. Intercontinental ballistic missiles could attack from anywhere, anytime, and with little warning.

Today, the coasts of the United States are without static defensive works. Technology has rendered fixed fortifications obsolete. Though once considered imperative to national security, the extensive and massive concrete emplacements are now antiquated. Airplanes and missiles have replaced the large guns. The defensive posture of the nation as a whole is reflected in its military policy. Coastal fortification was inherently defensive: to deter foreign invasion. These forts represent American ideals, American engineering marvels, American technological breakthroughs, and a commitment to protect what one has created and maintained. Though never attacked, the coastal defenses of the United States accomplished their goal. The greatest testament of the seacoast defenses remains embodied in the fact that the United States has been free from foreign invasion for almost two hundred years.

Glossary

Guns

Banded Rifle - See Parrot Rifle

Breech Loading Rifle - Guns which loaded projectiles from behind the barrel, at the breech, as opposed to muzzle loading, where the projectile is inserted from the muzzle end of the barrel.

Columbiads - Large, cast-iron smoothbore cannon. The name was taken from the Columbia Foundry. This weapon's main feature was that, during manufacturing, the gun was cooled from the bore outwards, thereby giving it greater strength. Pre-Civil War era.

Dahlgren Gun - Civil War era, cast-iron smoothbore cannon. The thickness of the barrel tube varied with the proportion of the intended charge.

Dynamite Gun - Pneumatic cannon used briefly during the 1880s that fired projectiles filled with dynamite. Used a 10-ton air reservoir to propel a 1,000 lb. projectile over 2,100 yards.

Howitzer - A relatively short cannon that delivers shells at a medium muzzle velocity, usually by a high trajectory.

Mortar - A very short cannon used to fire shells at low velocities, short ranges, and high trajectories.

Parrot Rifles - Muzzle loading, cast-iron rifled gun with a wrought iron band shrunk around the breech for extra strength. Civil War era. Could fire multiple types of ordinance, such as shot, canister, shell, grape shot, or case shot.

Rapid-fire gun - Breech loading rifled guns that could fire complete projectiles (casings that included both propellant and ordinance) in quick succession.

Rifle - Spiral grooves within a bore to spin a projectile so that it will have a greater accuracy of fire and longer range.

Rodman - Muzzle loading, cast-iron smoothbore guns first used in the Civil War. Also known as Union guns. This weapon is characterized by the large breech area.

Smoothbore - A bore that is smooth, without rifling and designed to shoot round objects. Shorter range and less accurate than rifled guns.

XX-inch - Classification of a gun based upon the diameter of the projectile or bore. I.E. A 10-inch gun is one that fires a 10-inch diameter projectile out of a bore 10 inches in diameter.

XX-pounder - Classification of a gun based upon the weight of the projectile. i.e., a 12-pounder cannon fires a 12-pound projectile.

Mounts

Barbette carriage - A gun carriage that elevates the gun sufficiently to fire over a parapet.

Disappearing carriage - A fixed mount in which a balancing mechanism lifts large caliber cannon into a position above a protective parapet to fire, and the recoil sends the gun “disappearing” behind the parapet.

Non-disappearing carriage - Stationary carriages emplaced above the parapet.

Pedestal mount - The base of a fixed gun mount which allows complete traversing of the gun.

Spindle carriage - The base of a fixed mount that allows the gun to move in a traversal manner upon a single axis, or spindle.

Other

Barbette - A mound of earth, platform, support, or carriage upon which guns are mounted to fire over a wall or parapet, rather than through a port or opening.

Bastion - A structure projecting from the main fortification. It consists of two salient angles that command the foreground and can provide flanking fire to the main fortification.

Battery - An emplacement of one or more pieces of artillery.

Caponier - Multi-story defensive towers.

Casemate - A bomb-proof structure used as a powder magazine, gun emplacement, or the like.

Floating battery - An artillery battery emplaced on rafts or hulls of ships. Normally not self-propelled.

Mine casemate - Bombproof shelter for mine storage. Also the location from which mines could be electronically detonated.

Nike-Ajax - First U.S. supersonic anti-aircraft guided missile, first emplaced in 1953.

