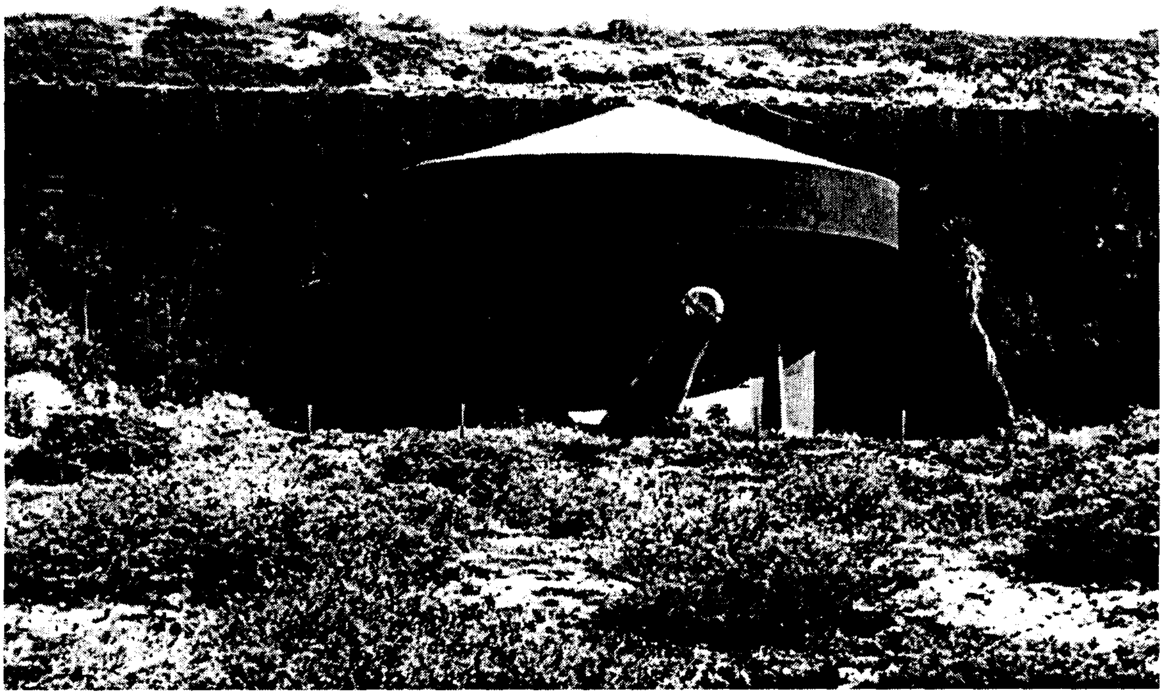

Plate 35. Battery Davis, Fort Funston, 1936-1940. View immediately post construction, September 1940. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

Plate 36. Battery Davis. Landscape camouflage at the power room entrance. View immediately post construction, September 1940. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

The larger issue raised here is that of landscaping with native vegetation. Army officers discussing native vegetation during the first half of the twentieth century used the term native loosely, most often meaning vegetation typical of the immediate area. Lupine and sagebrush were growing wild on the military reservations of San Francisco from at least 1901, and with eucalyptus and acacias introduced from Australia during the 1880s. Wickson described lupine as native, noting its presence on many California beaches.[65] Although iceplant is considered as originally Northern European, its tenure in California—and likely on the San Francisco coastline—was well established before the Endicott batteries. Certainly, sagebrush and lizard leaf were truly indigenous. Kudzu had been introduced to the U.S. in 1876, native to China and Japan, and initially used as for erosion control and as a forage crop like alfalfa. California's orientation to the Pacific, as well as its easy acceptance of exotic vegetation from both tropical and arid climates, made it an early recipient of non-native plants that then became wild. The last larger issue here is one of color. From the Arts and Crafts years forward into the late 1930s, chosen landscaping for the San Francisco batteries, both at the immediate installation sites and over the larger vicinity, was full of color. Lupine flowered blue-lavender and yellow; iceplant white and pink; sagebrush, violet; kudzu, purple (with large blossoms); lizard leaf, white; and, acacia, yellow. Efforts to intensify the given landscape, and its color, are steady during this thirty-year period.

The Cold War

Although not formally part of the Army's construction of batteries, the Nike installations of the late 1950s and early 1960s represent a thoughtful addendum in the discussion of historic materials for the coast defense of the San Francisco harbor. In response to the realization that the Soviet Union was anticipated to possess an atomic bomb stockpile numbering seventy-five to 200 by 1954, the Air Force pressured the Army in 1950 to develop an antiaircraft system for placement around strategic sites. After a review of the guided missiles program, the Department of Defense accelerated two Army antiaircraft programs, Nike Ajax and Nike Hercules. The Nike Hercules guided missile was intended to carry variable-yield nuclear warheads, developed at Sandia Laboratories and Los Alamos, in New Mexico. As of 1952, both were planned to use the same infrastructure, although the upgrading from Nike Ajax to Nike Hercules involved major rebuilding of the missile sites. Nike Ajax emplacement began in April 1954, with Nike Hercules replacements underway as of 1958. The Army incorporated a final set of Nike developments in the antiballistic missile defense program. The U.S. program relied on the Nike Zeus (1956-1963), and thereafter the Nike X (1963-1967), Sentinel (1967-1969), and Safeguard (1969-1976). San Francisco maintained Nike Ajax and Nike Hercules sites, and was slated for a Sentinel site. The deployed Safeguard system used the Sprint and Spartan missiles, with only a single location near Grand Forks Air Force Base in North Dakota. The Army intended Nike emplacements to replace gun batteries, and as such, the Nikes were the final chapter of coast defenses.[66]

By 1958 the Army had deployed almost 200 Nike Ajax batteries around U.S. cities and military installations, with the Nike Ajax total reaching over 300 sites at the program's buildout. The U.S. Army Corps of Engineers had projected that each installation would require 119 acres, a significant problem in real estate acquisition. First installations did, in fact, utilize large acreages, and had aboveground launchers. To accommodate a smaller, forty-acre installation, however, the Corps' architect on the project, Leon Chatelain, Jr., designed an underground magazine, built for twelve missiles with elevators lifting the missiles to the surface in a horizontal position. Three physical areas articulated each Nike battery, with the administrative center coupled with either the integrated fire area or the launching area, and with the integrated fire areas and the launching areas separated by distances no less than 1000 yards and sometimes exceeding a mile, but visible to one another.[67] Infrastructure followed patterns established for intermediate range and intercontinental ballistic missiles, in development simultaneously: sites used equipment trailers and prefabricated steel structures where possible, and were typically quickly erected, but for critical structures, such as warhead storage and assembly structures, were nominally hardened. In understandings of the early 1950s, hardening was intended to withstand non-direct hit, blast effects. As such, tests in Nevada by the Atomic Energy Commission had shown that thick-walled, reinforced concrete structures were most suitable, but that even windowless cement cinder block structures did well.[68]

The Nike site SF-88L, now restored at Fort Barry, was under construction as of 1953-1954, with "Type B" underground missile storage structures. Although not researched here, it is likely that the engineering firm responsible for the Type B storage structure was Black & Veatch of Kansas City. Sandia had hired Black & Veatch in 1946 to design the very first atomic weapons storage facilities in New Mexico, and by the early 1950s the firm consistently designed all such structures for the U.S. military. The Type B structure closely followed in name and typology Black & Veatch's Plant B for the nuclear weapons stockpile and operational storage sites, known as Q Areas (due to their restricted Atomic Energy Commission clearance status). Q Areas were associated with thirteen U.S. Air Force and Army installations, with selected additional facilities built in French Morocco for use by Strategic Air Command. Black & Veatch also typically designed missile assembly buildings for the Air Force over generations of nuclear missiles, and often undertook the associated design of heightened security systems. At SF-88L, the Army made early reuse of existing batteries for the aboveground needs in an ad hoc manner, even continuing this approach in its long use of assembly vans and a Butler building as the final missile assembly building in 1962. (See Plate 6, chapter 1.) Yet, such sustained improvised solutions were common during the Cold War, often running in tandem with permanent infrastructure. By the erection of the cinderblock warhead building in 1959 for Nike Hercules, it was understood that all aboveground structures would not survive the increased destructive power of thermonuclear warheads. Nonetheless, the structure remains cinderblock. The Air Force typically built such structures in reinforced concrete, windowless and with identical loading doors, for its missiles at Vandenberg and elsewhere. The choice of a Butler structure for the missile assembly building at SF-88L may also be an alternate use of the Butler Type III launch shelter for Bomarc, designed in 1958-1959 (Plate 37).

