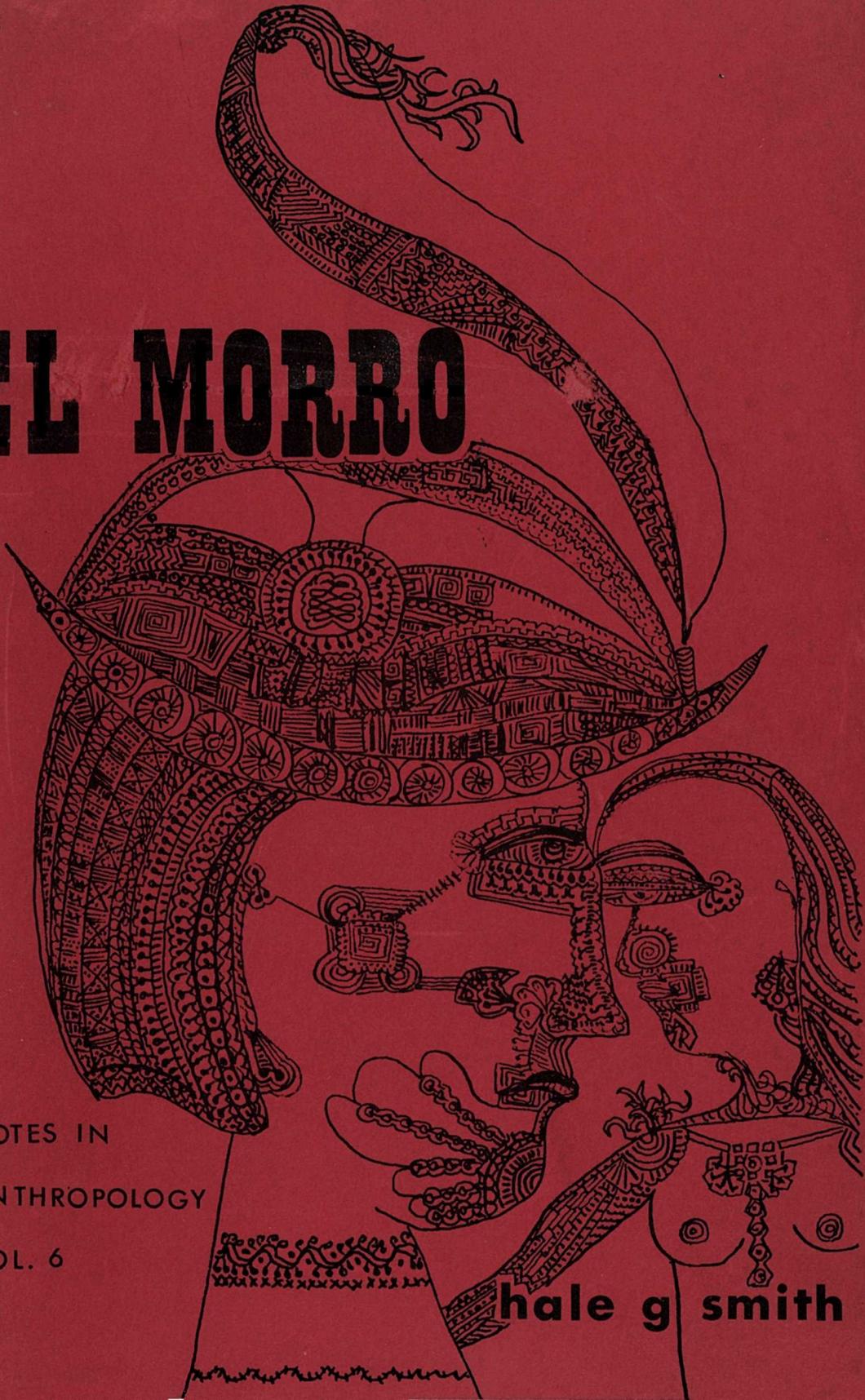
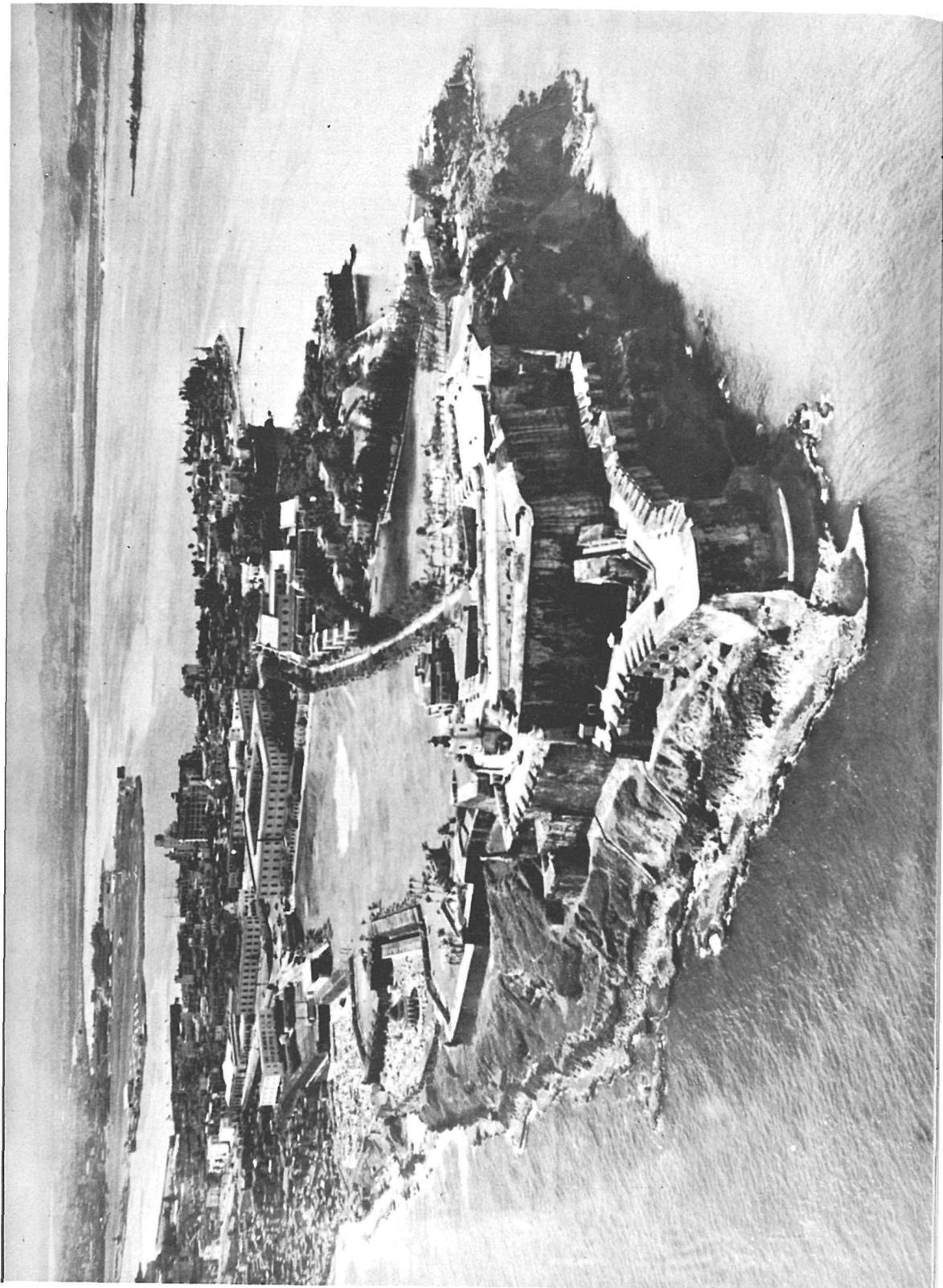


EL MORRO

NOTES IN
ANTHROPOLOGY
VOL. 6

hale g smith





ARCHAEOLOGICAL EXCAVATION AT
EL MORRO, SAN JUAN, PUERTO RICO

by
HALE G. SMITH

With Historical Background Sections By
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INTRODUCTION

During the period of June 12 to August 24, 1961, the author, under contract with the national Park Service, conducted archeological excavations at El Morro, a unit of San Juan National Historic Site, Puerto Rico. The purpose of the National Park Service in conducting this research was to disclose and record information which would serve as a guide to the repair, restoration, and interpretation of this historic fort. A secondary objective was to determine the extent of archeological research which might prove necessary at the site, and to this extent the excavations were preliminary in nature.