Nike-Hercules - Second-generation supersonic anti-aircraft guided missile, first emplaced in 1958.

Parapets - Earthen or stone embankments thrown up in front of a trench or emplacement to protect it from fire and observation.

Scarp - A steep slope directly in front of a fortification.

Totten Embrasure - Iron throats and doors on the outer openings of the casemates that open during firing, and then close to protect gun and crew during reloading.

¹ Robert S. Browning III, *Two if by Sea: The Development of American Coastal Defense Policy* (Westport, CT: Greenwood Press, 1983), xiii.

² On June 22, 1807, the British frigate *Leopard* demanded to board the United States frigate *Chesapeake* in order to search for four British deserters. When the *Chesapeake* did not comply, the *Leopard* opened fire and boarded the ship. The suspected deserters were taken into custody (only one was actually British), and the damaged *Chesapeake* slowly made its way back to port. The public demanded war, but Jefferson feared conflict with Britain. He deemed that the U.S. was ill-prepared for war, and, in addition to ordering all British ships out of U.S. waters, ordered the construction of harbor fortifications to ward off British war vessels.

³ Emanuel Raymond Lewis, *Seacoast Fortifications of the United States: An Introductory History* (Washington D.C.: Smithsonian Institution Press, 1970), 36.

⁴ Erwin N. Thompson, *Historic Resource Study: Seacoast Fortifications, San Francisco Harbor* (Denver: Denver Service Center Historic Preservation Team, National Park Service, U.S. Department of the Interior, 1979), 7. See also Captain George Vancouver, *Voyage of Discovery to the North Pacific Ocean and Round the World*, 3 vols., (New York: Da Capo Press, 1967).

⁵ *Ibid.*, 9.

⁶ Joseph J. Hagwood, *Engineers at the Golden Gate: A History of the San Francisco District U.S. Army Corps of Engineers, 1866-1980* (San Francisco: U.S. Army Corps of Engineers, San Francisco District, 1980), 23.

⁷ Lewis, 44-45.

⁸ Lewis, 44-45; Hagwood, 23.

⁹ Thompson, 32.

¹⁰ Hagwood, 24.

¹¹ Thompson, 40.

¹² Lewis, 59.

¹³ John Gibbon, *Artillerist's Manual, 1860*, in *Engineers at the Golden Gate: A History of the San Francisco District U.S. Army Corps of Engineers, 1866-1980* (San Francisco: U.S. Army Corps of Engineers, San Francisco District, 1980), 23.

¹⁴ John A. Martini, *Fortress Alcatraz: Guardian of the Golden Gate* (Kailua, HI: Pacific Monograph, 1990), 20.

¹⁵ Thompson, 44.

¹⁶ Martini, 38.

¹⁷ *Ibid.*

¹⁸ Thompson, 57-60.

¹⁹ Martini, 36-43.

²⁰ Prior to 1864, no Confederate warship threatened Pacific Coast shipping. In that year, however, the *CSS Shenandoah* was designed specifically for that purpose. This ship wreaked havoc on Pacific whalers, and intended to take San Francisco for the Confederacy. Fortunately for San Franciscans, an English ship found the *Shenandoah* outside the Golden Gate in August of 1865 and told the captain that the war was over. See U.S. Department of the Navy, *Civil War Naval Chronology 1881-1865*, 5

