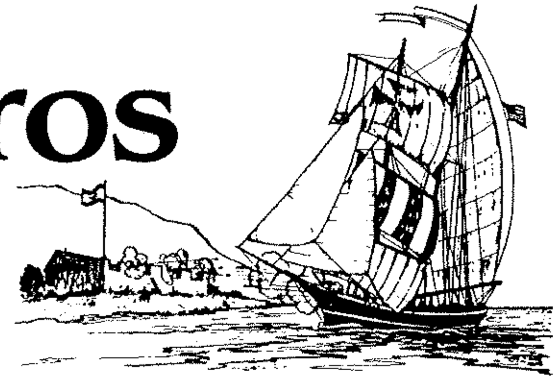
Fort Guijarros Quarterly



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Picture postcard of an unknown disappearing-gun battery emplacement of the same time period as Battery Wilkeson, Fort Rosecrans.

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FORT GUIJARROS QUARTERLY

Published by the Fort Guijarros Museum Foundation, a non-profit organization incorporated in 1981 to commemorate and preserve the heritage of Ballast Point and Point Loma. The Quarterly is a journal of research and information dedicated to the promotion of a better understanding of the history of San Diego from 1796 to the present.

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THE ADMINISTRATIVE HISTORY OF FORT ROSECRANS FROM 1872-1902

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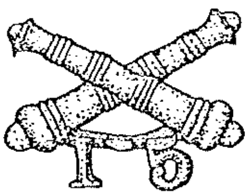


The fortified seacoast defense of America's harbors spans an era from 1812 to 1959 and comprises the integration of engineering, artillery, and naval evolutionary processes within the very political framework of the nation itself. This process is demarked by a series of engineering boards created by presidential direction and implemented by legislative intent. The defense was characterized by a shift from Jeffersonian gunboat policy to Theodore Roosevelt's "Command of the Seas" policy.(1)

It is within this dynamic process that the Endicott Period seacoast defense of San Diego emerged from 1895 to fruition in 1905.(2) The strategic harbor of San Diego Bay was among thirty-one sites targeted for massive infusions of fortification construction and development money. The resulting structures on Point Loma were so massive that most remain today as outstanding examples of post-Civil War military construction in the United States. The concrete gun and communication emplacements, as well as post buildings, are likely candidates for inclusion on the National Register of the United States.(3)

Evolution of the Boards

Coastal defense of America's civilian and military interests in the continental United States during the 18th Century was fragmented by local circumstances of political expediency and lacked a centralized policy for effective strategy against foreign invasion. Defenses were based upon local initiative and limited military and engineering principles. This evoked primarily a message of discontent rather than defense.

As early as the 16th Century, Dutch, Swedish, English, Spanish, and French colonists constructed defensive forts to protect local colonists from Indian hostilities. The earliest American seacoast fort was built on Society Hill in Philadelphia in 1750. During the American Revolution a second was built in 1775. All of these early structures were modeled after architecture familiar to the ethnic groups that produced them. These colonial forts were structures built from earth, rock, and brick, and thus subject to rapid deterioration under the onslaught of wind, rain, flood, and sea.(4)

The availability of inferior local building materials, and shortage of funds to import superior brick and stone, resulted in weak defenses in the New World. A few exceptions include one in New England, the British-made "Castle William," walled with fired-brick mortared with burned oyster shell.

In 1672, the Spanish built the Castillo de San Marcos, a limestone and coral block bastioned fortress in Saint Augustine, Florida. This fort stands today in striking contrast to the fallen and melted adobe, earth, and cobble forts of the greater Spanish Empire in 18th Century California.

In the late 18th Century, the Spanish government fortified the California coast in response to their fears of invasion by British or Russian expeditionary forces. Between 1794 and 1796 they designed and built three seacoast defenses at California harbors. The first defended the capital city of

Monterey, the second defended San Francisco, and the third was dedicated in San Diego on 16 November 1796.(5)

The fort at San Diego on Cobblestone Point in San Diego Bay, better known in the 18th Century as Punta de los Guijarros, was actually an outer cannon battery in Spanish defense schemes. The strategy was to create concentric circles of defense fortifications eminating away from a centralized town. The innner fort was the Presidio, a fortified town five miles northeast on a hill overlooking the bay to the south and Mission Valley to the north and east. In other locations, outer defenses of Spanish cities often included more elaborate structures such as trenches, walls, moats, and batteries of riflemen and cannons at key passes and waterways.(6)

As explained in the 1772 book Principios de Fortificacion, the cannon battery known today as Fort Guijarros served as an outpost and first point of contact to an invading force.(7) Actual construction of presidios and batteries may have been based upon the 25 B.C. writings of Roman architect Marcus Vitruvius Pollio.(8) A 1952 California Division of Mines and Geology publication, Fabricas, attributed the making of adobe bricks, fired tiles, and design of buildings and walls to an 1787 translation of Pollio's Book, De Architectura Libri Decem.(9)

Professor Brad Bartel, Associate Dean of Graduate Studies and Professor of Anthropology at San Diego State University supports the Roman connection.(10) He has compared Roman architecture with both the San Diego Presidio and Fort Guijarros.

Professor Steve Colston, Department of History at San Diego State University, has reported that Engineering Lieutenant Alberto de Cordoba designed Fort Guijarros after correcting defects pointed out by General of Artillery Pablo Sanchez.(11) No known reference to the actual sources Cordoba used in the design can be made to connect Principios de Fortification or De Architectura Libri Decem with Fort Guijarros. The original plans have yet to be uncovered despite several searches in the Archives of the Indies and other sources in Spain.

Following the War of 1812, the United States agreed upon a policy of mutual defense of civilian and military sites around the continental territories.(12) From the American Revolution up to that time, American defense depended upon naval shipping. This was the Jeffersonian gunboat policy.

On 16 November 1816, President James Madison directed Secretary of War George Graham to convene a board of professional engineers to establish a defense policy.(13) On that day President Madison also commissioned the brevet rank of brigadier general upon Simon Bernard of France to serve on that board. Bernard had been assigned by Napoleon Bonaparte as a diplomatic gesture to aid in the development of modern defenses. The board was to include two U.S. Army engineers and one engineer from the U.S. Navy. Brevet Lieutenant Colonel Joseph G. Totten was among those men to serve on that first board and later replaced Bernard in 1838.(14)

Bernard Board (1817-1838)

In 1817, the first Board of Engineers was created to study the continental United States and designate locations in a ranking of relative importance for the selection of seacoast fortifications.(15) The Board of Engineers developed the administrative infrastucture necessary to conduct coastal surveys, study geography, implement policies on defense strategies, design fortifications, critique designs in war boards, and submit requests for funding for contractors to develop the system. The Board of Engineers and subsequent agencies designed the defense of America through the first half of the 20th Century.

In the early years, defense work concentrated on the Atlantic Coast. In the years preceding the Mexican War of 1846 the Pacific Coast did not belong the United States. The Bernard Board developed war gaming with models and maps of coastlines to predict weaknesses and develop coordinated construction and troop training programs.

Artillery of the pre-Civil War era was smooth-bore cannon of short-range and variable accuracy. Defense depended upon strategic development of infantry and naval forces. Roped booms, nets, small warships, and coastal batteries were placed to defend the river and harbor entrances.

Implementation of the Bernard Board policies manifested in the early 1820s. While some of the earlier earth and cobble forts were incorporated in the Bernard Board sites, the majority were preserved for their historical values.

The primary consideration in defense strategy was to discourage foreign invasion. The Bernard Board viewed as failures those defenses where hostilities had already occured. The Bernard Board always considered (1) opposition of foreign naval forces, (2) retention of fortified positions, (3) denial of the enemy's goals, and (4) forcing the enemy to attack pre-selected locations that were the most advantageous to ground forces.

Totten Board (1838-1864)

In 1838, Brigadier General James G. Totten succeeded General Bernard and a new era of defense began. Totten emphasized the development of seacoast fortifications such that seacoast assaults would be only at great cost to foreign invaders.

The Totten Board carried out strategies initiated by the Bernard Board but expanded them to minute detail. The 1840s was a time for nationwide expansion and all branches of government pressed for the invasion of Mexican territories in the west. No doubt the Mexican War of 1846 was an end result of changes in the War Department at that time.

Following the capture of California, the Totten Board swiftly implemented its policies with the establishment of the Office of the Division Engineer in San Francisco and District Engineer offices in Los Angeles and San Diego. The first priority was given to San Francisco and in 1853 Fort Point was built on top of the north wall of the Castillo de San Joaquin, the Spanish fort. Outpost batteries were built on islands in San Francisco Bay and on the north shore of the harbor.(16)

By the time Fort Point was completed, the Totten Board had designed a complete defense for the continental United States. This included harbors and rivers from San Diego to Puget Sound. Tall brick and mortar forts like Fort Point were called "Third System" or "Totten System" forts. They are characterized by several tiers of rows of gunports that were often armored. Inside and on top of the fort were large smooth-bore cannons that were maneuvered on iron barbette batteries.