The areas selected for excavation included the moat area between the flanking battery wall of the Austria Bastion, the sally port, the kitchen and its courtyard, the water battery and selected areas on the Shoreline Trail.

In excavation, the trenching method was employed, with arbitrary stratigraphic levels of one foot or one-half of a foot being utilized to keep the artifacts separated. In the kitchen courtyard area, and the water battery where walls of former structures or features were encountered, the trenches were widened and the walls either followed or the feature exposed. In order to establish various elevations, datum planes were set up for the three major areas of excavation. The datum planes in the kitchen courtyard, the moat and the water battery were all given an arbitrary elevation of one-hundred feet. The location of the temporary bench marks are described in the separate sections.

Although El Morro was one of the most important forts in the New World, very little is known of its structural development. There is a paucity of maps and documents dealing with the various stages of construction.

A brief history of El Morro, taken from the National Park Service pamphlet, outlines the following sequence of events:

The Puerto Rican Colonist first settled in Caparra across the bay from the present site of San Juan. In 1521 the group moved from Caparra to San Juan where they were harassed by pirates and the Carib Indians. In order to protect the people defensive works were authorized for the headland at the entrance of the harbor in 1539. At this time the first battery and a tower were built.

In 1591 a famous military engineer, Juan Bautista Antonelli came to Puerto Rico and approved the Morro site and laid out a hornwork. This hornwork was designed so that it would give protection against land attack and therefore was constructed north and south across the headland.

In 1598, George Clifford, Earl of Cumberland, captured El Morro. He did not remain long in El Morro and after a short time withdrew after tearing down the land wall of El Morro.

During the first quarter of the sixteenth century 200 slaves were brought to San Juan and artisans from Spain arrived to work on the defenses. The hornwork of El Morro was rebuilt in 1610 and a new gun deck overlooking the harbor was constructed. Also during the latter part of the seventeenth century El Morro was strengthened further. In 1765 Field Marshal Alejandro O'Reilly brought Engineer Tomás O'Daly to San Juan where they planned additions to the fortifications. Between 1766 and 1777 O'Daly made El Morro essentially what it is today.

I would like to acknowledge my appreciation to the staff of San Juan National Historic Site for their cooperation. I would especially like to thank Superintendent Kittridge A. Wing, Historian Ricardo Torres Reyes, whose research is incorporated into this report, and Historian Julio Marrero Nuñez, all of whom were helpful in all the phases of this project. I was fortunate to obtain the services of Mr. Robert H. Steinbach as an assistant archaeologist. His efforts help-

ed facilitate the completion of the project. Also, Mr. James Shaw, the laboratory technician, who worked hard and diligently, was a great aid to this endeavor.

Permission was granted by the army for excavations in the moat, which is at the present time part of their golf course. I want to express my appreciation to them for all of the courtesies that they extended to us.

THE MOAT AREA

The moat area between the moat bridge and the flanking battery wall of the Austria Bastion was selected for a test excavation in order to observe various details of construction which were unknown because of the lack of previous archaeological work and the lack of adequate documentation available for El Morro.

Initially three areas were designated; Trench A, Trench B, and Trench C (Fig. 2). Trench A was approximately midway between the drawbridge area (the sally port facade or Trench C) and the Austria Bastion's flanking battery wall (Trench B). It was assumed that this trench would reveal the type of footing utilized for a "normal" running wall where other architectural details would not complicate an interpretation.

Trench A was a ten by twenty foot rectangle having a ten foot side tangent to the scarp battery wall and extending twenty feet out into the moat. The twenty foot limit was set by the United States Army when they granted permission to excavate in this area.

Trench B initially extended ten feet along the scarp wall and twenty feet along the flanking battery wall. In this area the problem was to discover the type of footing present and to detect, if possible, the relative chronological sequence of the wall development.

Trench C was opened in order to discover the type of footing used for the sally port facade and to investigate any structural remains of the drawbridge that might be present. The findings would be used in a future project of reconstruction of the drawbridge. Trench C extended along the scarp wall 14.50 feet and into the moat seven and one half feet. This area included the base of the last pier of the moat bridge.

Trench D was a five foot wide connecting trench between Trench A and Trench C.

A temporary bench mark was established at the base of the stairway to the golf course and was given an arbitrary elevation of 100.00 feet.