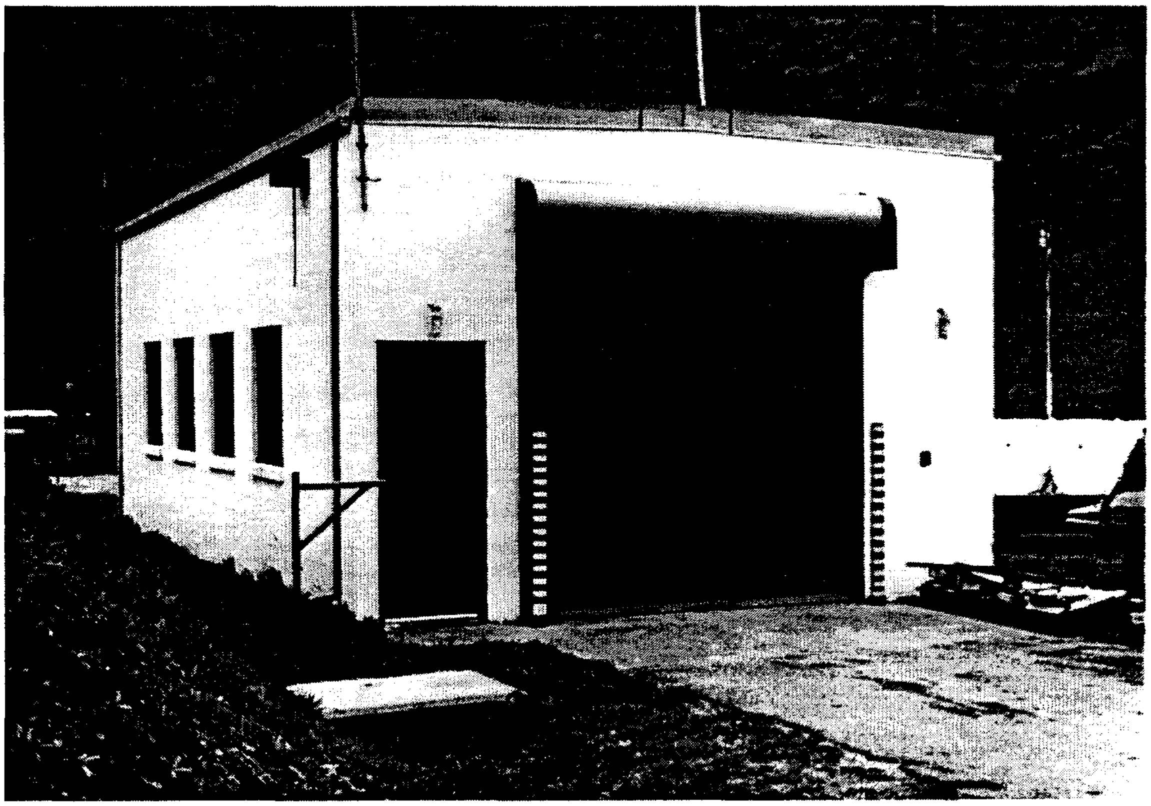

Plate 37. Nike Hercules Warhead Building, Nike Site SF-88L, Fort Barry, 1959. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

Plate 38. Advertisement for Jossen Portland cement in Architect and Engineer of California, November 1907.

Selected Highlights

Concrete Mixes of the 1890s

First mention of the details for the composition and mixing of the concrete for the San Francisco batteries occurs in the Army annual reports of 1891 and 1893, with references to the purchase of a 50 horse-power boiler, a 35 horse-power Westinghouse Junior Engine, a Gate No.3 rock-crusher, a Steam's bucket elevator, and two concrete mixers, a Ransome and a Smith No.3.[69] The machinery comprised the initial "concrete plant" for the batteries. Of note, the Ransome mixer was undoubtedly a machine patented by San Francisco engineer Ernest L. Ransome, who also patented numerous steel reinforcement bars—most notably that of the twisted square steel bar. Concrete used in Batteries Marcus Miller and Godfrey is described simply as made with one part cement, three parts sand, and eight parts rock, with gravel sometimes substituted for rock. The cement was imported Portland cement, Josson & Company by brand and bought for $2.21 per barrel. Josson's was still a preferred Belgian Portland cement sold in San Francisco as late as 1907 (Plate 38). The Army excavated the sand for these first batteries from the Fort Point and Presidio beaches, with rock quarried on Angel Island and gravel taken from Gravelly Beach and Horseshoe Cove at Fort Baker (then the Lime Point reservation).[70]

The concrete plant was mobile, set up near the sites under construction, and typically run for weeks or months at one location. Although desirable, it was not always practical to make continuous concrete pours due to the limitations of labor and mixing equipment. Interrupted pours created divisions in the concrete called "cold joints" that proved to be a deficiency that was more pronounced in unreinforced concrete than in the later reinforced material. The Army described the mix and pour procedures thusly: "The materials were dumped into hoppers feeding to the mixer, which automatically combines them in proper proportions, mixes them in a revolving churn, and delivers to boot of elevator, which raises them 32 feet to a hopper over the cars on a tramway above the top of masonry."[71] For Battery Howe-Wagner, the Army mixed some of the concrete by hand, using the concrete plant for only part of the work, spreading the pours over 1893 and 1894. For Howe-Wagner, the Army used rock from a different quarry located at Fort Point Beach, where personnel also excavated the needed sand.[72] During the second season, the Army altered the machine-mixed concrete in its basic proportions to one part Portland cement, 3.46 parts sand, and 9.16 parts rock and gravel, in effect increasing the proportion of both sand and rock/gravel to that of the Portland cement used in the mix.[73]

Specific mixing and pouring at the earliest Endicott batteries in San Francisco was somewhat dependent on the reliability of transportation, particularly the shipment and arrival of the imported Portland cement, and on the availability of the mobile concrete plant. For Battery Spencer, at Fort Baker, the portable concrete plant again did the mixing and pouring via tramway, until supplies ran out. At that point, the Army resolved to add the remaining 200 cubic yards by hand mix and pour, once the shipment of Portland cement docked. As of 1896, the Army began actively testing all available Portland cements, adding Gillingham's to its supplies of Josson's. Testing of the Portland cements increased in 1897, with the arrival of division engineer Colonel Charles R. Suter. The Army simultaneously continued its practice of partial hand-mixing and partial use of the concrete plant. For Battery Lancaster, Fort Winfield Scott, concrete mixing and pouring was exclusively by hand from October 1896 into early December 1897, thereafter exclusively by machine. Assistant engineer Captain Charles L. Potter described the two processes, hand and machine, in a letter to Suter in late 1897. He noted that both processes required a gang of thirty-five men, but that the concrete plant could mix as many as fourteen barrels in an hour—at a rate of about four minutes to the barrel. Potter gave concrete mixes as one barrel of Portland cement, to one or one-and-one-third cubic yards of rock, to one-half to five-ninths of a cubic yard of sand. Army personnel "scraped, loaded and hauled" the sand from an immediately accessible beach.[74] Concrete at Battery Stotsenburg-McKinnon was also handled by the hand and machine processes, with hand mixing and pouring preceding arrival of the concrete plant, and, with completion by hand in very late 1897.[75]