General Totten himself designed a sheet iron embrasure that sealed the gunport as the cannon rolled back upon firing. These embrasures protected the gunners from incoming fire. The cannons fired 24, 32, and 42 pound projectiles. As ordinance and artillery developed through the Totten Board era the large masonry fortifications became obsolete.

When the Columbian Foundary at Georgetown, D.C. developed their Columbiad cannons, it then became possible to maneuver the cannon at any angle from 0 to 40 degrees. In addition, 64 pound projectiles could also be fired as far as ten miles.

Between 1845 and 1860, the use of high strength metal alloys enabled manufacturers to produce artillery with calibers up to 10, 15, and 20 inches. On 4 February 1861, the Rodman gun replaced the Columbiads and Third System forts posed no match for projectiles fired from those guns.(17) Both the Rodman guns and a later rifled-bore cannon shattered masonry forts during the American Civil War. Within months of the first battles, fortification shifted to earthen embankments backed by timbers and concrete.

Post Civil War (1865-1895)

Following the death of General Totten, the Board of Engineers became a functioning part of the U.S. Army Corps of Engineers. Chief engineers served as presidents of those boards. Two boards were created, one each for the Pacific and Atlantic. As specific fortifications were developed, the officer selected as "secretary" became the district engineer assigned to implement the Congressionally-funded projects. Until the work was completed, the district engineer served as commanding officer.

The post Civil War period was marked by accelerated construction at sites selected by the Totten Board. Many of those sites had not been developed because of funding short-comings and the Civil War. Lessons from that war caused many of the designs to be scrapped. The earthen embankments merged with masonry bunkers to defend systems of mortars, underwater mines, channel obstructions, and outpost shore batteries.

When the Board of Engineers of the Pacific Division convened on 10 December 1872, Secretary and First Lieutenant John Hall Weeden submitted an architectural rendering of a proposed fifteen-gun barbette battery for Ballast Point, San Diego Harbor, California.(18) The Board of Engineers for Fortifications received and endorsed the design on 25 March 1873 and recorded the document with the chief engineer in Washington, D.C. on 2 April 1873.(19)

Weeden arrived in San Diego in 1873. He had orders from Lt. Colonel R.S. Alexander, President of the Board of Engineers, Pacific Division. Weeden hired a civilian construction crew and the necessary equipment to begin cutting an earthen embankment just north of the ruins of Fort Guijarros at a place where the sandstone ridges of Point Loma touched the shale cobblestones of Ballast Point.

Weeden had funds to construct a mess hall, barracks, and other buildings. The fort was to have occupied a spot that measured 750 feet wide by 450 feet deep.(20) That excavation impacted the archaeological remains of prior Spanish and Mexican settlements, as well as a Yankee whaling station. A map dated 29 October 1896 (U.S. National Archives, Record Group 77, Drawer 102, Sheet 20-1), reveals that Weeden had completed one ammunition magazine for a gun emplacement. That magazine measured 23.2 feet long on an east-west axis and 8.1 feet wide. Under the earthen pad were two concrete box culverts designed to drain the site to the sea. An access ramp had also been cut from the beach north of Fort Guijarros up to the top of the pad.

During the period Weeden and his crew were constructing the fort on Ballast Point, the chief engineer and secretary of war learned that, in experiments with Rodman guns against armor-plated earth and masonry forts, the structures were pierced. They concluded that forts such as the one at San Diego were obsolete. Congress cut the funding of such forts in 1874 and Weeden was recalled to San Francisco.(21) Caretakers guarded Ballast Point, driving off whalers and fishermen. There is, however, no clear record of events at Ballast Point after 1874 until whaler Enos A. Wall returned to render whale oil on the point until he died in December of 1884.

Endicott Period (1895 to 1905)

Throughout the 1880s, Congress and the Executive Branch became aware of seacoast weakness. Congressional representatives testified and lobbied for completion of the nation's defenses. In 1885, President Grover Cleveland directed Secretary of War William C. Endicott to assemble a special board of engineers to accomplish that task. The Endicott Board emerged in 1886.(22)

Ordinance research through the 1880s led to a series of dramatic breakthroughs that resulted in the development of rifled cannons which could be loaded through the breech. The barrels were made with successive concentric tubes of high strength forged metal. By 1890, rifled guns could fire ten-inch caliber 123 pound projectiles up to 12,300 yards. New propellants with timed-burning rates enabled longer barrels to be developed.

A special concern in the United States at that time was the development of similar weapons in Europe and the Orient. Mobile battle fleets with rifled guns posed a serious threat to national security.

The Endicott Board presented the secretary of war with a list of twenty-six coastal sites to be fortified. The Endicott System involved floating batteries, torpedo boats, and submarine mines to support the coastal guns. Electrical power enabled system-wide communication and controlled detonation of in-place torpedoes (later known as mines). Optical sighting bases enabled triangulation and calculations for speed and trajectory to be communicated to gun emplacements for plotting of moving targets. Five more ports were added to the list before Congress approved $126,377,800 to implement the plan.(23)

The massive concrete batteries and command posts installed in the natural topography and encased in reinforced concrete were characteristic of the Endicott Period. Plumbed with huge volcanic or granitic boulders, these defenses were designed to withstand 1000 pound projectiles fired from naval battleships. The fortifications typically have twenty to thirty foot thick walls behind another thirty feet of earth. The earthen banks were then planted with native vegetation to camouflage the profiles from offshore. Deep below the gunpits were projectile and gunpowder magazines. Mechanical elevators and chain-hoists brought the munitions up to the gun crews.

The Endicott System guns that fired from these batteries were like none the world had seen before. Projectiles measuring 8, 10, 12, and 14 inches in diameter were fired from "disappearing guns." Gun carriages were counter-weighted to swing up above the top of the emplacements upon command. Upon firing, the guns would swing back in an arc from a fulcrum in the carriage and disappear behind the emplacement. About 300 of these heavy guns were installed in the Endicott Period.

The main batteries were backed up by smaller batteries with light caliber guns placed further away. These smaller guns fired more rapidly and increased the fields of fire. Mine fields offshore were electrically detonated from mining casemates. Behind the rifled guns were mortar batteries. Large caliber mortars fired clusters of projectiles in groups of four. A total of 376 mortar sites were developed during the Endicott Period.

The lighter caliber guns were three or five inch caliber and could fire from five to fifteen rounds per minute. Known as rapid-fire batteries, they were installed in large numbers after 1895. Over 500 of these emplacements were built.

Following the Civil War, fixed mines were hauled out to defend harbors and rivers. In peacetime, these weapons and their cables were stored on land. The term "torpedo" and "mine" were interchangeable during the Endicott Period. During combat, the mines were hauled in light rail cars down wharfs to be swung out to minelaying boats. Cables attached to the mines were connected to cables emanating from mining casemates onshore.

The "Specifications for Submarine Cable of American Manufacture," 27 May 1897, described the cables as having seven-strands of copper cable insulated with rubber wrapped with jute, dipped in insulation rubber, and stored in two-mile lengths in cable drums. Torpedo warehouses were concrete structures under thirty-five feet high and roofed with non-flammable slate.

During the Spanish-American War of 1898, San Diego Bay was mined. Civilian crews worked with the U.S. Army Corps of Engineers to install the cables and mines.(24) None of the troops assigned to the mines were trained in this form of warfare, as construction on the Endicott System had not been completed.

The San Diego Defense

By 1890, the Endicott System had been implemented at eighteen harbors around the continental United States. San Diego was among those ports approved for the system. On 18 February 1893, Congress appropriated $45,000 to preserve and study the unmanned defense structures abandoned by the U.S. Army in 1874.(25) This examination was reported in the Annual Report of the Chief of Engineers and the District Engineer to the Secretary of War, 1893-1903. Colonel Henry L. Abbot was President of the Board of Engineers. He was joined by Colonel C.B. Comstock, Lieutenant Colonel Henry M. Robert, Lieutenant Colonel G.L. Gillespie, Lieutenant Colonel G.H. Mendell (Pacific Division Engineer), and Lieutenant Colonel W.P. Craighill (Southeast Division Engineer). That board inspected Ballast Point on 8 March 1894 and proposed two designs.

When Colonel Craighill was promoted to Brigadier General and Chief of Engineers, Colonel Charles R. Suter became Pacific Division Engineer on 8 August 1896.(26) In turn, Suter appointed Major Charles E.L.B. Davis secretary on 29 October 1896. Davis became district engineer and commanded the construction of fortifications on Ballast Point.

Fort Rosecrans

The defense of San Diego Bay initially called for the development of a series of gun and mortar batteries along the southern shore of North Island and the Silver Strand, opposite the shore of Point Loma, as well as at Ballast Point. Several architectural designs for a mortar battery on North Island were proposed in 1895 and then abandoned when civilian real estate negotiations stalled.(27) The Coronado Land Company would have forced condemnation, a course rejected by the secretary of war. Instead, the Zuniga Shoal Tract opposite Ballast Point enabled the U.S. Army to develop gun batteries and search light facilities on the south shore of San Diego Bay after the turn of the 20th Century.