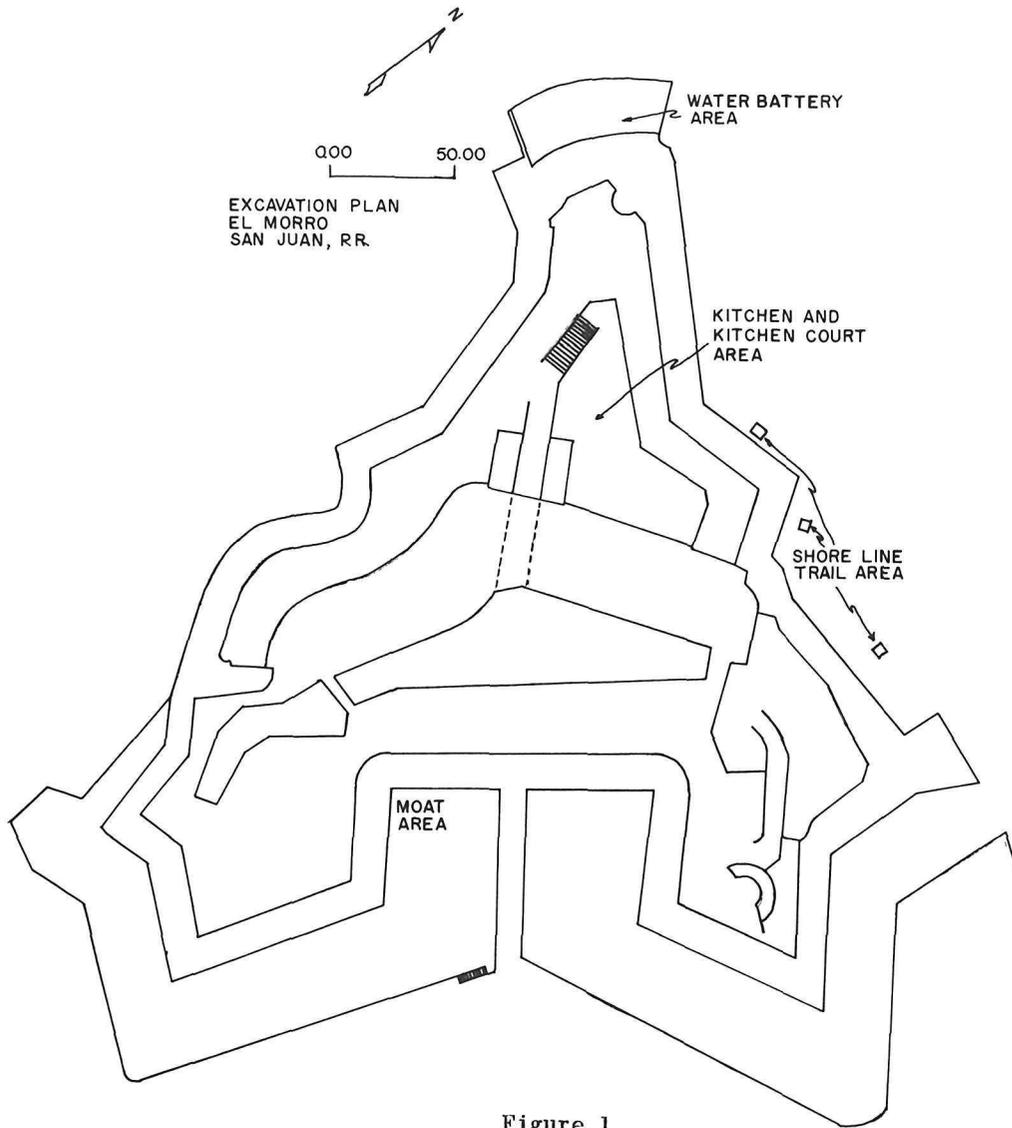


Figure 1

Excavations

Trench A: The profile of Trench A indicated that a different situation was present here than in Trenches B and C. The top stratum was dark humus that had been brought in by the United States Army to level the grade and provide a base for the grass of the golf course, part of which occupies the moat. The next stratum was red clay that had an average thickness of two-tenths of a foot. This level was probably the remains of a tennis court that was present in this area in 1926. Although the court was made of cement the grade was brought up to level with the red clay.

The third stratum was composed of concentrated building rubble and dated from the A. D. 1850-1929 period. The fourth stratum was a brown sand rubble and the cultural material indicated an A. D. 1760-1850 period. In the base of the brown sand rubble stratum a layer of bricks was found. The bricks fell into the size range of ninety-three hundredths of a foot long, forty-three hundredths of a foot wide and sixteen hundredths of a foot thick. This is the size range of the middle period Spanish brick of Puerto Rico (Personal communication with Kittridge Wing). These bricks were made before A. D. 1850. The bricks were arranged in a haphazard manner and no patterning was apparent. In this level a post hole also appeared that dated from the twentieth century.

The underlying yellow sand stratum represents two periods of intentional filling and leveling and/or additional repair on the fort in this general area. This stratum dates from the same general period as the one above.

Beneath the yellow sand stratum was a red sandy clay level that had plaster fragments admixed throughout. Very little cultural material was found in this level; however what was present indicated an A. D. 1660-1760 dating. The last stratum excavated contained Spanish Flint Inlay ware of the seventeenth century.

Excavation was discontinued for reasons of safety. Be-

cause of the nature of the soil and the heavy rains, the sides of the trench periodically caved-in, endangering the lives of the workmen.

The deepest point of excavation was seven feet, or a relative elevation of 92.90 feet. This was enough to expose the scarp wall footing. The scarp wall with batter¹ rested on a vertical course of dressed sandstone. This footing was nine-tenths of a foot thick and was set out six-tenths of a foot from the scarp wall with batter. The dressed-stone footing, in turn, rested on a dressed-stone mamposteria wall.² The dressed-stone mamposteria wall had a batter of two-tenths of a foot in two feet.

Trench B: In the soil profile there were three stragraphy zones. The top dark humus level was one foot thick and capped a uniform stratum that extended to a depth of eight feet. This second zone or stratum was composed of sand and sandstone chips which were tightly compacted. Under this was a more sandy stratum that lay on top of a fallen mamposteria wall, or rubble remains of mamposteria construction.

The excavation along the flanking battery wall carried down to 10.60 feet, or to a relative elevation of 89.40 feet (Fig. 10, Pl. 3). The original ground level had been smoothed and a prepared "floor" was present. This "floor" was made of mortar, sandstone chips and clay. The "floor" was four-tenths

1. Batter is an architectural term meaning to slope gently backward.

2. Because of the fact that the term "mamposteria" has several connotations in various places and at various times, the following terms were used, although it was recognized that rough stone mamposteria was redundant and dressed stone mamposteria was contradictory.

Rough stone mamposteria: This is mamposteria where undressed stones are used, being placed in the forms in a haphazard manner.

Dressed-stone mamposteria: A mamposteria where the exterior stone has one face dressed and is set in place rather carefully. In some cases it appears almost as coursed masonry, however, the red-clay mortar that separated the stone may be as great as the width of the stone. The stones are relatively small, being about one foot by four-tenths of a foot, exterior surface.

of a foot thick and lay on top of rough sandstone fragments. The "floor" was comparable in hardness to the floor in Building 1 of the Kitchen Courtyard area. This "floor" presented a hard surface to the shovel but was relatively easy to penetrate with the pick.

The dressed-stone wall with batter of the flanking battery extended down five and eight-tenths feet below datum with a relative elevation of 94.20 feet. At this point it rested on a rough stone mamposteria brick-capped wall. The dressed stone batter wall was completely plastered except for two areas where bricks used for patching were visible. Also, in the corner where the scarp wall and the flanking battery wall met, and extending over a one square foot area, a mamposteria area was present. The stones of the mamposteria extended out irregularly from this section as much as eight-tenths of a foot. This area was an upward extension of the mamposteria wall section immediately before it joined the scarp wall. In two of the dressed stone scarp wall courses, stones were cut out in a rounded concave manner to a maximum of six-tenths of a foot in order to receive and bind the mamposteria wall.

The rough stone mamposteria wall was 4.90 feet high and had a batter of two-tenths of a foot in four feet. This wall was originally plastered with a very poor grade of plaster. The plaster, at time of excavation, was very soft and only occurred in small areas having been worn off or having fallen off most of the wall. This wall was capped with brick set in a very hard mortar. The bricks were laid with their longest diameter at right angles to the wall. The mamposteria wall was outset from eight-tenths of a foot to nine-tenths of a foot from the dressed-stone wall with batter and extended under it for an unknown distance (Fig. 10, Pls. 3, 4).

The mamposteria wall rested on a compacted "floor" mentioned above. At the base of this wall and parallel to it were two courses of brick. The bottom course was laid on a fifteen-hundredths of a foot lens of mortar and was attached

to the mamposteria wall by a mortar fifteen-hundredths of a foot thick that contained brick fragments. The second course of brick was laid directly over the bottom course and was attached to this course with mortar. However, this course was not bonded to the mamposteria wall and a fifteen-hundredths of a foot gap existed between this course and the wall. This gap was filled with a light brown sand. In the corner where the scarp wall and flanking battery wall came together a single brick was laid atop the second course. Since this brick also had mortar on its top it seems probable that a fourth course of brick was at one time present.

Further evidence for at least a third course was the presence of mortar on top of the second course of brick. Since only two courses were left intact it is suggested that the upper courses of brick were salvaged (removed) when the ground level had built up to a depth of two courses.

Adjacent to the mamposteria wall mentioned above and at the lowest levels of the trench were several ruined sections of a mamposteria wall. It appears, from this evidence, that the existing wall was at one time higher and either fell down or was pulled down before the dressed-stone wall with batter was constructed.