By Spring 1898, the Army annual reports indicate a full, or nearly full, shift to use of the concrete plant, and machine mixing and pouring. Described in detail for construction at Battery Duncan, the process used a steam-driven, "cubical" mixer, an elevated hopper, ten or more revolutions of the mixer per batch, and delivery by cars "running on a track that extended from the mixer to all parts of the work." Water used was brackish, taken from a lagoon in Horseshoe Cove. Typically, however, mix water was fresh. For all except the gun platform foundations, the concrete mix had not changed much: one part Portland cement, three parts sand, and eight parts broken stone. For the gun platforms the Army altered the mix to one part Portland cement, three parts sand, and six parts rock.[76] Exclusive machine mixing is also the noted process with Batteries Mendell and Alexander in early 1901. For this site, the Army excavated a new porphyritic sandstone quarry into the face of the site cliff. The Army annual report noted that the particular sandstone was nearly identical to that which had been in use for thirty years, excavated for coast defense construction at the quarry on Angel Island. A tramway connected the mobile concrete plant to both batteries via gravity. At this site, a train transported rock from the new nearby quarry, with a cableway lifting very large stones from the train and positioning them into the unreinforced concrete of the batteries.[77]

For work at the batteries after the turn of the century, the concrete mix definitively changed: one portion Portland cement, to two portions sand, to five portions rock for Batteries Mendell and Alexander, and 1:3:6 at Baldwin and Boutelle.[78] The Army continued to use the older proportional mix, 1:3:8, only for retaining walls at the rear of the emplacements.[79] During this hallmark year for concrete mix proportions, the Army also experimented very heavily with multiple brands of imported Portland cement, and, with the American Portland cement manufactured in Utah, all mentioned above. Mixing partially returned to a hand process, notably at Batteries Baldwin and Chester.[80] Final concrete character for the batteries of the Endicott period, although not definitively either hand- or machine-mixed, also acknowledged what had been learned regarding planes of weakness. Any needed below grade site stabilization, discussed below, was handled at approximately 1:6:12 Portland cement/sand/rock proportions; the gun platforms and their foundations, at 1:3:6; and the remainder of the battery at 1:3:8.[81]

The proportions that closed the active experimentation of the Endicott years attempted to compensate for differing settlement and cracking patterns inherent in the batteries respective parts. The 1:6:12 mix foreshadowed the cement-stabilization process adopted during the late 1930s, while the differentiation between the gun platforms and the host battery paid respect to planes of weakness. Engineering the final Endicott batteries as "separate monoliths" at each installation—for example, six at Battery Chester—

further recognized the role that planes of weakness played in coast defense design. At Chester, the gun platform was one monolith (with 1:3:6 concrete mix), while the breast wall in front of the gun platform was a second monolith (with 1:3:8 concrete mix).[82] Such lessons would become codified when battery construction re-commenced in earnest just prior to World War II.

Surfacing Schemes: Damp-Proof Coatings; Camouflage Paint, Washes, and Tints

Real discussions of surface treatments for the batteries begin with those of the Endicott period. The Army applied coatings to the battery surfaces primarily for two purposes, to try to keep water from seeping into the structure or from causing metalwork to rust, and, to disguise the installation against its setting. Earliest references focus on the issue of dryness. The Army typically treated the top surfaces of the exposed concrete masonry and the outdoor floors with a three-to-six-inch thick layering of bituminous rock, sometimes also called asphaltum, in the first designs. (Such treatment for flooring was present in San Francisco's earth-and-brick batteries of the early 1870s.[83]) Walls, inside and out, were given a coating of hard plaster.[84] At both Batteries Marcus Miller and Godfrey, the Army also coated the hard plaster finish of the magazine upper surfaces with a bituminous paint. For Howe-Wagner, the exposed hard plaster exterior wall surfaces and arches of all rooms and passages were "painted with bitumen," as were the exterior surfaces of the structure to be covered by sodded earthen slopes. To drain water away from those parts of the battery in contact with soil, the Army placed a layer of sand between the bitumen paint and the earthworks.[85] First mention of any kind of color treatment came with the fencework for Battery Howe-Wagner in 1895, where Army personnel applied a "dull-red lime wash," mentioned above.

At mid-decade, experiments with coatings began to accelerate, with the intent broadened from just achieving damp-proofing, to one including steps toward camouflage. Effective water resistance was, however, still uppermost. When the Army began to add the three-inch layer of asphalt to the parapets, blast aprons, and magazines at Battery Godfrey in July 1895, personnel discovered that multiple small cracks appeared in the line of fire for emplacement three. For emplacements one and two, the Army selected a softer bitumen, to create a "more elastic" asphalt covering, noting that blast effects required surfacing distinct from that of street pavements. The mix for battery asphalt at the San Francisco coast defenses at this time was eighty-five percent sand to fifteen percent bitumen, prepared at 300 degrees Fahrenheit. Men spread the asphalt layer with hot shovels and rakes, first treating the concrete surfaces with a coating of hot bitumen paint. The bitumen paint was intended to encourage the bonding between the concrete and the asphalt. Final application steps used rollers, with an initial compacting by a 300-pound machine, and a second compacting by a 1000-pound machine. Further experimentation with asphalt continued with the blast apron at emplacement one, Marcus Miller. Here the Army added asphalt directly to a concrete-like mix, using sixty percent broken stone, thirty percent sand, and ten percent bitumen, and then covering the apron with the traditional three-inch layer of asphalt.[86] Mixtures soon addressed not just damp-proofing, but also disguise. At Battery Spencer, personnel mixed higher amounts of sand in with the asphalt before application to the exposed top surfaces, creating a somewhat mottled and textured surfacing. At Marcus Miller, also discussed above, personnel applied a "wash of cement colored with lampblack." The tinted wash was intended to dull the reflection of light off the exposed walls, thus helping to hide the battery against the landscape. Use of a lampblack-tinted wash became standard Army treatment for its batteries nationwide.[87]

Beginning in 1897 and significantly increased in 1898, Army annual reports again discussed new surface treatments. First mentioned is "paraffin painting," as an 1897 treatment at Batteries Lancaster and Saffold, both at Fort Winfield Scott.[88] Application of hot paraffin as moisture-proofing had first been tried with an outdoor monument in Central Park, New York, in 1879, with a variety of "cement and stone waterproofing solutions" available commercially in the early years of the twentieth century—some effective, some less so. For example, in San Francisco during 1907, the Paraffine Paint Company offered the Pabco Damp-Proof Compound for "coating cement and brick walls."[89] (Plate 39) The Army continued to apply paraffin paint to the walls of Batteries Cranston, Howe-Wagner, Stotsenburg-

McKinnon, and Duncan in 1898 and 1899, listing thirty-three gallons priced at $33 for the work at Howe-Wagner.[90] Paraffin paint appears to have been a replacement for bitumen paint, used by the Army to treat all battery surfaces "in contact with the earth"—either direct concrete or plastered surfaces. For the latter, a gallon covered eight square yards of wall in a single coat, or, six square yards of wall in two coats.[91] In 1902 at Battery Chester, the Army moved toward a true moisture membrane, applying the paraffin paint and placing a course of rock between the battery walls and the earthen cover. Archeologists discovered a cobble layer also serving this same damp-proofing purpose at turn-of-the-century Battery Baldwin.[92]