Battery Wilkenson

The focus of the new San Diego defense was the neck of Ballast Point where Spanish architects had designed and emplaced Fort Guijarros in 1796. The 1872 Weeden map of Ballast Point revealed that the Spanish fort was located just in front of the earthen embankment of the unfinished construction. Major Davis ordered Lieutenant Charles L. Potter and Lieutenant Herbert Deakyne to produce a new map. Davis recommended that Weeden's earthen pad of 1874 be used for a four-gunpit disappearing rifle battery design, thus differing from a plan 15 January 1895. Prior to Davis' arrival, the Board of Engineers had considered demolishing the site of Fort Guijarros with the construction of the new battery.

Davis explained his rationale to the Board as a method for:

1. Reduction of the cost of the battery, due chiefly to great reduction in amount of fill required.

2. Greater field of fire, due to change in direction of front the battery.

3. Less exposure to reverse fire from ships inside Ballast Point, because of the change of direction of the front (Document 16484/3, War Department, National Archives, Record Group 77, 29 October 1896).

Davis went on to explain in detail how the old earthworks would serve well for the placement of 10 inch guns. The driveway to the beach would serve the wharf. The cost estimate for the first two emplacements was placed at $128,610.25.

Under the Congressional Act of 6 June 1896, a request for proposals was advertised only days after the board approved Davis's design change. The actual schedule of details was mailed on 7 July 1896 and the bids were opened on 30 November 1896. The California Construction Company of San Francisco received the contract with a low bid of $109,417.39.

Work began on 1 February 1897 with re-shaping of the 1874 earthwork and demolition of the old concrete magazines. Problems relating to the procurement of cement in the United States were exacerbated through U.S. Customs regulations. The project deadline was extended and work placed on hold temporarily.

Brigadier General General John M. Wilson ordered Major Davis to submit plans for the third gun emplacement. The schedule estimated the cost at $64,000, and noted that additional earth would have to be removed because of defense construction during the Spanish-American War alert. He later lowered that estimate by reducing the concrete and ventilation system.

Major Davis assumed the role of district engineer and commanded all work by the California Construction Company and the defense of San Diego from Point Loma during the alert.

Brigadier General Wilson and Major Davis arranged through the secretary of war to purchase 4000 barrels of German-made cement and then route the cargo through hostile waters.

On 1 October 1898, Major Davis wrote to General Wilson to implore the secretary of treasury to allow passage of 3500 barrels of cement to San Diego duty-free on the British ship _Gunford_. Failure of the _Gunford_ to arrive by 3 December 1898 stimulated another series of letters clearing the ship _Thalassa_ to bring 1500 barrels of cement, which arrived on 9 January 1899.

Meanwhile, Major Davis described the excavations of Ballast Point by the California Construction Company as

> clay mixed with sand, mostly made ground, and becomes very soft when wet. The excavated earth has been placed in front of (the) embankment in front of (the) emplacement and in traverse. On site of (the) gun platform, the ground was wet and soft. It was excavated down to afirm stratum, then moist sand was placed in six-inch layers and tamped; upon this the concrete was laid. (Annual Report, 1893-1906, page 746, U.S. National Archives).

The cement used in the construction of the 10-inch gun emplacement was made from a combination of Hilton, Germania Porta, White Brothers, and Jasson cement mixed with clean white sand that had been recovered from Ballast

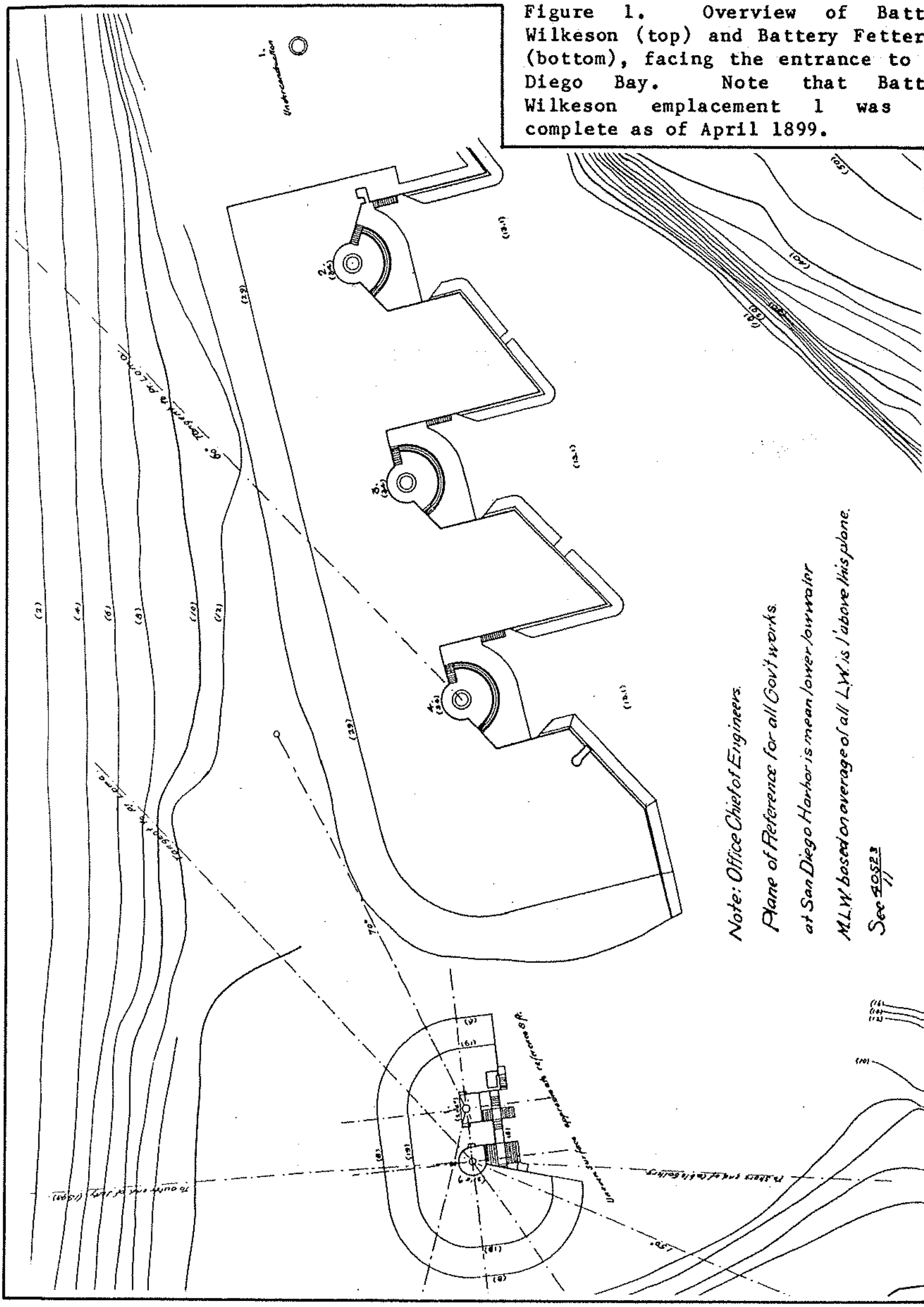


Figure 1. Overview of Battery Wilkeson (top) and Battery Fetterman (bottom), facing the entrance to San Diego Bay. Note that Battery Wilkeson emplacement 1 was not complete as of April 1899.

Point. Major Davis tested the foundation strength with a load of 7,600 pounds of cement poured in a two-foot square wooden form where the

> foundation consisted of five feet of sand, underlaid by a firm stratum of clay, sand, and shells.

The load bore 1900 pounds per square foot and settled one half inch immediately and one third inch ten hours later. Davis found this settlement acceptable and ordered forms constructed for the emplacement.

Cobbles from the beach were dumped in a Gates Crusher to make concrete out of the cement. It was mixed in a Ransom Mixer. After ten turns, it was poured into a bucket and swung on a derrick to the part of the work under construction. Spread in six-inch layers, the concrete was tamped with iron rods. Massive rock boulders weighing up to five tons had been quarried near the Sweetwater Dam and hauled by boat to the site. The boulders were swung into place in the concrete about six inches apart. Men tamped the conrete into the voids as it poured around the mass.

The effect of the concrete and boulder mass was to deflect incoming naval artillery on a flat trajectory. This architecture was then covered with an earthen embankment about sixteen feet thick.

The impregnability of the battery can be underscored by a project in 1902 to cut tunnels between gun pits to enhance communication. Thirty-three foot long galleries, seven feet high, and another gallery forty-seven feet long required removal of sixty-one and a half cubic yards of material. Over one hundred boulders were encountered and forty cut-off. Removal of the entire boulders left holes in the walls, ceilings, and floors, increasing the actual removal to sixty-nine yards. One hundred and ten pounds of Giant Number 2 powder was used in 700 small blasts. Cement without rock filled the holes (Annual Report, 1893-1903, pages 2471-2472, U.S. National Archives).