Additional evidence indicating that the mamposteria wall was constructed after the vertical section under the belting of the scarp wall was the fact that the mamposteria wall continued over the footing of the scarp wall (Pl. 3).

The scarp wall evidence from Trench B indicated that it was, in this area, made completely of dressed-stone. This situation differed from that found in Trench A where mamposteria occurred under the batter scarp wall footing. In Trench B at one and two-tenths feet below datum, or an elevation of 98.80 feet, an outset dressed-stone belting was present (Pl. 4). The outset was forty-five-hundredths of a foot and this course was one foot thick. Above the belting the scarp wall had a batter but below the belting the wall was vertical

(Fig. 8). The belting extended the width of Trench B. At the junction of the scarp wall and the flanking battery wall the belting butted into, and stopped at, the flanking battery wall.

After Trenches A, B, C, D and E were completed and the excavations refilled, a trench was dug to connect Trench A and Trench B. This was designated as part of Trench B, and completed the moat excavations. This trench was 26.50 feet long and five feet wide. It was discovered that the belting extended 17.50 feet northward along the scarp wall from the junction of the scarp wall and flanking battery wall (Fig. 9). The vertical dressed-stone wall under the belting extended 18.80 feet from the above point.

The vertical wall butted against the dressed stone mamposteria (Pl. 4). The belting butted against the dressed stone footing above the mamposteria. The dressed stone that the belting butted into was four feet long and under this stone the mamposteria had been cut back (northward) one and three-hundredths of a foot in order to receive the vertical stone wall (Fig. 9).

The top of the belting was at the same elevation as the top of the dressed-stone footing of the scarp wall.

Trench C: The purpose of this excavation was to investigate the sally port footings, the manner in which the sally port facade was constructed and its relationship to the scarp wall. The excavations extended 14.50 feet southward from the south side of the moat bridge. The width of the trench was initially five feet but due to cave-ins and extensions its width was seven and one half feet when excavations were completed. The depth of excavation went to a relative elevation of 89.36 feet.

It was discovered that the sally port facade rested on a footing platform that extended outward from the front of the facade three and eight-tenths of a foot. This footing platform had a step that was two and six-tenths feet below its upper

surface. The ledge formed by this step varied in width from four-tenths of a foot to one and eighty-five-hundredths of a foot. The step became wider as it approached the moat bridge pier to which it was joined (Fig. 12).

The footing platform, not including the step, was made of dressed-stone laid two courses high and two deep. The stones were laid in mortar and mortar had also been used to cover the whole platform. In irregular places brick fragments were included (Pl. 6).

The step, or bottom, section was made up of a mixture of mortar, small undressed-stone and brick. The excavations in this area went to four and four-tenths feet below the top of the footing platform.

During the construction of the sally port facade the scarp wall dressed-stone footing was cut out and down to an elevation of 96.51 feet. The back or rear buttress of the facade rested on this level. The scarp dressed-stone footing that occurred at this point was one and seven-tenths feet high and it had been cut down one and one-tenth of a foot which left an "L" shaped stone with the end nearest the sally port being only six-tenths of a foot thick. The stone at the base of the sally port facade's rear buttress was not tangent to the vertical of the "L" notch but was one and four-tenths of a foot northward. This gap probably represents the working tolerance allowed the workmen who did the cutting of the scarp footing stone to receive the sally port facade buttress.

The front or most forward buttress rested on the sally port facade footing platform. This footing platform was constructed up to and over the dressed-stone mamposteria wall of the scarp wall.

It was evident that the two buttresses of the sally port facade were constructed at the same time since in all three of the lowermost courses single stones were cut so that they were part of both buttresses or part of one buttress and tied into the scarp wall.

It was noted that the surface of the stones of the sally port facade were more carefully cut and finished than those of the scarp wall.

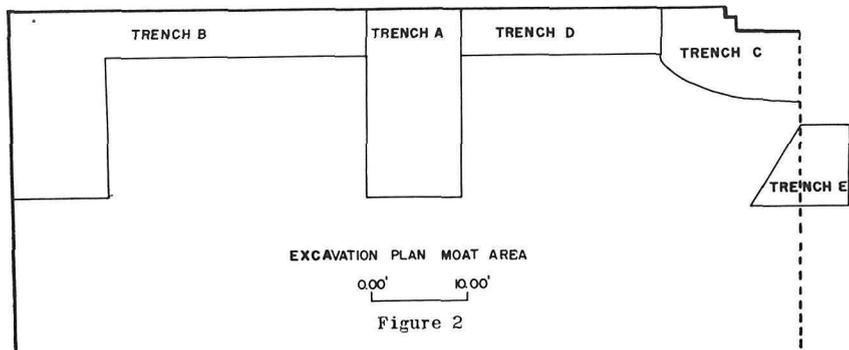
The batter of the front on the facade was one half foot in three feet and that on the south side of the facade buttresses was six-tenths of a foot in three and three-tenths of a foot.

Trench D: This trench was a connecting trench between Trench A and Trench C and did not possess any unique features. The scarp wall, its footing and the mamposteria wall were the same as discussed in the Trench A section.

Trench E: This trench was located under the moat bridge in the archway adjacent to the drawbridge span. At an elevation of 96.49 feet the top of the footing for the drawbridge pier was encountered. The elevation of the top of the sally port footing and the top of the drawbridge pier footing only varied twenty-three hundredths of a foot (Fig. 14, Pl. 5).

Below the top of the moat bridge pier footing at an elevation of 95.64 feet a former "causeway" or moat bridge pier footing was encountered (Fig. 13). This feature extended into the north wall of the trench and the exposed horizontal surface measured five feet by six feet. The total depth of this feature was not discovered as excavation was stopped at an elevation of 92.97 feet after two and seventy-hundredths feet had been exposed. This feature had a yellowish appearance being composed of mortar, undressed or rough stone and clay.

In stratum 3 of the excavation, from an elevation of 97.97 feet to 96.97 feet, a layer of sandstone chips with some tile and brick fragments occurred. There may be some correlation between this stratum and a stratum noted on a map of El Morro by Don Manuel F. Castro of 1860 that shows a stratum, at about this level, that covered an area under all of the arches of the moat bridge.



PLASTER	—————	P
MORTAR	—————	M
DRESSED STONE	—————	[]
ROUGH STONE	—————	[]
MAMPOSTERIA	—————	[]
HUMUS	—————	[]
BUILDING RUBBLE	—————	[]
GRAY RUBBLE	—————	G
YELLOW SAND	—————	Y
RED SAND	—————	R
RED SANDY CLAY	—————	R
BROWN SAND	—————	B
BROWN SAND RUBBLE	—————	B
RED CLAY	—————	[]
BRICK	—————	B