In this same year, the Army begins to mention "whitewashing" for the San Francisco batteries, specifically for these same three batteries, and at Marcus Miller. Whitewashing was also adopted Army-wide, with published mimeographs and circulars giving suggested chemical formulas. Whitewash was the counterpoint to lampblack—used to lighten interior walls and ceilings just as lampblack was employed to darken exteriors.[93] The formula for Army whitewash at Battery Duncan is given as one barrel lime, one pound bluing, one pound potash, and 10 pounds Russian tallow. "The tallow is melted and mixed with the potash and the mixture is added to the lime during the process of slaking. The bluing is dissolved in water and added to the slaked lime, the whole being thoroughly stirred and then screened through a sieve having at least 10 meshes per linear inch to remove lumps."[94] Painting the metalwork, too, became a concern at the turn of the century, with initial mention the protective painting for the I beams at Battery Cranston. California architectural journals of the period listed iron oxide paints and boiled linseed oil as rust inhibitors, noting that the best effects were had when a final black varnish coating of "pitch or asphaltum" was applied.[95] As of 1903, the Army had turned to a portable sand-blaster, devised by the Rix Engineering Company of San Francisco, to first clean the metalwork of the Bay Area batteries, then adding a "priming coat of red lead" and leaving it to weather.[96]

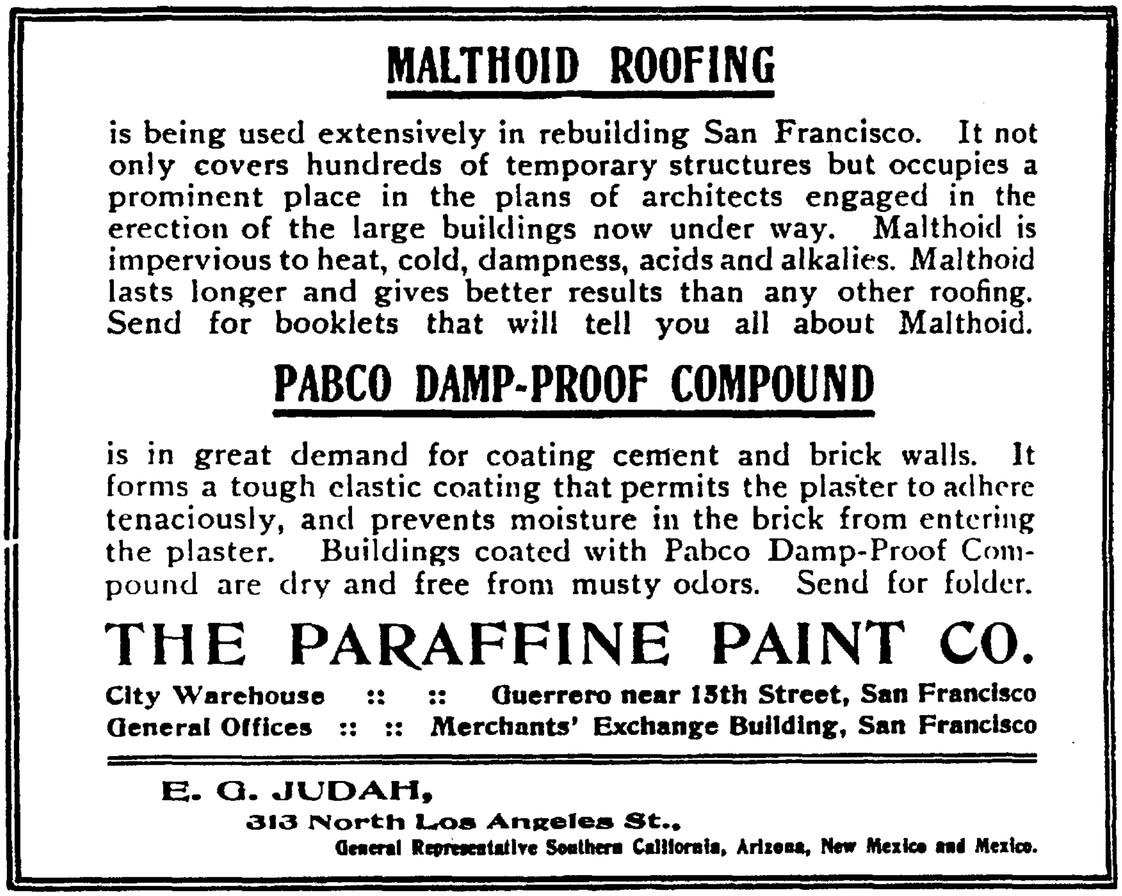

Plate 39. Advertisement for the Paraffine Paint Co. in *Architect and Engineer of California*, November 1907.

The most remarkable innovation in surface treatments at the San Francisco batteries, however, came in 1899 at Battery Duncan. Under the direction of division engineer Suter, the design of Duncan was the first of the San Francisco harbor defenses to demonstrate a more sophisticated camouflage. The battery stood out against the skyline, on an isolated knoll. To blend the man-made form with its site, Army engineers called for the walls to be "tinted to correspond with the color of the spoil bank surrounding the battery." The applied wash was a mix of cement and water, to whitewash consistency, to which was added "Pecora mortar stain, yellow ocher, and lampblack in such proportions as to produce as nearly as possible the dull red color" of the site.[97] Army engineer Winslow noted that the Army frequently did add "powdered blue stone" or "powdered red stone" to concrete surface treatments as a darkener, akin to the use of lampblack, but does not mention when this practice came into being, and whether it was typically a generic attempt at darkening, or, as at Duncan, a deliberate matching of the landscape.[98]

A final surface treatment adopted by the Army nationwide for its batteries pre-1920 was the use of boiled linseed oil. In San Francisco, the Army applied two coats of boiled linseed oil to battery roofs and the tops of parapet walls, "allowing the cement to absorb all the oil it will take." A third final coating consisted of boiled linseed oil mixed with "Prince's metallic brown." While these treated surfaces were still wet, Army personnel spread screened, dry sand over the oiled and painted surfaces. Slow drying, the sand and oil-paint layer hardened as a single unit, and provided both camouflage and an improved walking surface.[99] The Army used boiled linseed oil, generally, to darken its coast defenses, and as in San Francisco, sometimes added pigment. The oil was thought to also help waterproof concrete, but was discovered in the early twentieth century to often injure it. Linseed oil was found to be very damaging to any hard plaster layer, dissolving both the plaster and the bond between the plaster and the underlying concrete. The actions of linseed oil were observed as very slow, and even as late as 1920, Winslow advised caution in using oil and recommended strongly against oil-based paints when water-based paints could be had.[100]

After the long hiatus between the Endicott batteries and those of World Wars I and II, many of the surfacing treatments attempted early on had become formulaic. Membrane coatings of asphalt were standard for those structural concrete elements to be earth covered, and concrete surfaces were grouted and polished for plaster applications (Plate 40). In maintaining Battery Davis, the Army advised against any interior painting of exposed concrete. If that proved necessary, directions were to wet the walls, and mix white Portland cement with black iron oxide for a gray color scheme, or, with yellow iron oxide for a cream color scheme. When the interior surfaces were to be repainted, the Army indicated that any earlier oil paint or Portland cement plaster be removed with muriatic acid first. The late-1930s interior paint scheme of gray-and-cream was exactingly noted for Battery Townsley: a gray, five-foot dado for all rooms, with the remaining wall and ceiling surfaces painted cream.[101] Treatment for all exposed iron and steel work began with wire brush cleaning, or other abrasive cleaning, and then, as had been true at the turn of the century, included one or more applications of red lead paint. This technique had also been in steady use for maintenance of highway bridges since at least 1919, with formulas at that time suggesting eighteen pounds of red lead to one gallon of linseed oil.[102] The Army camouflaged outer walls with a mottled paint scheme, with no maintenance painting planned. World War II color schemes found at Batteries Dynamite, Wallace, and Townsley were green, ochre, and brown, respectively. [103]