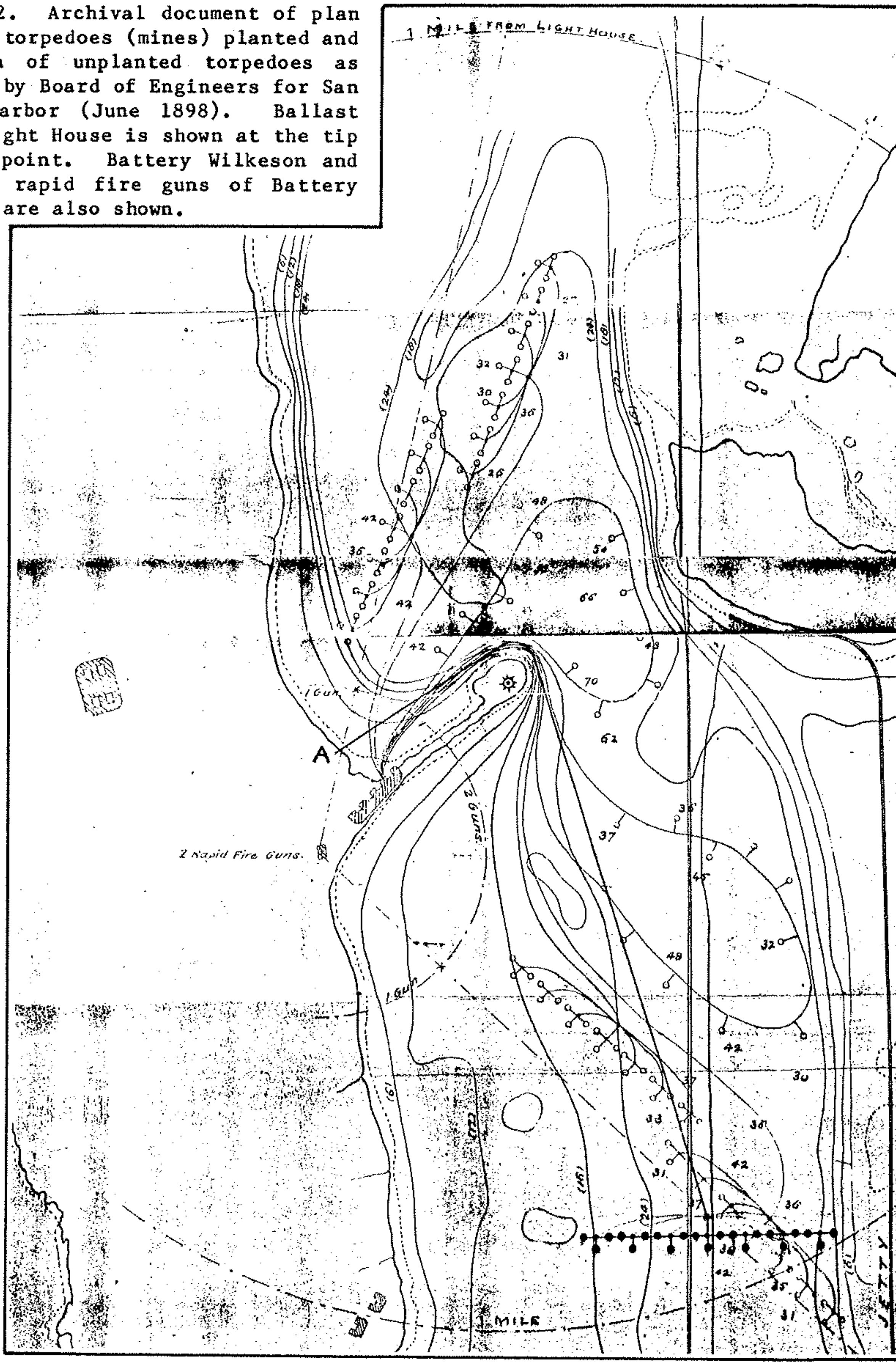
General Wilson authorized construction on the third emplacement on 17 June 1898 and work commenced on 7 February 1898. Two months later, Major Davis was able to report that the first two emplacements were complete and ready to receive the 10-inch rifles. Davis then recommended that an officer from the San Diego Barracks be designated to receive command of regular troops to install the carriages and guns. General Wilson then transmitted the message to Brigadier General Shafter, Commanding Officer, San Diego Barracks that quarters were ready in the 1874 barracks near Ballast Point.

On 21 May 1898, Davis telegraphed General Wilson that the guns were installed and teams of civilians had been recruited to install mines in San Diego Harbor for the Spanish-American War. Fifteen mines were installed two days later and two Civil War vintage Napoleon cannons were transferred from the San Diego Barracks to assist in the detonation of the mines in the event of battle. The U.S.S. Corwin had been diverted from revenue duties to patrol the harbor and mine field (Annual Report, 1893-1903, page 30, U.S. National Archives).

The mines were laid with a volunteer crew of eighty citizens, including carpenters, electricians, civil engineers, surveyors, telegraphers, boiler-makers, steam engineers, boatmen, and mechanics. General Shafter received material from Major W.H. Heuer, U.S. Army Corps of Engineers, San Francisco. One Non-commissioned officer and four enlisted men were assigned from the Engineer Battalion. Mariners received a notice on 20 May 1898 that the harbor was mined and orders published in the newspapers to enforce a blackout after 25 May 1898.

Major Davis devoted his efforts to designing the fourth emplacement, following orders to that effect from

Figure 2. Archival document of plan showing torpedoes (mines) planted and position of unplanted torpedoes as devised by Board of Engineers for San Diego Harbor (June 1898). Ballast Point Light House is shown at the tip of the point. Battery Wilkeson and the two rapid fire guns of Battery McGrath are also shown.



General Wilson on 7 May 1898. Davis estimated an additional 8,000 cubic yards of excavation, "due to the fact that under the stress of the war excitement in the early Spring, an earth filling was put around the uncompleted and exposed flank of emplacement number 2." (Annual Report, 1893-1903, page 975, U.S. National Archives; Major Davis to Brigadier General Wilson, 5 July 1898).

Modifications of the design for emplacement 4 by Colonel Charles R. Suter, Division Engineer, Pacific Division, and Captain Joseph Kuhu of General Wilson's staff reduced the cost estimate to $60,000. The Congressional Act of 7 July 1898 funded the work and the California Construction Company commenced work in September of 1898. The layout of this last gun emplacement was far more elaborate than the other three.

Unforeseen problems arose during the construction of emplacement 4. Excavation pierced the water table. The weight of the mass of emplacements 1 through 3 pushed the water table higher. Pile driving in the cobbles of Ballast Point would have cracked the other emplacements and excavation to basement rock would have required extensive shoring and pumping. The latter plan was selected by Major Davis, but at greater cost.

Foundation and water problems encountered by the U.S. Army Corps of Engineers and the California Construction Company later led to serious cracks in numerous areas of the 10-inch gun battery. One large crack near emplacement 4 currently measures three inches wide.

Cracks in the concrete became a serious problem during the history of the battery. Regular artillery commands repeatedly requested the District Engineer to seal leaky cracks. Gallons of linseed oil were poured down the cracks, only to leak again the following season. Eventually, a veneer of cement troweled into small squares "in imitation of sidewalk to mask flaws and other narrow cracks" camoflauged the problem (Annual Report, 1893-1903, page 978, U.S. National Archives).

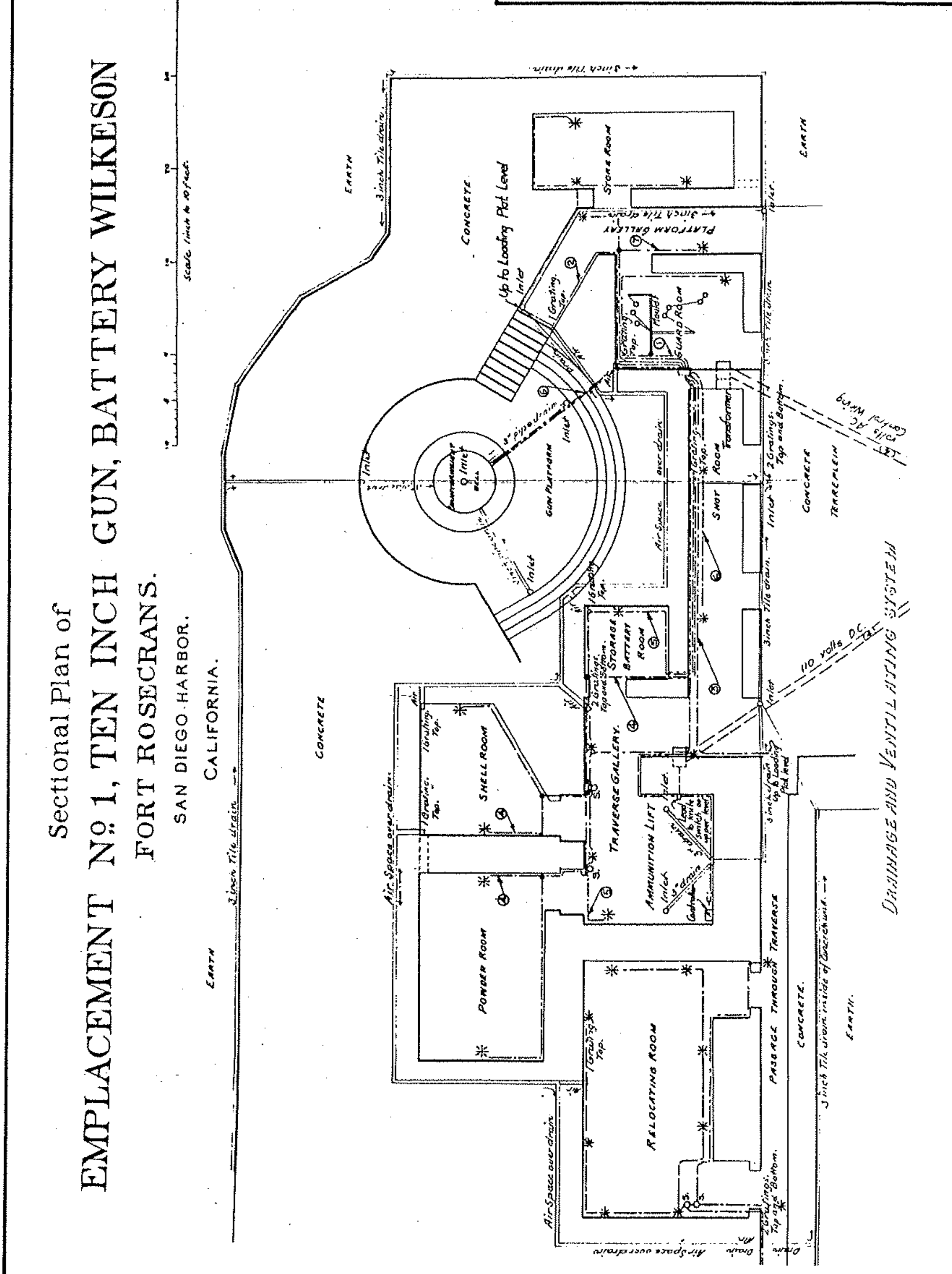
After the guns were installed, soldiers then assisted the contractors in placement of the aerial trolley, ammunition lifts, cranes, speaking tubes, staircases, railings, and doors. In small pits on top of the battery, Type A Lewis Range finders were installed.