Figure 3: Key For All Figures

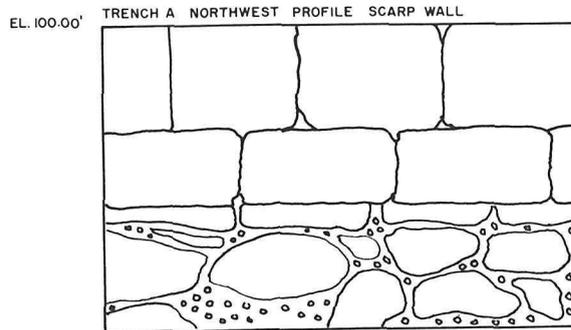


Figure 4

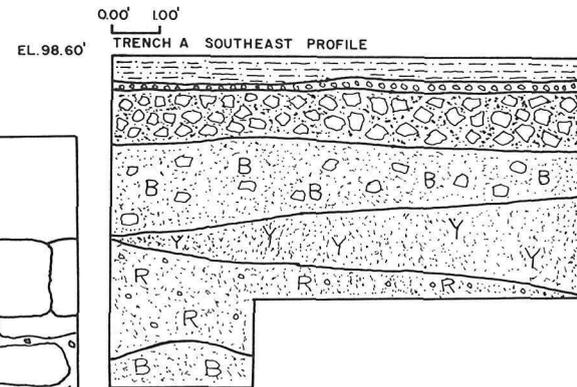
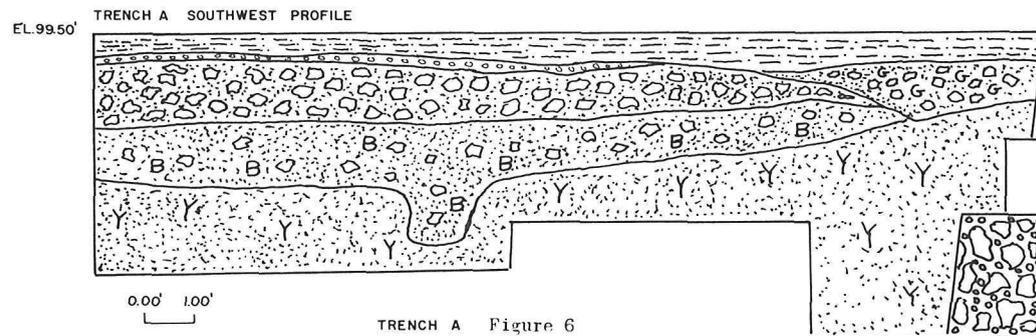
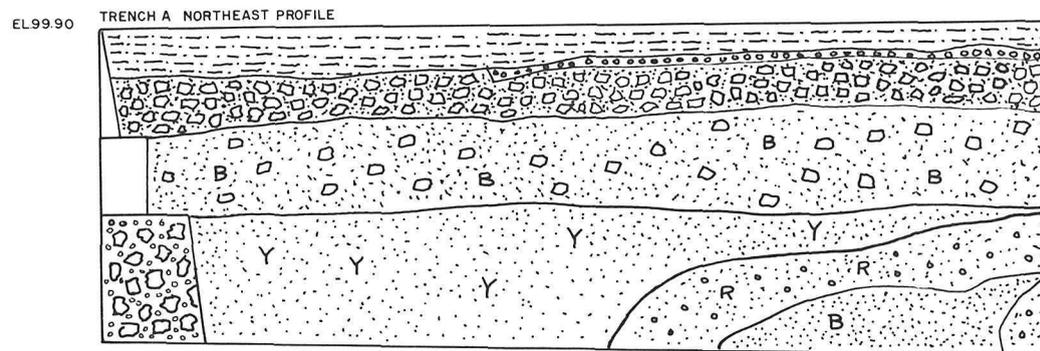


Figure 5

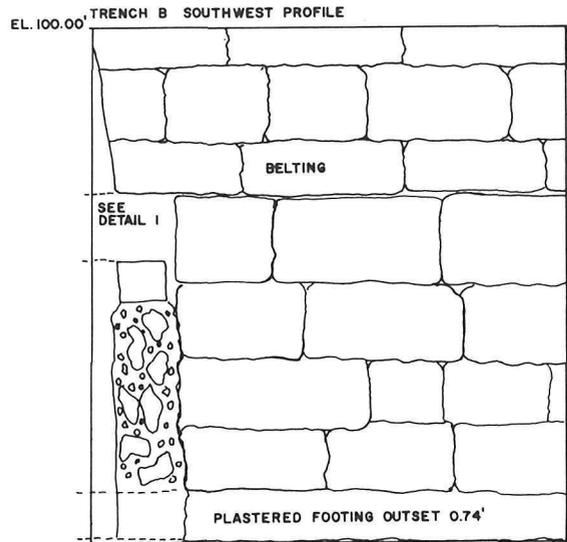
TRENCH A



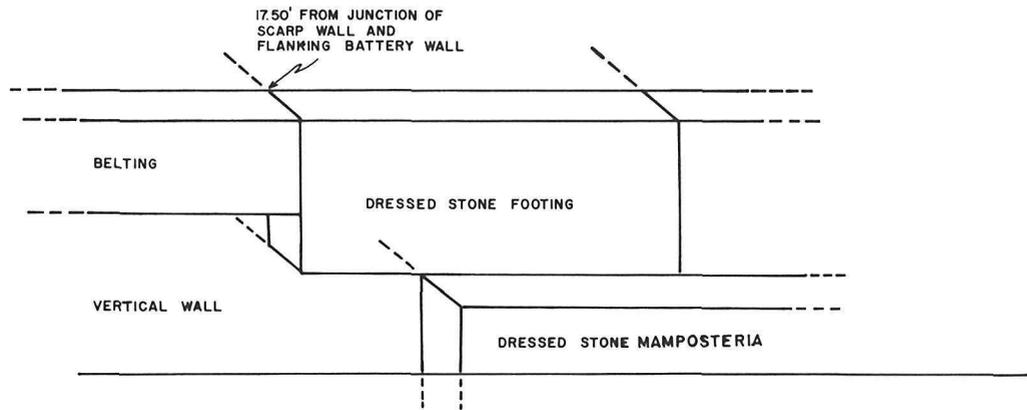
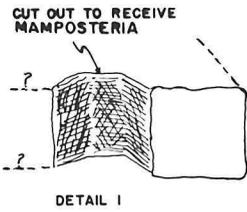
TRENCH A Figure 6