<u>Site Preparation and Issues of Settlement: Excavations and Fill</u>

From the very first, erecting coast defense fortifications required massive earth movement, with significant excavations and backfills. At the close of 1870, the Army had embanked 29,586 cubic yards of earth for East and West Batteries on the south side of the bay,[104] while during early stages of site work for Cavallo Battery in 1875 the Army removed a nearly equal amount of dirt, rock, and sand: 24,000 cubic yards.[105] Settlement was a continuing problem even before batteries were completed: at Ridge Battery—where initial construction had necessitated heavy earthen fill of 15,000 cubic yards, settlement

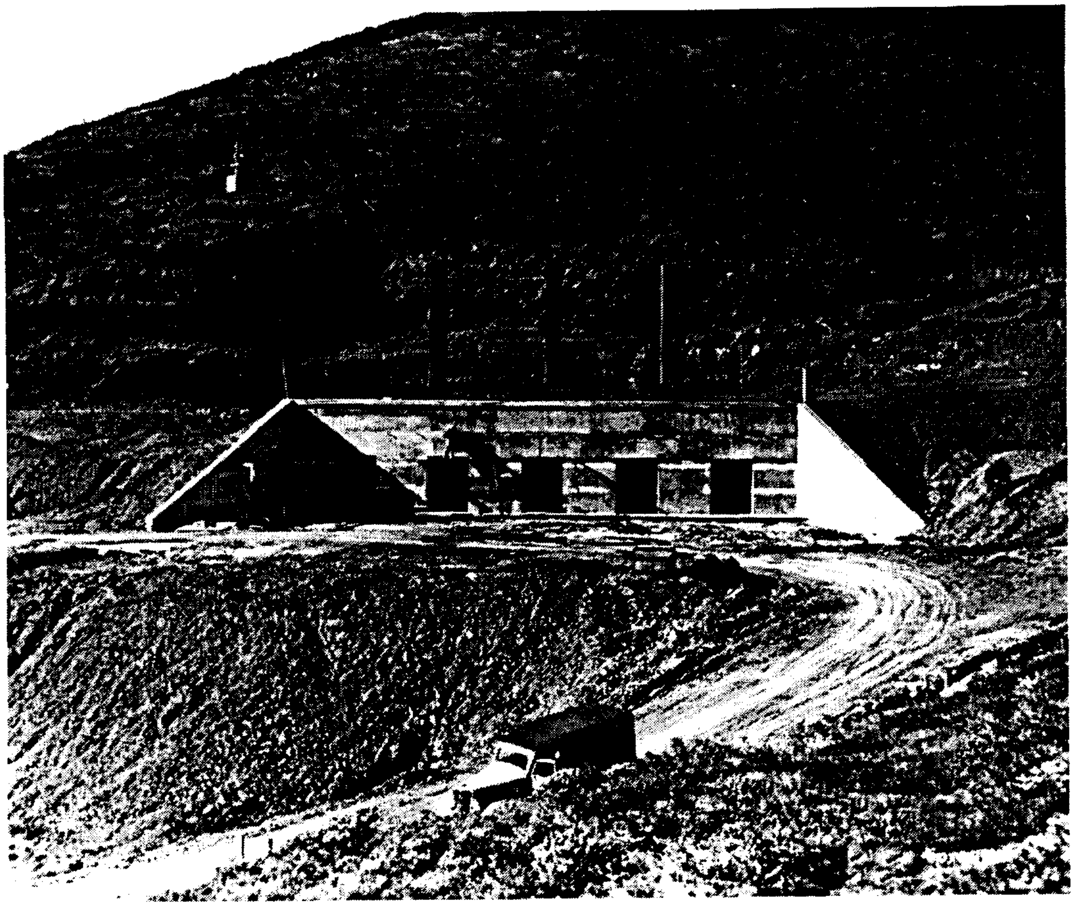

Plate 40. Townsley Reserve Magazine, Fort Cronkhite, 1938-1940. Grouting and polishing of reinforced concrete, before final surfacing. View of January 1939. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

was already compromising the installation in 1875. The situation forced the Army to add 2,100 cubic yards more material to the site.[106] Following the fifteen-year hiatus until construction renewed in the early 1890s, not much changed. Before 1892 ended, Army engineers had poured 20,000 cubic yards of concrete at the excavated sites for Batteries Marcus Miller and Godfrey. The Army report for that year commented: "Much back filling has been executed."[107]

Often excavated materials were reused for backfill, at the front and rear of the battery site. Excavation of the roadway and parade area at Batteries Marcus Miller and Godfrey provided fill for front slopes. Battery plans of these Endicott-era installations called for sand as additional fill to protect the seaward-facing emplacements from artillery damage and to shield the bitumen-painted concrete work from direct contact with wet earth and clay. Usually, sand for fill at the battery sites was hauled from nearby. At these two batteries, sand came from the Fort Point Beach and from dunes in the rear of the installation. In order to accommodate sodding and seeding the protective fill of the battery slopes, the Army applied a final layer of loam. Marcus Miller's and Godfrey's loam came from excavations to the rear of its site. In all, the Army excavated 10,004 cubic yards of site materials for the two batteries during 1892 and 1893, with 23,946 cubic yards of fill—19,922 cubic yards earthen and the remainder, sand.[108] For Battery Howe-Wagner, initial site preparation featured "plowing and scraping on the shallow portions" and "blasting on the deeper ones, with 10,781 cubic yards of preliminary excavation.[109] By the end of fiscal year 1894, the Army had excavated a staggering 32,324 cubic yards of site materials at Howe-Wagner, with a large proportion of rock in the yardage. Total fill at the installation, at that time, was 44,124 cubic yards: 6,714 cubic yards of loam; 4,136 cubic yards of sand; and, the remainder, presumably, a combination of rock and earth from the original excavations on site.[110]

Foundation work at the base of site excavations, and generally effective drainage, were immediate Army concerns for the coast defenses. For Battery Godfrey, excavations to thirteen feet for the foundations of the gun platforms uncovered a yellow clay that was particularly unsuitable as a stable base when wet. To counteract this condition, Army engineers placed an open concrete drain, layered in gravel, around the base of the concrete gun platform foundations.[111] Drainage was an even greater issue for the steeply-sloped mortar installation, Battery Howe-Wagner. Following very heavy rainfall during the winter of 1894-1895, the Army experienced its first major recorded landslide at the San Francisco batteries. In January 1895 more than 200 cubic yards of embanked clay and loam slid into mortar pit one, with another 800 cubic yards cascading into pit two—completely burying the platforms under construction with mud and water. Gophers and moles had honeycombed the topmost seeded loam of the battery slopes, allowing water to saturate the embanked earth. To correct the situation, Army engineers installed a new drainage system during the spring and early summer. They benched the underlying clay slopes, laying them with blind drains, and redressing the top with equal parts loam and sand. Engineers then designed a low, 322-foot long, concrete retaining wall and 1,135-foot gutter at the base of the magazine slope, with another blind drain discharging into the weepers of the base gutter.[112]