Modification of the emplacements was a daily activity in the final days of the dual operations of the soldiers and engineers. Orders from various U.S. Army research and development branches required improvements in the electrical, sighting, and loading systems. In 1901, for example, the ammunition lifts wre replaced by chain-hoists and balanced platform lifts. The Taylor-Raymond Chain Hoist, made by the Ellicott Machine Company of Baltimore, had been ordered by Colonel Suter out of the Division Engineer's office for this replacement.

At that time, Captain James J. Meyler, U.S. Army Corps of Engineers, and civilian engineer, David Hughes transferred to San Diego to join Artillery Inspectors Captain George L. Anderson and Captain Sedgewick Pratt in the formation of the Artillery District of San Diego.(28) They were joined by Major A.W. Vogdes, who assumed command of the San Diego Barracks on 18 June 1901. Major Vogdes relieved Captain E.T. Cole, Infantry, who had been on temporary assignment to supervise the installation of the guns. Captain Cole remained under the command of Major Vogdes.

On 22 July 1899, General Order Number 134, War Department, named the Military Reservation on Point Loma "Fort Rosecrans" in honor of General William S. Rosecrans, a Civil War veteran who later advocated the development of rail and military facilities in San Diego. Major

Figure 3. Emplacement No. 1 of Battery Wilkeson.



Vogdes moved from the San Diego Barracks on Market Street after assuming command of the San Diego Artillery District. General Order 63 authorized the transfer of Captain Meyler to the Artillery District as district engineer.

Major Vogdes assumed command of one of the first U.S. Army Artillery Corps units in the United States. This administrative unit had been created on 2 February 1901 with 126 companies assigned to thirty-one coastal and river forts. Each company had been organized to service a major caliber gun, mortar battery, two or more rapid-fire gun batteries, or a mine battery. From regular troops at the San Diego Barracks and veterans of the Spanish-American War, Major Vogdes first formed the 30th Company of Coast Artillery and assigned Lieutenant G. A. Youngberg as the first company commander. Upon completion of training of the 30th Company, Major Vogdes then divided a portion of the troops and formed the 115th Company of Coast Artillery under Captain E. T. Cole.

Administratively, Captain Meyler remained under the command of Lt. Colonel D. P. Heap, Division Engineer, San Francisco, in addition to direct command of Major Vogdes. Vogdes answered to Major William E. Birkhimer, Artillery Inspector, and Major General S. B. Young, Artillery Division, San Francisco.

The San Diego Artillery District also included two batteries of rapid-fire guns on the flanks of the 10-inch battery, known then as Battery Wilkeson. Uphill was Battery McGrath and down on the east was Battery Fetterman. In later years, searchlight batteries were placed further east on Ballast Point and above Battery McGrath. The 115th Company serviced Battery Wilkeson and the 30th Company divided their troops among the rapid-fire batteries and the mine cables.

By 1902, Major Vogdes ordered the oil lamps in the batteries to be replaced by incandescent lights powered by a dynamo borrowed from the Torpedo Station and placed in the Relocating Room. Clocks, megaphones, and telephones followed.

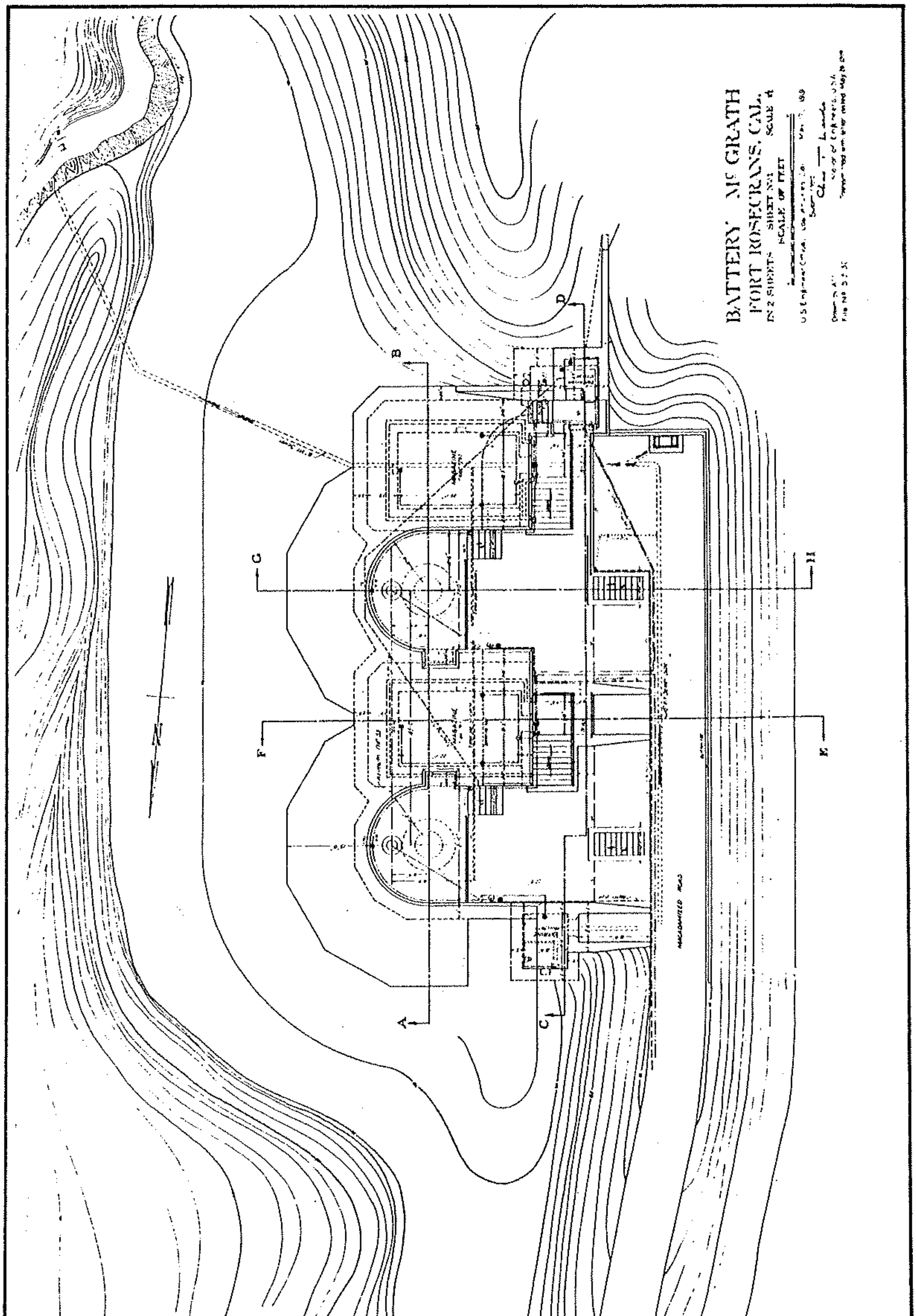
> On March 28, at 9:23 PM, the call to arms was sounded without previous warning, the U.S.S. Farragut, having been sighted off Coronado, Cal., in an attempt to torpedo the U.S.S. Wisconsin; within a trifle less that (sic) five minutes the men were all at their assigned stations except that "A" and "B" stations were not manned, these details being held on the flank of the battery. Within fourteen minutes No. 3 gun was loaded with dummy shot and cartridge, laid in case III and fired; Twenty minutes later the Farragut was communicated with, by signal lantern as she entered the harbor.(29) (Major Vogdes to Adjutant General, Artillery Corps, Department of California)"

Battery Fetterman

Battery Fetterman protected the eastern flank of Battery Wilkeson with two three-inch caliber, 15-pounder, rapid-fire guns. Design changes placed the location of this battery essentially parallel with the front slope of Battery Wilkeson. The final plan was submitted by Captain Meyler to General Wilson on 2 February 1899. Meyler estimated that it would cost $8865.24 to remove 2750 cubic yards of earth from behind Battery Wilkeson to cover the concrete of Battery Fetterman.(30) Labor and equipment were taken from the latter project and the tramway extended 300 feet from the cement plant behind Battery Wilkeson. Cement from the Thalassa was used in this construction.