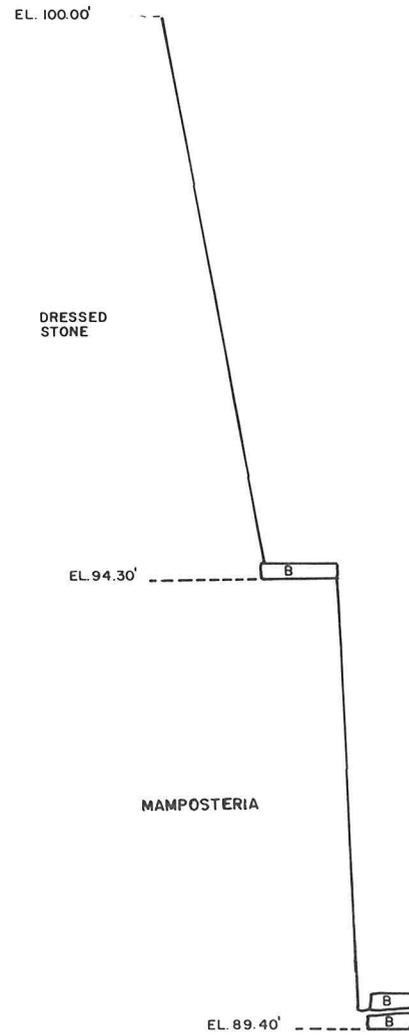
TRENCH A Figure 7



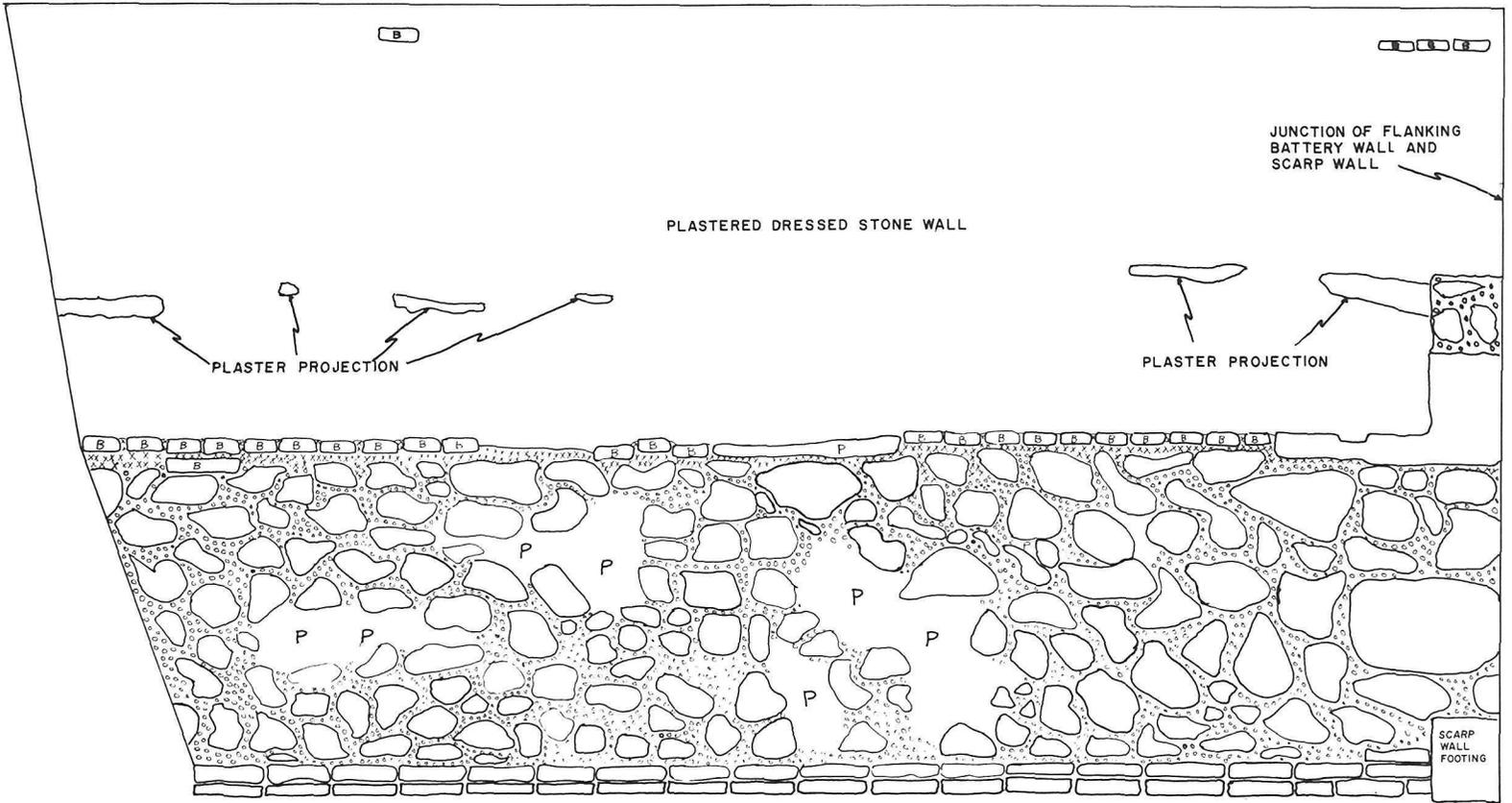
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Figure 8