For Battery Duncan, beginning in April 1898, the Army re-engineered the soft red rock ridge site at Fort Baker. Excavating sixteen hours daily into mid-May, personnel altered the natural slope, sinking a water tank into the ridge above and behind the battery. The Army annual report noted that "[m]uch grading was required in trimming off the ridge in front of the battery."[113] The Army removed the rock by blasting, with the shifts running from 4am to noon, and noon until 8pm, with two crews of men. The blasting teams used large oil lamps to illuminate the site after dark. The substantial grading in front of Battery Duncan, not surprisingly, accommodated the field of fire. To facilitate Battery Duncan's straddling of the ridge, work crews also built a 2,400-foot long road, connecting the existing lower road to the ridge site. Evocative of its time, the new road to the battery climbed at a 6.67 percent grade.[114]

Prototypical cement-soil stabilization at San Francisco battery sites is first encountered in 1901, with discussions for Battery Baldwin at Fort Winfield Scott. Engineers excavated the site more deeply in the front than in the rear, using horse-drawn scrapers and plows to loosen and clear the sand and clay. Excavated material was entirely sand at the front of the site (down seven feet), while at the back (down fourteen feet) it included both sand and moderately hard clay. At the northeast corner of the immediate site for the installation, sand extended below the intended foundation. To achieve a firm base at this corner, excavation continued below grade, down to clay. Engineers then backfilled the corner area with a rough concrete mix, in the proportion of one part Portland cement, five parts sand, and twelve parts rock/gravel.[115] Army personnel undertook a similar approach to site stabilization at Battery Chester in July the same year. Here the problematic corner was that of the northwest, with the excess excavation up to the main floor grade backfilled with a concrete mix of 1:6:12.[116] As of the autumn of 1902, Army engineers carried the subgrade concrete stabilization work further, with enhanced footings for Battery Mendell. The base material was a porous mix of sandy soil and clay at grade. To offset this condition, engineers devised a general concrete foundation over three feet deep, rather than a then-typical feature of one foot depth.[117] The "foundation" was completely unreinforced by iron or steel, although mention is made in Army reports that this was by reason "that there were no old rails on hand, nor could any be obtained in the market cheaply at the time."[118]

By the time of the World War II batteries, soil-cement stabilization around reinforced concrete foundations was standard, drawing upon lessons learned from both the engineering of concrete dams and soil-cement highways. Nonetheless, virgin battery sites still required massive amounts of excavation and backfilling, with completed installations literally implanted into the land (Plates 41 and 42).

Plate 41. Battery Townsley. Initial construction, January 1938. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

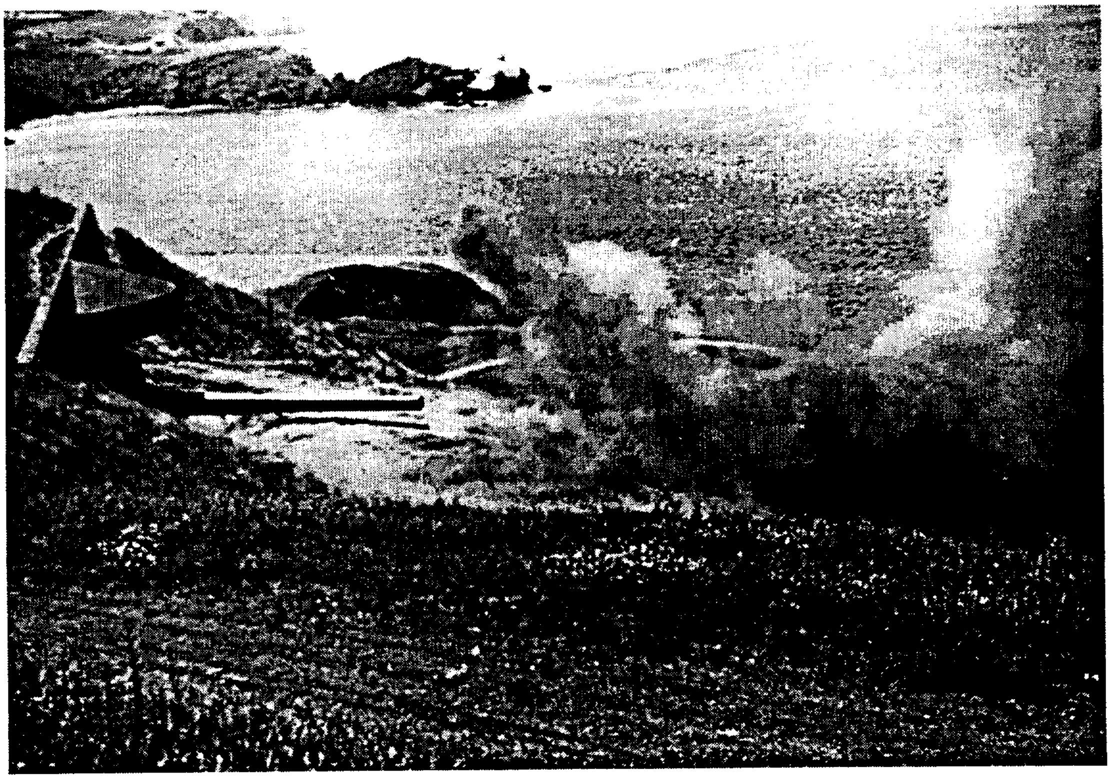

Plate 42. Battery Townsley. Immediately post construction, July 1940. Test firing gun no. 2. Courtesy of the Park Archives of the Golden Gate National Recreation Area.

Landscape: Cultivation of Native Vegetation versus Imported Plants and Trees

The coast defense fortifications for the San Francisco harbor raise a variety of questions focused on landscape. Landscapes exist as constantly changing over time. They vary with sustained microclimatic conditions such as long-term drought or multiple wet-year periods. Man-introduced alterations to waterways; cultivated fields; forest removal; and chemical usage are just a few other factors that can precipitate shifts in landscapes many miles away. Birds, rodents, and animals—as well as the wind—can accentuate change in progress. Landscape layers, as slices of chronological understanding, are important to batteries. In order to interpret the landscape designed—and redesigned—for the batteries, a benchmark landscape might be useful. Deeper analysis of the meaning at a battery landscape to its designers, in its own time, would also offer insights. Terms like "native," in particular, may range in intent from "typical" to "indigenous." Larger landscape movements, like that of the Arts and Crafts and the back-to-the-land movements of the 1890s-1920s, too, affected battery landscape design. These issues, and doubtless others, should be addressed in future studies at the Golden Gate National Recreation Area.

Engineer Winslow, in *Notes on Seacoast Fortification Construction*, summarized Army-wide policies on landscaping the batteries before 1920. He noted that the practice of landscaping was a very old one, with respect to grasses. "The custom of sodding the slopes of fortifications originated many, many years ago and at a time when the range of gun was so small as to make an attempt at concealment unnecessary." Winslow commented, however, that from the first both sodding and seeding grasses tended to call attention to the batteries, as the manicured appearance was overly conspicuous. He stated that Army policy formally had changed in the early twentieth century ("some years ago") to include planting "trees between the batteries and the shore" and "fine bushes, shrubs, and small trees...along the outer slopes of the batteries." Winslow distinguished between "sodding" and "seeding" as methods to hold a newly established earthen embankment in place, with sodding common in the northern states, and seeding or transplanting elsewhere. As an example, he noted that the Army planted Bermuda grass tufts, watering them artificially, to create a sod on batteries in the South. Installing hydrants for watering the battery embankments through dry seasons appears to have become Army policy in the early twentieth century.[119]

Winslow exemplified Army attempts with a multi-tiered landscape at, and in the vicinity of batteries, through a deliberately "experimental" emplacement at Fort Morgan, Mobile, Alabama, in 1915. Before the landscaping, a natural vegetation did exist at the site, inclusive of "irregular splotches of vegetation, bushes, wild grass, small trees, etc."