The ground at the site of Battery Fetterman was described as a fine, wind-blown sand containing much mica,

Figure 4. Battery McGrath.



some black magnetized sand and appearing light gray in color (Annual Report., 1893-1903, page 2470, U.S. National Archives). Mortar was used to coat the interior and lampblack darkened the exposed walls. The outer earth was then coated with crude oil to retain the soil from erosion. Lt. Youngberg and the 30th Company of Coast Artillery installed the guns in 1902.

Battery McGrath

Uphill from Battery Wilkeson, Battery McGrath had been designed by Captain Meyler and plans submitted on 21 June 1899 with an estimated cost of $10,270. The location and plan were adopted by General Wilson and work completed on 16 October 1900. The Artillery Corps assumed command on 7 November 1900, but the guns were not installed until late 1902.(31)

It is interesting to note that the construction crew complained about the basement in the excavation. They encountered a resilient adobe and concrete-bonded cobble construction that had to be blasted to penetrate.(32) This is likely to have been a Spanish or Mexican construction, perhaps the powderhouse. More on the feature remains a mystery.

Mining Complex

Fort Rosecrans also included a mining complex that protected the harbor from naval invasion. Initially, the Torpedo Station and Cable Tank lay one mile north at the Quarantine Station, but was later moved to the inside of Ballast Point in 1910.(33)

The Mining Complex was a well-protected encasement that had been buried and entered in underground tunnels. Cables led from the tunnel out into the water to the end of a wharf. In the event of war, more cable from the Cable Tanks would have been hauled on a tram to the end of the wharf, connected to the permanent cable, and extended into the harbor. The Mining Casemate housed the electrical dynamo, power storage batteries, and cable gallery.

Changes in design and equipment created quite a stir during the Spanish-American War. In the excitement of the alert, it was discovered that the doorways were too small to allow the new dynamo to pass through. Thus it had to be hidden outside in the canyons above Sylvester Road.

Other Facilities

The power and light facilities, battery commander's station, and the post buildings supported the gun batteries and mine system. The strategy for Fort Rosecrans in 1902 was to hide the power stations and sighting places in the canyons and uphill from the main emplacements.

Conclusion

Fort Rosecrans in 1902 lacked the impressive officer and enlisted men's structures that remain today. Post buildings were limited to the barracks, mess hall, stable, and old whaler's shacks left behind by Lt. Weeden in 1874. Even Fort Pio Pico, designed for the Zuniga Tract, across the bay on North Island, would not be constructed until 1906.

When Major Vogdes ordered the practice firing on the U.S.S. Farragut, Fort Rosecrans must have been an awesome sight for the civilians of San Diego. Hidden under the Coastal Sage Scrub vegetation, back in the canyons and below the old 1874 post buildings, immense concrete bunkers greeted the 20th Century with the mightiest defense ever to have been mounted in San Diego history to that time.

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OFFICERS OF THE U.S. ARMY AND OTHERS IN HONOR OF WHOM COAST ARTILLERY POSTS AND BATTERIES IN THE HARBOR DEFENSES OF SAN DIEGO HAVE BEEN NAMED

Compiled by Alvin H. Grobmeier

ASHBURN, Major General Thomas Quinn, U.S. Army.	GO 69, 1942
CABRILLO, Juan Rodriguez, navigator in the Spanish service, who discovered San Diego Bay, and who died January 3, 1543.	RCW, 1944
CALEF, Lt. Col. John Haskell, 3rd U.S. Artillery, who died January 4, 1912.	GO 36, 1915
CORTEZ, Hernando, Spanish soldier and explorer, conqueror of Mexico, who died December 2, 1547.	RCW, 1944
EMORY, Brigadier General Helmsley, U.S. Army.	GO 67, 1942
FETTERMAN, 2nd Lieut. George, 3rd U.S. Artillery, who died June 17, 1844. (2 batteries)	RCW, 1944
GILLESPIE, Major Archibald H., U.S. Marine Corps, who participated in the first American occupation of southern California in 1846, and who died August 16, 1873.	Note 2
GRANT, Colonel Homer Blackie, Coast Artillery Corps, U.S. Army.	GO 69, 1942
HUMPHREYS, Captain Charles, Coast Artillery Corps, the first commanding officer of Fort Rosecrans.	GO 28, 1942
MCGRATH, Major Hugh Jocelyn, 4th U.S. Cavalry, holder of the Medal of Honor, who died November 7, 1899 of wounds received in action at Noveleta, Luzon, Philippine Islands on October 8, 1899.	GO 16, 1902
MEED, Captain James, 17th U.S. Infantry, who was killed in action at Frenchtown, Michigan, January 22, 1813.	GO 20, 1906
PIO PICO, Last governor of California under Mexican rule.	GO 20, 1906
ROSECRANS, Major General William S., U.S. Volunteers, Brigadier General, U.S. Army, who died March 11, 1898.	GO 134, 1899
STRONG, Major General Frederick Smith, U.S. Army, who organized the 40th Divison at Camp Kearny, California, in 1917 and commanded the division in France in WWI.	GO (unknown)
WHISTLER, Colonel, Garland Nelson, Coast Artillery Corps, U.S. Army, who died June 25, 1914.	GO 15, 1916
WHITE, Colonel John Vasser, Coast Artillery Corps, U.S. Army, who died August 24, 1915.	GO 15, 1916
WILKESON, First Lieut. Bayard, Bvt. Lt. Col., 4th U.S. Artillery who was killed in the battle of Gettysburg, Pennsylvania July 1, 1863.	GO 16 1902
WOODWARD, Colonel Charles C., who died November 23, 1939, or First Lt. Evan M., Medal of Honor recipient. (Note 3)	GO (unknown)
ZEILIN, Brigadier General Jacob, U.S. Marine Corps, who took part in the conquest of Califoria, and who died November 18, 1880.	Note 2

*GO - Army General Orders.
*RCW - Report of Completed Works - Seacoast Fortifications.
Note 2 - Unofficial name given to interim/temporary battery in WWII.
Note 3 - Clarification required for whom Battery Woodward was named.

POSTWAR USE OF BATTERY CONSTRUCTION NUMBER 134

Alvin H. Grobmeier

Editor's Note: Alvin H. Grobmeier was the Asst. OIC at NAVRADSTA (R) Imperial Beach in 1958-60.

Fort Emery (Coronado Heights Military Reservation) was a subpost of Fort Rosecrans at San Diego and the location of Battery Construction Number 134. Construction of 134 commenced on March 27, 1943, and was completed in a curtailed status on February 21, 1944, transferring to the Coast Artillery on November 11, 1944.

It was to have mounted two 16-inch guns on barbette carriages and was reportedly to have been named Battery Gatchell after a former Fort Rosecrans commanding officer, but the guns were never installed and the name was never officially assigned. The huge structure, costing $1,044,970.29 and built of reinforced concrete, remained vacant until 1947 when the U.S. Naval Radio Station (R) Imperial Beach was established in 134, having moved from a site on Point Loma. It retained the Radio San Diego call sign NPL.

The 500 ft. long main corridor tunnel of 134 was inclined sightly upward from the emplacements at each end for about 100 feet with the center 300 feet being level and slightly elevated from the emplacements. It was in this 300 feet that the Navy placed the operating positions and radio receivers for one of its main west coast radio stations. The south shell room and powder room became the officer-in-charge's office and administative office, respectively, while the north powder room became a communication-security monitoring space and the north shell room housed the large AN/FRM-3 frequency measuring equipment.

The two storerooms at the north part of the main corridor were used by the Navy Electronics Laboratory, Point Loma, for experiments with LORAN and OMEGA, both radio navigation systems. The casemates' fronts were for parking space for the station's emergency communications van and station vehicles. The 25 x 60 ft. powder room in the rear of the tunnel and on a lower level had had the generators removed and was an empty space with a highly polished light green tile floor, used occasionally for personnel inspectios during inclement weather. The old Army motor-generator set in nearby Battery Grant provided the station with emergency power when required.

Along the west wall of the main corridor was where the Navy radiomen maintained a continous 24-hour watch for ship-to-shore traffic. Nearby was a large bank of remote controlled radio receivers used by Fleet Air Wing 14 and other commands at the Naval Air Station, North Island, six miles north on the Silver Strand and next to the city of Coronado.