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Figure 9

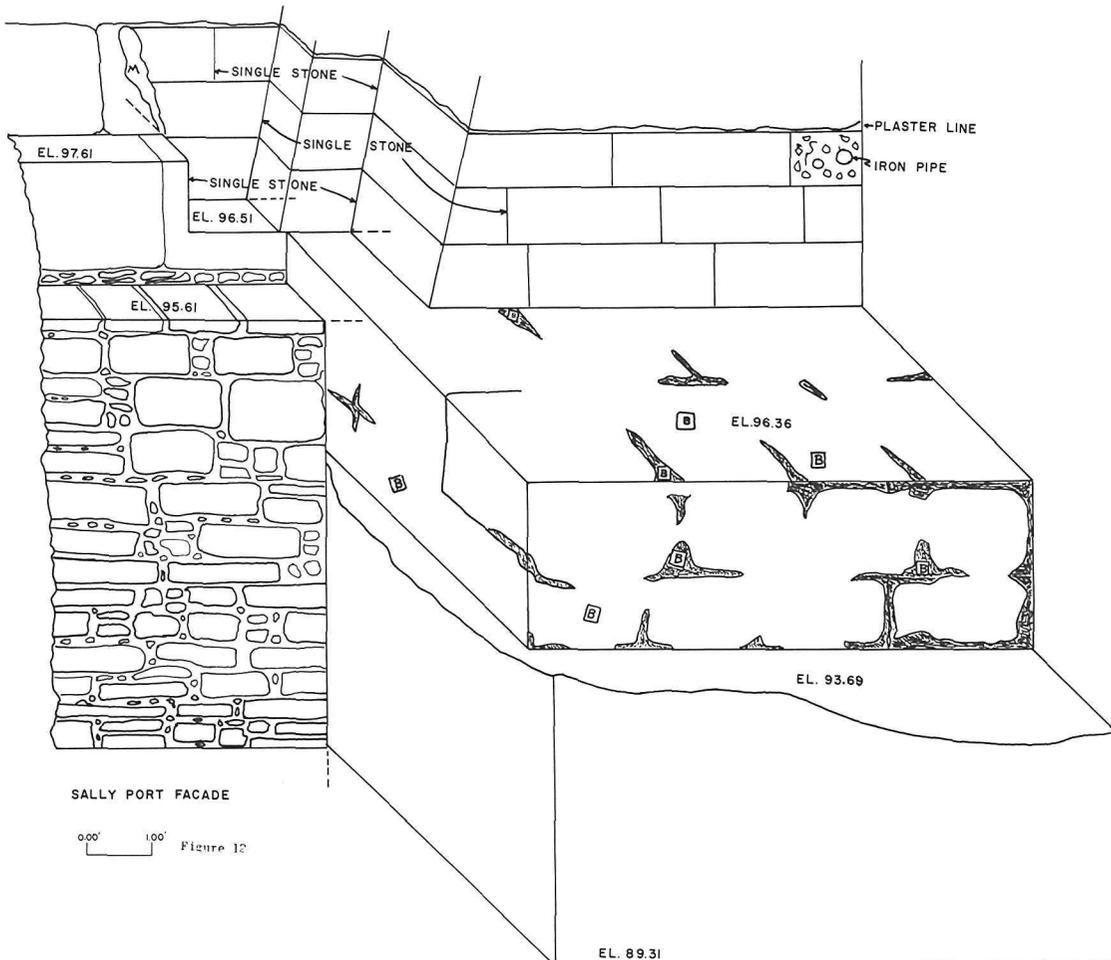


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Figure 11



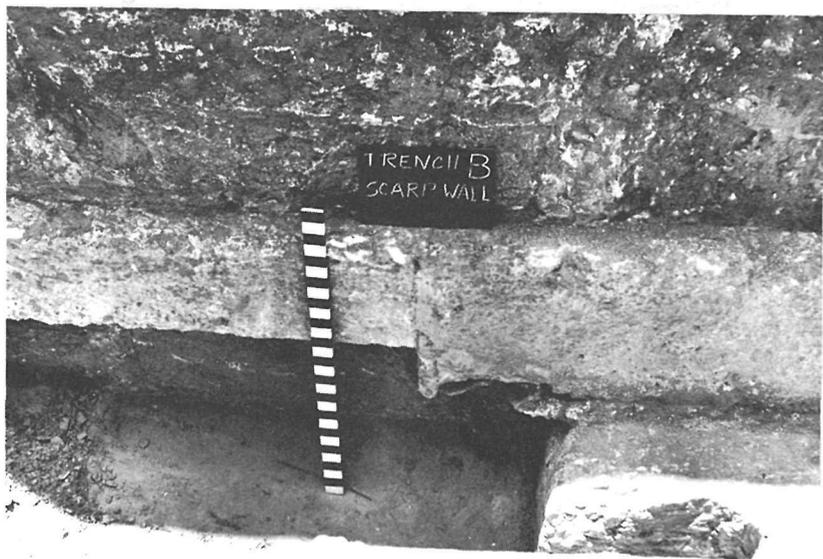
FLANKING BATTERY WALL OF THE AUSTRIA BASTION

0.00 1.00 Figure 10

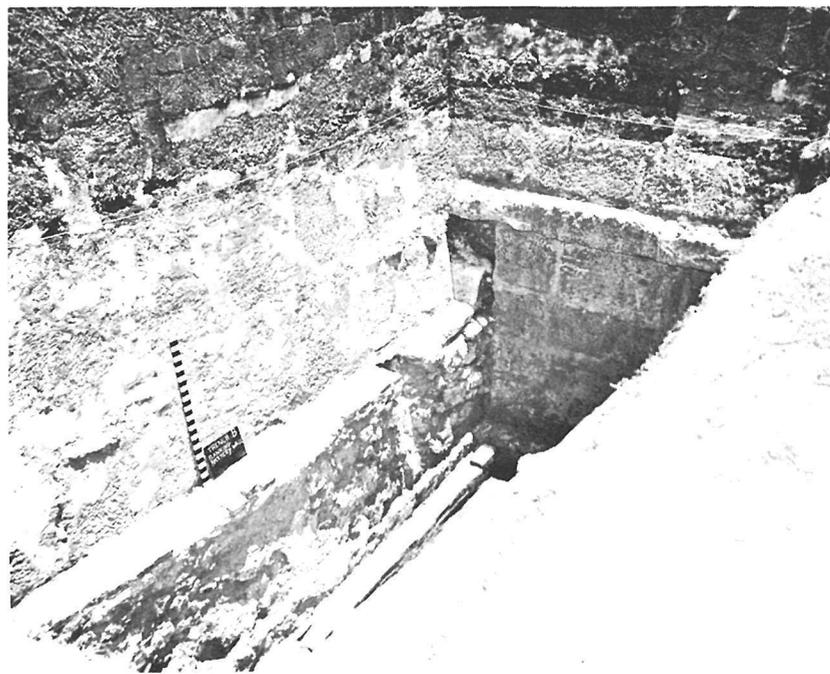
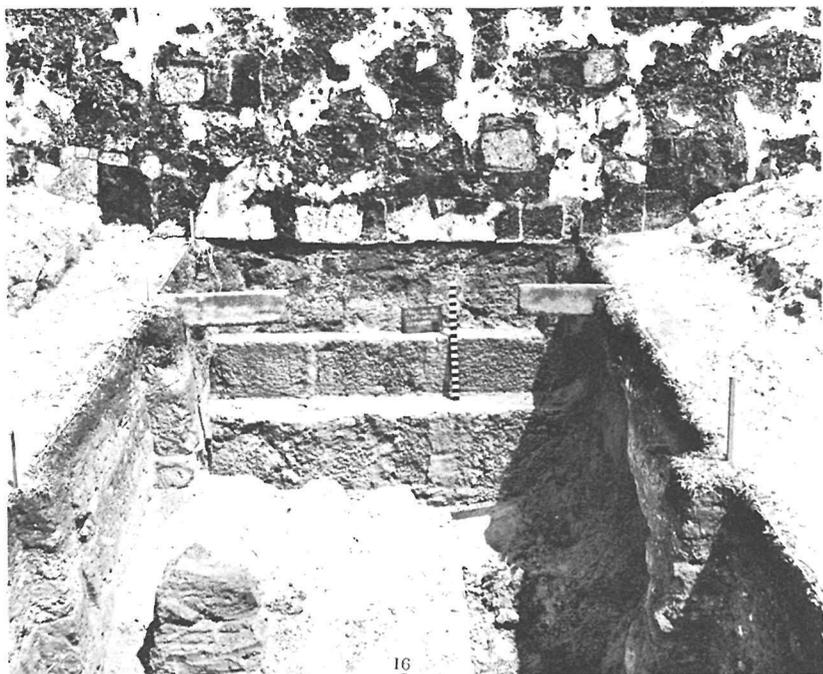


SALLY PORT FACADE

0.00 100' Figure 12



1. ABOVE: MOAT, TRENCH B, SCARP WALL SHOWING JUNCTION OF BELTING AND DRESSED STONE FOOTING.
 2. BELOW: MOAT, TRENCH A, SCARP WALL AND DRESSED STONE FOOTING. MARKED SCALE IS SET ON MAMPOSTERIA WALL.



3. ABOVE: MOAT, TRENCH B, CORNER OF FLANKING BATTERY WALL AND SCARP WALL.
 4. BELOW: MOAT, TRENCH B, CORNER FLANKING BATTERY WALL AND SCARP WALL.

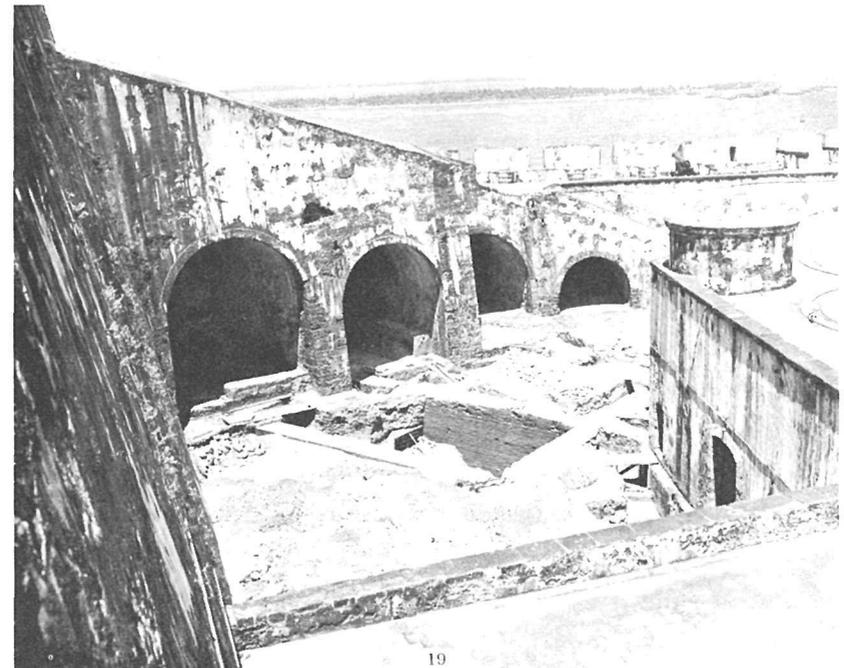




5. MOAT, TRENCH E, SCALE IS STANDING ON MOAT BRIDGE FOOTING. TRIANGULAR AREA IN FOREGROUND IS A SIDEWALK. THE AREA BETWEEN THESE FEATURES IS REMAINS OF EARLIER MOAT CAUSEWAY OR FORMER BRIDGE PIER FOOTING.