- vols. (Washington D.C.: Government Printing Office), 1964.
- ²¹ Martini, 40-41.
- ²² Lewis, 142.
- ²³ Hagwood, 28.
- ²⁴ Tom Killion, *Fortress Marin* (Santa Cruz, CA: Quail Press, 1977), 23.
- ²⁵ David A. Clary, *The Corps of Engineers, Hampton Roads, and United States Coastal Defense* (Charlottesville, VA: University Press of Virginia, 1990), 66-70.
- ²⁶ Martini, 1.
- ²⁷ U.S. Army Engineering School, *Pamphlet on the Evolution of the Art of Fortification, #58 Occasional Papers* (Washington, D.C.: Government Printing Office, 1919), 100.
- ²⁸ Lewis, 68.
- ²⁹ Thompson, 105.
- ³⁰ *Ibid.*, 106.
- ³¹ Hagwood, 28.
- ³² Clary, 126, 129.
- ³³ Lewis, 77.
- ³⁴ Clary, 130.
- ³⁵ *Ibid.*
- ³⁶ Hagwood, 33; Thompson, 131.
- ³⁷ Lewis, 142.
- ³⁸ Clary, 130.
- ³⁹ Lewis, 79.
- ⁴⁰ *Ibid.*, 69.
- ⁴¹ *Ibid.*, 79-82.
- ⁴² Thompson, 202.
- ⁴³ Sedwick Pratt, "Service of the 10-inch Disappearing Guns at Fort Point, CAL., During the War with Spain," *Journal of the U.S. Artillery* 12 (July-August 1899): 4.
- ⁴⁴ Thompson, 202.
- ⁴⁵ U.S. Army Engineering School, *Pamphlet on the Evolution of the Art of Fortification, #58 Occasional Papers*, 101.
- ⁴⁶ U.S. Army, *Drill Regulations for Coast Artillery* (Washington, D.C.: Government Printing Office, 1898), 119.
- ⁴⁷ U.S. Army Corps of Engineers, *The History of the U.S. Army Corps of Engineers* (Washington, D.C.: Government Printing Office, 1986), 67.
- ⁴⁸ U.S. Army Engineering School, *Pamphlet on the Evolution of the Art of Fortification, #58 Occasional Papers*, 97.
- ⁴⁹ U.S. Army, *Drill Regulations for Coast Artillery*, 119.
- ⁵⁰ Thompson, 200-206.
- ⁵¹ Hagwood, 33; Thompson, 208-209; Killion, 40.
- ⁵² Hagwood, 33; Thompson, 209-211; Killion, 40.
- ⁵³ Thompson, 206-07.

- ⁵⁴ Ibid., 207-08.
- ⁵⁵ Ibid., 206.
- ⁵⁶ Martini, 83.
- ⁵⁷ Clary, 148-150.
- ⁵⁸ Lewis, 99.
- ⁵⁹ Lewis, 93; Clary, 151.
- ⁶⁰ Hagwood, 216.
- ⁶¹ Clary, 154.
- ⁶² Ibid., 155.
- ⁶³ Hagwood, 220.
- ⁶⁴ Lewis, 100-101; Hagwood, 220.
- ⁶⁵ Sidney Ballou, "The Coast Defenses of San Francisco," *The Coast Artillery Journal* 61 (December 1924): 531.
- ⁶⁶ Ibid., 532.
- ⁶⁷ Stetson Conn, Rose C. Engelman, and Byron Fairchild, *Guarding the United States and its Outposts*, Volume in *United States Army in World War II: The Western Hemisphere* (Washington D.C.: Department of the Army, 1964), 47.
- ⁶⁸ Lewis, 124.
- ⁶⁹ Clary, 163.
- ⁷⁰ Brian B. Chin, *Artillery at the Golden Gate: The Harbor Defenses of San Francisco in World War II* (Missoula, MT: Pictorial Histories Publishing Company, 1994), 13-14.
- ⁷¹ Hagwood, 231-34.
- ⁷² Ibid., 230.
- ⁷³ Conn et al, 48.
- ⁷⁴ Hagwood, 227.
- ⁷⁵ Killion, 40.
- ⁷⁶ Killion, 40; Thompson 495-500.
- ⁷⁷ Hagwood, 249.
- ⁷⁸ Conn et al, 54.
- ⁷⁹ These temporary wharves were not intended to supply to the entire Allied army till the end of the war. In fact, one of the tenets for Operation Market Garden in September 1944 was to gain access to port facilities at Antwerp.
- ⁸⁰ Clary, 165.
- ⁸¹ Lewis, 133.
- ⁸² Ibid., 124.
- ⁸³ Golden Gate National Recreation Area, *Nike Missile Site SF88L, Fort Barry* (San Francisco: Golden Gate National Recreation Area, National Park Service, 1995), 6.