The site at Imperial Beach was a "quiet area" for long-range radio reception and provided space for a large field of rhombic receiving antennas in front of 134. Far-ranging Navy patrol seaplanes and ships close to shore and far at sea sent their messages there without delay. The NPL radiomen often vied with their counterparts at NPG San Francisco, NPM Honolulu and even with NPN Guam to be the first to answer a ship's call and accepts its radio traffic. When the first U.S. Navy submarine surfaced at the North Pole in 1959, NPL's radiomen were the first to answer its call.

Stretching some 2000 feet in a north-south line, the PSR, 134 and Battery Grant (239) remain today covered with earth and ice plant. From seaward they appear as three large humps along the Coronado Bay beach which is only a few hundred feet away. A two-story concrete building has replaced 134 as the main receiving site, the rhombic antennas replaced by a circular display antenna array and satellite dishes, and the Morse code dots and dashes replaced by high speed radio teletype and digital data systems.

Navy men and women now work side by side as opposed to the days when there were no women assigned to NPL at Imperial Beach. Even the name has changed as Naval Radio Receiving Facilty Imperial Beach continues to use 134 as spare office and storage space. Although it has been within the city limits of Coronado for many years, 134 will always be known as the fort at Imperial Beach.

TRAGEDY AT BATTERY MCGRATH

Alvin H. Grobmeier

Battery McGrath at Fort Rosecrans, San Diego, California, was named in honor of Major Hugh Jocelyn McGrath, 4th U.S. Cavalry, who died November 7, 1899 of wounds received in action at Noveleta, Luzon, Philippine Islands, on October 8, 1899. Commenced in August 1899, the battery was completed in March of 1900 and transferred to the Coast Artillery on November 17, 1900. Two 5-inch guns were mounted on balanced pillars. These guns were removed to an overseas outpost on September 23, 1917*, and replaced on February 28, 1919* by two 3-inch pedestal mount guns transferred from Battery Meed, Fort Pio Pico, which was across the San Diego harbor channel from Fort Rosecrans.

For a period during World War II, Battery McGrath was the examination battery for Fort Rosecrans but it was disarmed in 1943 and abandoned after the war. In 1957 it came under Navy ownership and in 1963 under what is now the Naval Submarine Base, San Diego.

In more recent years, Battery McGrath has been used to store illegal fireworks confiscated by the Customs Service at the Mexican-U.S. border before they were eventually destroyed by personnel of the Army's 70th Explosive Ordnance Detachment. On the morning of July 29, 1980 tragedy struck when Army EOD personnel were loading a truck with fireworks stored in the battery. A fire started on the truck, either from a spark or some careless smoking, and quickly spread to the concrete bunker where an explosion and fire killed three and injured two. Two were burned beyond recognition - a man huddled over a woman soldier, apparently trying to protect her. Thereafter, the Army no longer stored and destoyed illegal fireworks for the Customs Service at San Diego.

Battery McGrath's wartime black tar and paint on its outer concrete surface has been changed to a creamy white with the structure little used now and completely enclosed by a fence within the naval Submarine Base.

*Dates in Report of Completed Works and the Fort Record Book differ.

Fort Guijarros Metal Conservation Proposal

Diana Dessel
Research Associate

EDITOR'S NOTE: Diana Dessel is a graduate student at San Diego State University pursuing a master's degree in Anthropology. She is using the Fort Guijarros metal collection as the topic for her master's thesis. The Foundation has committed a portion of the Colonel Frank Wood Memorial Trust, San Diego Community Foundation Grant to assist in her conservation of the metal.

Conservation of archaeological artifacts is an imperative step in all field research. Proper care of artifacts will allow future researchers and museum visitors a valuable study resource. The science of metal conservation is being studied and practiced in many fields, such as art conservation, metal corrosion science (with its many industrial applications), museum science, and archaeology. These fields have such divergent goals, in most cases, that they have shared little information. I was therefore extremely fortunate to be able to consult with Ms. Rosa Lowinger, an experienced art conservator with extensive experience in marine metal artifact curation.

I am indebted to the Fort Guijarros Museum Foundation for the moral and financial support for the consultation with Ms. Lowinger. The consultation took place in Santa Monica, California, in late February, 1989. This paper (for which I claim sole responsibility) is an outgrowth of Ms. Lowinger's verbal guidance and the written resources which she graciously provided.

Before explaining the metal conservation treatments, it is crucial to cover the process of corrosion. Metals, in the form we use them (spoons, steel girders, and nails), are electrochemically unstable (ions). As such, when subjected to certain elements of the natural environment, metal will tend to return to the mineral state (ore). Rust and the green film (patina) that forms on objects of copper are evidence of this process. The rust and green film, also called corrosion products, form on metal surfaces at different rates. For instance, due to differences in molecular structure, iron corrodes much faster than copper.

Other corrosion factors are environmental. Metal artifacts exposed to air will attract oxygen atoms in order to form oxides (in the case of iron, iron oxide or rust) (Sanford:1977:57). Metals exposed to water will also attract oxides, but the liquid nature of water also makes movement of other atoms easier. Sea water, for instance, provides salts which combine with attracting metal ions (to form cupreous chloride, on a copper surface), and a liquid ion-exchanging environment allowing one metal object to lose ions to another metal object (Pourbaix:1977:15). This latter process is commonly called plating and we use it, in a controlled fashion, to plate silverware, musical instruments, and many other everyday items.

As mentioned above, metals corrode at different rates. In the plating process a metal which corrodes at a relatively slower pace (copper, for example) will attract ions from a metal which corrodes at a faster pace (iron) (Chilton:1973:16). This is why it is better, even in a relatively dry environment, not to bag artifacts of different metals together.

This is the corrosion process at the atomic level, but how does this process appear on the artifact? As corrosion progresses, the metal forms layers of corrosion product (the iron oxide or cupreous chloride mentioned above). This process occurs under the previous layers of corrosion at the metal surface. The corrosion products are heavier and larger than the underlying metal. Thus, if an artifact is cracked and corrosion takes place in the crack, it can distort the shape of the artifact or break it apart (Ibid:1973:11). In addition, the corrosion process produces a porous matrix functioning much like a sponge attracting corrosive elements to the underlying layer of pure metal (Lowinger: 1989:6).

In the wake of prolonged exposure to the aforementioned environmental and human-made elements, what factors are involved in choosing conservation measures? From an academic standpoint, the conservator's primary responsibility is to stabilize the collection. The archaeologist, in particular, must use reversible conservation techniques, where feasible, to allow for future spectrographic and microscopic evaluation. From an administrative perspective, it is difficult to balance these responsibilities with the realities of time, budget, and materials. The procedures are time-intensive. Then too, the financial burden of these processes is great. (A preliminary estimate of supplies for curation of Fort Guijarros Field III metal came to $1,249.72.) Fortunately, most metal collections are smaller than that of Fort Guijarros and will therefore require a smaller volume of supplies.

Researching supply sources will help keep costs down. For instance, local chemical outlets will generally sell chemicals at a better price than out-of-state or international outlets. (Be careful not to skimp on the grade of chemical. Reagent grades [chemicals of the purest form]) are necessary to avoid contamination of the artifacts with possible corrosive elements of less pure grades.) (Lowinger:1989:19).

Despite these money-saving suggestions, the price of curation of metal is likely to be steep. Fortunately, many conservation grants are available and the reader is advised to look to the foundation section of the local library for a listing of these grants.

What follows is a general overview of treatment processes for metals suffering from prolonged exposure to a marine environment. Generally, these conservation processes have three parts: (1) removal of corrosion product; (2) treatment of the artifact to prevent further corrosion; and (3) safe storage.

Following Lowinger's suggestion, I have developed eight treatments. Each treatment was developed according to the condition of the artifact at excavation and the chemical composition of the artifact. The treatments are designated by an alphabetical code to facilitate recording in a laboratory journal (Lowinger: 1989:24).

CAUTION: The chemicals involved in these processes have various hazardous properties. Under no circumstances should anyone attempt to use them without the guidance of a trained and knowledgeable professional. Use of the proper equipment and precautions are also essential. (Chemical supply houses will mail, upon request, safety sheets which spell out the hazards of a given chemical.)

FIELD TREATMENT A

This process is for fragile and wet artifacts removed from a site and transported to the laboratory.

1. Pedestal if possible.
2. Photograph in situ.
3. Carefully drape the upper portion of the artifact in loose cheesecloth. Gently undercut the artifact, wrapping the artifact and its matrix in loose cheese-

cloth. Allow to dry. This step was devised by Storch for use in his field manual. (1986:132)

4. When dry, paint the bundle with a 5% solution of Acryloid B72, Xylene to 100 ML of solution.
5. In the lab, dissolve the dried acrylic solution with xylene and mechanically clean.
6. Photograph or sketch in the lab.
7. Proceed with treatment D, F, G, or H.