> In building the emplacement care was taken not to injure any of the bushes or vegetation in the neighborhood. The emplacement itself was given a generally rounded contour not unlike that of most of the sand dunes. The sand used in the parapet was that taken from the vicinity and appeared just like the sand exposed in the dunes. In order not to make the area of bare sand around the parapet too large and thus too conspicuous, a number of bushes were transplanted from neighboring sand dunes and were made to grow on the parapet so that in its general appearance from the sea there was nothing to distinguish the emplacement from the sand dunes in which it was placed.

In addition to the landscaping, the Army added a burlap netting to the parapet of the Fort Morgan battery, coating it with a sand-and-cement grout. Winslow concluded his discussion by praising the combined landscape-and-burlap treatment as effectively hiding the battery in the dunes, from ranges as far away as 5,000 yards. He also noted that the time was coming when the Army would need to conceal batteries from the air, with "modern development of air craft."[120] These issues would all surface for the coast defense fortifications in San Francisco as well.

Can a pre-existing pattern of vegetation, a pattern of vegetation characterizing the landscape immediately before construction of a battery, be established? Can, or should, patterns of vegetation be assigned to temporal periods, with change occurring due to both man and to nature? Were some plants introduced into California so early that by the time of the batteries they were essentially a part of the immediately pre-existing landscape? And, as such, thought of as "native?" Are some plants considered indigenous in one period of time, and "introduced" in another? Such a situation would make the interpretation of period terminology of critical importance. When and where did seed gathering and cutting (for landscaping the batteries) occur on the military reservations associated with coast defenses? When and where were nurseries established for propagating vegetation for the batteries? How frequently did man-made drainage and watering systems accompany landscaping the batteries? In what periods? What were the truly exotic plantings at the batteries, vegetation never considered to be native to the area? When did the Army coordinate landscaping with camouflage painting and/or net schemes?

For reference, landscape treatments known to have been in place at the San Francisco batteries are summarized in Table 3 below. Two plantings appear to have been interpreted as indigenous in one period and introduced in another—thus having conflicting columns of data. The table is intended to reflect the opinions current during the periods when the listed plantings are known to have been in place at the batteries—not to indicate professional assessments of "native" and "introduced" today.

Table 3
Landscaping at the San Francisco Batteries, 1870-1944

	Period in Active Use	Planted on Site	Considered Indigenous	Considered Introduced	Considered Temporary
Barley	1870-circa 1902	Yes	No	Yes	No
Oats	1870-circa 1902	Yes	No	Yes	No
Alfalfa	1901	Yes	No	Yes	No
Iceplant	1901-1905	Yes	Yes	Yes	No
Lupine	1901-1938/44	Yes	Yes	Yes	?
Eucalyptus	1901-1938/44	Yes	No	Yes	No
Bunch grass	1901-1902	Yes	Yes	No	No
Sagebrush	1902[?]/1938	Yes	Yes	No	No
Rye	1905	Yes	No	Yes	Yes
Leptospermum	1938/44	Yes	?	?	No
Acacia	1938/44	Yes	No	Yes	No
Pine	1938/44	Yes	No	Yes	No
Kudzu	1938/44	Yes	No	Yes	No
Wormwood	1938/44	Yes	Yes	No	No
Baccaris	1938/44	Yes	Yes	No	No
Lizard Leaf	1938/44	Yes	Yes	No	No
Vetch	1938/44	Yes	No	Yes	Yes
Mustard	1938/44	Yes	No	Yes	Yes
Meliolotus Indica	1938/44	Yes	No	Yes	Yes

Historic Maintenance Methods and Issues in the Recent Past

Over the past 10 to 20 years maintenance methods used at the San Francisco batteries have focused on practical solutions to problems at hand, with substantial deferred work. Actions taken have included isolated replacement of handrails; painting of handrails to retard rust; adding some new hinges; sealing and welding selected wood and steel doors; attempts at graffiti removal; latex painting-out of graffiti; selected installation of lighting and security doors; selected removal of asbestos and lead paints; spot carpentry; occasional weed cutting; selected experimentation to remove lichen; some erosion and drainage work, and, security fencing of sites attractive to vandals. Such actions are reasonably inferred as probable maintenance practice historically, with specific methods those most common and expeditious at the time. Army maintenance, in particular, may have followed the published directives of the Coast Artillery. Personnel of the Coast Artillery were those men responsible for upkeep at the batteries. Future studies might review Coast Artillery records for San Francisco to glean further information on historic maintenance practices. A final probable source of useful references is likely the *Coast Artillery Journal*, which is understood to have published several articles between World War I and World War II on the caretaking of batteries.

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[1] U.S. House of Representatives, *Annual Reports of the Chief of Engineers, United States Army, to the Secretary of War*, 1869, 19, and 1870, 27.

[2] U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1894, 11.

[3] Erwin N. Thompson, *Historic Resource Study Seacoast Fortifications San Francisco Harbor Golden Gate National Recreation Area California* (Denver: U.S. Department of the Interior, National Park Service, 1979), 105, and, U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1893, 10.

[4] U.S. House of Representatives, *Annual Reports of the Chief of Engineers, United States Army, to the Secretary of War*, 1872, 22-23; 1874, 27-28; 1875, 26-28; and, 1876, 28-29; Thompson, 108-109; Charles L. Potter to Colonel C.R. Suter, 10 December 1896, Operation and Maintenance Files, 1896-1941, RG77, Box 58, National Archives Record Center, San Bruno.

[5] U.S. House of Representatives, *Annual Reports of the Chief of Engineers, United States Army, to the Secretary of War*, 1895, 11-12, and, 1896, 535.

[6] *Annual Report*, 1896, 535-538.

[7] *Annual Report*, 1893, 620.

[8] *Annual Report*, 1896, 528-530.

[9] Colonel Eben Eveleth Winslow, *Notes on Seacoast Fortification Construction*, Occasional Papers, Engineer School, United States Army, No. 61 (Washington, D.C.: Government Printing Office, 1920), 60.

[10] *Annual Report*, 1896, 528-530.

[11] *Annual Report*, 1896, 528-538, and, U.S. House of Representatives, *Annual Reports of the Chief of Engineers, United States Army, to the Secretary of War*, 1897, 748-755, and 1898, 779-797.

[12] *Annual Report*, 528-538.

[13] U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1892, 8.

[14] *Ibid.*

[15] *Annual Report*, 1894, 11, 465-466, and , Potter to Suter, 28 February 1897, Operation and Maintenance Files, 1896-1941, RG77, Box 58, National Archives Record Center, San Bruno.

[16] *Annual Report*, 1896, 536.

[17] U.S. House of Representatives, *Annual Reports of the Chief of Engineers, United States Army, to the Secretary of War*, 1898, 781, and, 1899, 987.

[18] *Annual Report*, 1896, 535.

[19] *Annual Report*, 1899, 986.

[20] *Annual Report*, 1897, 749.

[21] Potter to Suter, 20 October 1896, Operation and Maintenance Files, 1896-1941, RG77, Box 58, National Archives Record Center, San Bruno.