NOTES: The Acryloid B72 mixture is a solidfying solution. It is composed of a 5% solution (by weight) of Acryloid B72 to Xylene (Lowinger:1989:24). Avoid inhaling Xylene and Acryloid B72 fumes. Work only in open air with an industrial grade chemical mask. Wear gloves when applying the solution and avoid spilling it on clothing. Xylene is a solvent, so it should not be stored near flame or in direct sunlight. Do not smoke or allow flame around it. Do not breath the fumes. First aid: remove contaminated clothing, give fresh air, warmth, CPR if breathing stops. Move only by car, stretcher, or ambulance (Organ:1968:387).

FIELD TREATMENT B

For use on fragile and dry artifacts in removing from site and transporting to lab.

1. Pedestal.
2. Photograph in situ.
3. Consolidate with the Acryloid B72 solution. (See Treatment A for the proportions used). Let dry. Tag.
4. Transport to laboratory.
5. In lab, dissolve consolidant with xylene and mechanically clean.
6. Proceed with Treatment D,F,G, or H to extent possible.

NOTES: Please note precautions as specified in the notes for Field Treatment A.

LABORATORY TREATMENT C

For iron or iron alloy objects put aside for spectroscopic or microscopic analysis.

1. Sketch.
2. Wash, mechanically clean.
3. Distilled water leach baths.
4. Dry in 200 degree oven for 2 hours.
5. Dip in acetone (to dry).
6. Put in dry storage.

NOTE: The leach baths in this treatment and treatments D, E, F, and G are principally the same as described in Lowinger (1989:9). In the beginning, a test bath is run. To start, place distilled water in a glass pot (Corningware or Pyrex works best). Heat the water to boiling, then reduce to a medium heat. Tie a long string to the artifact and attach a provenience tag to the other end of the string. The artifact is then ready to insert in the boiling water. Boil the artifacts for an hour, then turn off the heat. Let the artifacts soak overnight. Test the water for salinity in the morning. (Cole Parmer sells a saline test kit which yields over 100 tests for approximately $20.00. Next, test the salinity of the tap water. If there is less salt in the tap water, use it for the first few baths; then switch to distilled water. The artifacts are then boiled for one hour every day and left to soak the remaining 23 hours. The baths are continued until the bath water contains no chlorides.

LABORATORY TREATMENT D

For iron or iron alloy objects which are being preserved as recognizable objects for museum display or archaeological research.

1. Sketch.
2. Wash, mechanically clean objects.
3. Distilled water leach baths (4-5 days).

4. Dry in 200 degree oven for 2 hours.
5. Acetone dip.
6. Paint with Exxon Rust-Ban 392. Let dry.
7. Paint with a solution of Acryloid B48N (5% by weight), Xylene and microcystalline wax solution. Let dry.

NOTES: Please observe warnings and precautions described in Treatment C for the leach bath. Exxon Rust-Ban 392 is a rust-inhibitor recommended by Lowinger (1989:16). The can comes with a brochure of precautions. Basically, it is flammable, toxic if inhaled, and may be cancer causing. Wear an industrial strength chemical mask and wear gloves. Do not smoke or use around an open flame. The Xylene, Acryloid B48N and microcrystalline wax solution is an acrylic protective coating. When using this solution, wear a mask and gloves. Use both products in a well-ventilated area and keep the artifacts in this area for 48 hours after treatment to allow the Xylene to dissipate.

LABORATORY TREATMENT E

For copper or copper alloy objects set aside for microscopic or spectroscopic analysis.

1. Sketch.
2. Wash, mechanically clean object.
3. Modified leach bath (4-5 days).
4. Acetone bath (to dry).
5. Distilled water rinse.
6. Acetone rinse.
7. Manual clean.
8. Acetone rinse, dry.

NOTES: Lowinger suggests brass artifacts not be boiled during the leach baths. Rather, bring the water to a boil and turn the heat off before placing brass objects in the bath (1988:18). The artifacts under this treatment should be completely dry when stored. See cautions for acetone (Treatment C). Please note, this treatment does not involve the use of the oven.

LABORATORY TREATMENT F

For copper or copper alloy objects which are being preserved as recognizable objects for museum display or general archaeological research.

1. Sketch.
2. Wash, mechanically clean.
3. Leach baths (4-5 days).
4. Acetone bath, manually clean.
5. Mechanical cleaning.
6. Sodium carbonate (5% by weight) distilled water bath (5 hours). (See Treatment E.)
7. Mechanical cleaning.
8. Distilled water rinse.
9. Mechanical acetone rinse.
10. Manual cleaning.
11. Benzotriazole (3% by weight) and Ethanol bath (7 days).
12. Dry.
13. Paint with Incralac (5% by weight), Xylene, and microcrystalline wax emulsion.

NOTES: If the item is badly corroded, do not paint it with this mixture. See the notes on the modified leach bath and the sodium carbonate bath in Treatment E. the sodium carbonate bath serves to indicate otherwise hard to see areas of coorrosion. CAUTION: Sodium carbonate is caustic. Avoid physical contact and ingestion of this chemical. Benzotriazole, for reasons as yet unclear to the scientific community, acts to deter corrosion in cupreous objects (Greene:1975:2). This chemical may be carcinogenic. Use an industrial strength chemical mask and gloves when handling it and take special care not to spill it. Take similar precautions when handling the Incralac since this mixture also contains Benzotriazole. Incralac impregnates the pores of the object to stop corrosion processes. For this treatment, observe safety precautions for acetone (see

Treatment C), sodium carbonate (see Treatment E), and Xylene (see Treatment B). First aid: keep warm, give large amounts of warm water, then an emitic, then coffee (Organ:1968:384).

LABORATORY TREATMENT G

For lead objects.

1. Sketch.
2. Wash object in tap water only.
3. Soak in caustic soda, water, and zinc solution.
4. Rinse in distilled water which has not been deionized.
5. Dry in 200 degree oven.

NOTES: Due to time constraints, Ms. Lowinger and I did not cover curation of lead. This treatment for lead was developed by the Department of Scientific and Industrial Research, H.M.S.O., in London (Organ:1977:142). Organ did not give the exact strengths of the elements of the solution, so future research is needed. In working with lead, Lowinger recommends the following precautions: Use distilled water which has not been deionized. (Lowinger:1990); It is also important that during treatment and storage lead should not contact organic objects or chemicals.

LABORATORY TREATMENT H

For use with objects of more than one material (composite) artifacts.

The treatment for composite objects will require research on an individual basis and cannot therefore be listed here. They will be fully described in the conservation log.

STORAGE

Long term storage of metal artifacts requires protection from the environment. As such, storage containers must be air tight and bone dry at all times. In addition, smaller artifacts must be stored in a way which protects them from crushing. With these factors in mind, I propose to store small artifacts in small polyethylene bags stapled to acid-free cards (the acid in regular card stock will corrode metal). These cards can then be filed in square polyethylene air-tight containers with small bags of silicon which absorb moisture. Larger artifacts can be wrapped in acid-free tissue paper and placed in polyethylene zip-lock bags with silicon. These bags can then be stored in acid-free storage boxes (again, regular cardboard contains corroding acid vapors which will invade bags with air leaks).

CONCLUSION

Conservation of metals interred in marine environments requires consultation with a skilled conservator such as Ms. Lowinger, a thorough understanding of laboratory safety procedures (and expert assistance in the laboratory), financial assistance (in the form of grant monies), and a great deal of patience and time. Once these have been secured, one can also rest in the security one has done everything ethically and scientifically possible to preserve the collection and ultimately to serve the stuff upon which archaeology is based, its artifacts.

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MEMBERSHIP REPORT

Michael Nabholz
Membership Chair

Thank you again to the following who joined the Foundation or renewed their memberships as of March 25 (new members are indicated by *):

Individual

Maxine Iritz *
Walter Kerrigan *
June D. Moeser
J. David Reynolds *

Institution

Cabrillo National Monument

Family

Frank and Beverly Ducey *

All members receive the Fort Guijarros Quarterly, a publication reporting the results of archaeological and historical research by the Foundation. Members are also able to participate in the Foundation's summer weekend archaeological excavations and receive notice of all other Foundation events. Previous experience is not required to participate in the archaeological excavations.

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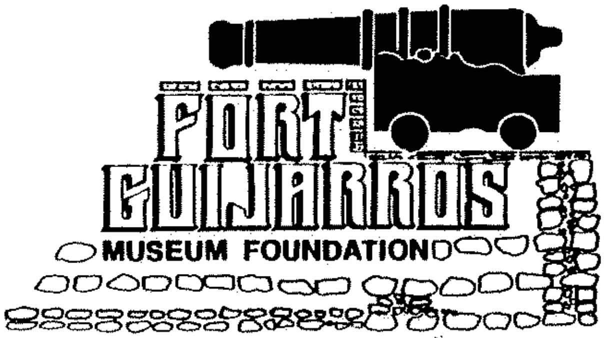

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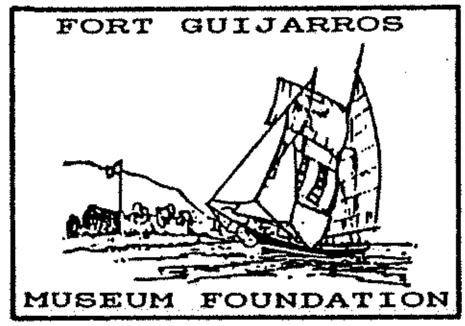

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