[22] Potter to Suter, 18 October 1897, Operation and Maintenance Files, 1896-1941, RG77, Box 58, National Archives Record Center, San Bruno.
[23] *Annual Report*, 1895, 517.
[24] *Annual Report*, 1893, 619.
[25] *Annual Report*, 1895, 518.
[26] U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1901, 864.
[27] *Annual Reports*, 1893, 620, and, 1896, 538.
[28] *Annual Report*, 1901, 874, 878.
[29] Winslow, 60-61.
[30] *Annual Report*, 1901, 860-894.
[31] *Ibid*, 876.
[32] *Ibid*, 861.
[33] *Annual Reports*, 1895, 516, and 1899, 985.
[34] *Annual Report*, 1898, 779-797.
[35] *Annual Report*, 1901, 877, 880.
[36] *Ibid.*
[37] U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1902, 764.
[38] *Ibid*, 763, 769.
[39] *Ibid*, 764.
[40] Winslow, 61.
[41] U.S. House of Representatives, *Annual Report of the Chief of Engineers, United States Army, to the Secretary of War*, 1903, 2419.
[42] Thompson, 213, 235.
[43] Paul V. Turner, "The Collaborative Design of Stanford University," *The Founders & the Architects* (Stanford: Department of Art), 1976, 53.
[44] Thompson, 213.
[45] Thompson, 237.
[46] Battery Stotsenburg Emplacement Book, Coast Artillery Harbor Defenses of San Francisco, RG392, Entry 335, Box 3, National Archives Record Center, San Bruno.
[47] Thompson, 251.
[48] Donald McLaren, "Landscape Gardening at the Exposition," *The Architect* 10:1 (July 1915), 12-14, with unpaginated plates. [Rare holding of a limited-run periodical, California State Library, Sacramento.]
[49] Kevin Starr, *Inventing the Dream: California Through the Progressive Era* (New York: Oxford University Press, 1985), 137-139.
[50] Edward J. Wickson, *California Garden Flowers, Shrubs, Trees and Vines* (San Francisco: Pacific Rural Press, 1926), 118.
[51] McLaren, 12-14, plate immediately following; Karen J. Weitze, unpublished manuscript on the career of architect Hart Wood.
[52] *Architect and Engineer of California*, 1906-1918, advertisements, *passim*.
[53] Karen J. Weitze, *Historic American Engineering Record Addendum to Little Rock Dam, Palmdale, California, HAER No. CA-8*, August 1994, 80-92.
[54] Lars Jorgensen, "Solidification of Sand, Gravel and Granular Materials by Chemical Means," undated offprint published by Lars Jorgensen, Hydro-Electric Engineer, Berkeley, California. Contained in "Reports of Foundation Development for Casements Battery Davis, Fort Funston, December 6, 1938," Records of the Office of the Chief of Engineers San Francisco District, RG77, Box 19, National Archives Record Center, San Bruno.
[55] Norman W. Haner, "Development of the Casemate Foundations by Cement-Stabilization Method at Battery Richmond P. Davis, Ft. Funston, California," memorandum, 6 December 1938, in "Reports of Foundation Development for Casements Battery Davis."
[56] *Ibid.*
[57] Frank T. Sheets and Miles D. Catton, "Basic Principles of Soil-Cement Mixtures," and, "How to Process Soil-Cement Roads," *Engineering News-Record*, circa 1938, in "Reports of Foundation Development for Casements Battery Davis."
[58] Battery Davis, dated construction photographs, in "Reports of Foundation Development for Casements Battery Davis."

[59] "War Department Seacoast Defenses 1938, 1939, 1940. Specifications for Construction of Battery Elements for a Battery of Two 16-Inch Guns at Fort Cronkhite, California," Records of the Office of the Chief of Engineers San Francisco District, RG77, Box 19, National Archives Record Center, San Bruno.
[60] U.S. Army Corps of Engineers, *Instructions for Maintenance and Operation of Battery Richmond P. Davis, Fort Funston, Calif.*, 3, Records of the Office of the Chief of Engineers San Francisco District, RG77, Box 19, National Archives Record Center, San Bruno.
[61] *Annual Report*, 1903, 2419, 2421.
[62] Thompson, included foldout illustration.
[63] *Instructions for Maintenance and Operation of Battery Richmond P. Davis*, 14.
[64] Office of the Chief of Coast Artillery, memorandum of 30 April 1910, in Battery Stotsenburg Emplacement Book.
[65] Wickson, 169.
[66] John C. Lonnquest and David F. Winkler, *To Defend and Deter: The Legacy of the United States Cold War Missile Program*, USACERL Special Report 97/01 (Rock Island, Illinois: Defense Publishing Service, 1996), 55-64, 107-117, 165-183, 463-473.
[67] *Ibid.*
[68] Karen J. Weitze, engineering context, in Inventories for U.S. Air Force, Air Mobility Command, Cold War Properties, Andrews, Charleston, Dover, Grand Forks, McChord, Scott, Travis Air Force Bases, 1996.
[69] *Annual Reports*, 1891, 8, and 1893, 620.
[70] *Annual Report*, 1893, 620, 622.
[71] *Annual Report*, 1893, 620.
[72] *Annual Report*, 1893, 622.
[73] *Annual Report*, 1894, 465.
[74] Potter to Suter, letter of 31 October 1896, and, letter of 18 October 1897, Operation and Maintenance Files, 1896-1941, RG77, Box 58, National Archives Record Center, San Bruno.
[75] *Annual Report*, 1898, 792.
[76] *Annual Report*, 1899, 987.
[77] *Annual Report*, 1901, 864-865.
[78] *Ibid*, 869, 874.
[79] *Annual Reports*, 1901, 874, and, 1902, 769.
[80] *Annual Report*, 1902, 771.
[81] *Annual Report*, 1902, 769.
[82] *Ibid*, 772.
[83] *Annual Report*, 1874, 27.
[84] *Annual Reports*, 1892, 8, and, 1893, 624.
[85] *Annual Report*, 1894, 465-466.
[86] *Annual Report*, 1896, 534-535.
[87] Winslow, 57-58.
[88] Annual Report, 1897, 754.
[89] Maximilian Toch, "History and Development of Waterproofing," *Architect and Engineer of California* 9:3 (July 1907), 88-90.
[90] *Annual Reports*, 1898, 788-789, 793, and, 1899, 987.
[91] *Annual Report*, 1899, 987.
[92] *Annual Report*, 1902, 772; Leo Barker, Park Historical Archeologist, to Stephen A. Haller, 1 May 1999, personal communication.
[93] Winslow, 58.
[94] *Annual Report*, 1899, 987.
[95] "Painting Ironwork" and "The Protection of Iron from Rust," *California Architect and Building News* 19:8 (August 1898), 91, 92-93.
[96] *Annual Report*, 1903, 2420.
[97] *Annual Report*, 1899, 987.
[98] Winslow, 58.
[99] *Annual Report*, 1903, 2422.
[100] Winslow, 59-60.
[101] "Specifications for Construction of Battery Elements for a Battery of Two 16-Inch Guns at Fort Cronkhite," 42; *Instructions for Maintenance and Operation of Battery Richmond P. Davis*, 2-3.
[102] Charles D. Snead, "Maintaining and Painting Highway Bridges," *Architect and Engineer of California* 58:2 (August 1919), 86-89.

[103] *Instructions for Maintenance and Operation of Battery Richmond P. Davis*, 3. National Park Service personnel offered the World War II camouflage colors for Batteries Dynamite, Wallace and Townsley.
[104] *Annual Report*, 1871, 24.
[105] *Annual Report*, 1875, 27.
[106] *Annual Reports*, 1872, 22, and, 1876, 28.
[107] *Annual Report*, 1892, 8.
[108] *Annual Report*, 1893, 621.
[109] *Ibid*, 622.
[110] *Annual Report*, 1894, 466.
[111] *Annual Report*, 1895, 515-516.
[112] *Annual Report*, 1895, 517.
[113] *Annual Report*, 1898, 781.
[114] *Annual Report*, 1899, 987.
[115] *Annual Reports*, 1901, 874, and, 1902, 769.
[116] *Annual Report*, 1902, 771.
[117] *Ibid*, 763.
[118] *Annual Report*, 1903, 2417-2418.
[119] Winslow, 183.
[120] *Ibid*, 184-185.