6. ABOVE: MOAT, TRENCH C, SALLY PORT FOOTING AND TO LEFT THE DRESSED STONE SCARP WALL FOOTING THAT HAS CUT AWAY TO RECEIVE THE SALLY PORT FACADE KEYING STONES.
7. BELOW: KITCHEN AREA, SHOWING VAULTS UNDEE RAMP. VAULTS FROM LEFT TO RIGHT: LATRINE, KITCHEN, VAULT 3 AND VAULT 4.



The Chronological Sequence of Wall Construction of the Scarp Wall and the Flanking Battery Wall

From the structural evidence present it appears that the following was the sequence of the various building phases. The initial wall construction, from the evidence that is now available, was the dressed-stone mamposteria wall with batter under the present batter scarp wall. The top of this wall was at an elevation of 96.00 feet. The base, if at the same level as the base of Trench B, would have been at 89.40 feet. This would make the present height of the dressed-stone mamposteria wall six feet and six-tenths of a foot. The height of this wall and its batter indicates that this was no mere footing for the dressed-stone scarp wall. It is recorded in the documents that the Earl of Cumberland, when he withdrew from El Morro, tore down the landwall of El Morro. The document also mentions the fact that the wall that was destroyed was in a rather bad state of repair. It would be much easier to destroy a mamposteria wall, in a bad state of repair, than a dressed-stone wall. If the mamposteria wall, that is now present, was the wall of 1598, it indicates that the whole wall was not demolished.

The second building phase was the dressed-stone batter scarp wall that extended from the sally port to the beginning of the belting and vertical wall section. This period of construction was followed by the installation of the vertical wall and the belting. The reason for this aberrant type of construction at this particular level and place is a mystery at the present time.

The fourth addition occurred in the flanking battery area. Here a rough stone mamposteria wall was constructed. This wall was tied into the vertical wall section of the scarp wall.

The last building phase was the dressed-stone flanking battery wall.

Possible Sequence of Moat Levels

The original ground surface, as found in Trench B at an elevation of 89.40 feet, appears to have been an early moat level. This is at the base of the rough stone mamposteria wall of the flanking battery and the level would date from the time after (and very possibly before) the fourth period of wall construction.

It is believed that the initial moat elevation was at this depth and it remained at this level until after the fourth period of construction.

The second discernable moat level was at an elevation of 94.30 feet. This level is at the top of the mamposteria wall of the flanking battery wall.

The third level is indicated by remnants of plaster fragments that are at an elevation of 96.50 feet. The last level was the existing level before excavation and was at an elevation of 99.60 feet.

THE KITCHEN COUPT AREA

The kitchen court area is located on the second level of the fort. The kitchen was located in a vaulted structure under the main ramp. There were four vaults here; the one on the left, as one faces the ramp from the courtyard area, was the latrine; the second was the kitchen and the next two were un-named so they were designated as vault 3 and vault 4 (Pl. 7).

Historical Notes by Ricardo Torres Reyes

Very little is known about the physical growth or formation of the kitchen court area because there are no plans or maps showing the topographical conditions of the promontory when work on the Fort was begun in 1539. Documentary information is very fragmentary, and in many cases, contradictory as to the nature of the buildings erected during the course of the centuries. Accurate and reliable maps appeared only during the second half of the eighteenth century when the

Fort had been partially completed. It is quite certain, however, that the formation of the kitchen court followed the natural configuration of the promontory. As early as 1587, Governor Diego Mendez de Valdes stated that the bluff had a sloping view which ended in a sort of rocky terrace at the point. The first master plan of El Morro (1539)¹ called for enclosing the promontory, on the land and sea sides, with a continuous parapet wall. During 1591 - 1614 the landward and north-eastern sides were enclosed in walls, and by 1625 a west wall joined the point of the promontory with the seaward flank of the Austria Bastion. At this date, the inside of El Morro looked like a small village because of the several buildings which were scattered around the area.²

The first independent buildings near the slope of the promontory, where later the present kitchen court was formed, were a "Lombard-man and munition house," and a sentry box, erected around 1582. From 1582-1731, different buildings were added which had to be repaired periodically because they were not bomb-proof.

The following is a chronological list of facts and statements about the construction of powder magazines from 1582-1731:

- 1582: A "Lombard-man and munition house" and a sentry box, above and behind the area of the old tower (1539)³.
- 1591: Two munition houses behind the gorges of Austria and Tejada Bastions⁴.
- 1627: Powder was kept in casemates located on the flanks of the Bastions⁵.
- 1632: The warden of El Morro recommended to build two or three powder magazines; the magazine which existed was "uncovered on the sea side and can be destroyed."⁶
- 1636: There was only one powder magazine in very bad shape⁷.
- 1644: Powder was kept in casemates because there were no magazines⁸.
- 1651: Magazines have fallen down and need rebuilding from

the foundations⁹.

- 1671: Buildings of the Fort were in bad shape due to damages caused by hurricanes of the last four years¹⁰.
- 1673: Powder magazine was repaired¹¹.
- 1680: A powder magazine was built¹².
- 1689: The walls of the magazine were reinforced and powder was packed up in boxes¹³.

In 1731 there were only two powder magazines in the city, one in El Morro and the other at San Cristobal. The one of San Cristobal had been built around 1680. That of El Morro is described in 1731 as follows:

"This magazine needs, because its first flooring is of earth, to make it of hor-migon of about one hand-breadth thick, and then to superimpose beams on top of this flooring to form a bed of planks for placing the munitions. If the beam bed were covered with tar, it would last a long time. The wooden pillars which support the higher flooring will be placed over footings of hewn stone for a longer permanency. The breathing-holes of the magazine should have their gratings of metal wire in the inside and the outside, and the window, which is located in the lower part of the magazine, should be reduced to two breathing-holes...The use of any kind of locks for doors and breathing-holes should be avoided unless they are made of a combination of metal and iron. Due to the great uselessness of all the timbers of this magazine there are needed, for the higher flooring, eight beams of eleven varas and two-thirds long, and of one hand-breadth thick...For the greater

safety of the above mentioned flooring, there are needed four joists of the same length and one-third of a vara thick...To form the bed of beams there are needed eight stringers of eleven varas in length, and one hand-breadth thick...There are also needed, for both floorings of the magazine, eighteen timbers, six varas long, one-third vara wide and a hand-breadth thick; these timbers will be used to make one hundred and forty-four flooring boards, two inches thick."

The document cited above describes also the powder magazine of San Cristobal, which had two stories but more than one third of its height was underground. The magazine was:

"three toesas and a half in height, with a tile vaulted roof, and with more than one-third of the said height inlaid or sunk in the form of a cistern, which part has been and is too humid...Experience has taught that the portion of powder which had been sotred in the said level, has been taken out completely useless; suffering at the same time all the timbers which formed the middle flooring, for which reason the timbers rotted and collapsed the last year of 1730."

The authors of these statements, a team of three military engineers, proposed to level off the sunken part of the magazine up to the level of the middle flooring in order to form a new masonry flooring instead¹⁴.

According to an engineer's report of October 9, 1752, the magazine of El Morro had a cobertize (shelter or shed) on the side which was used for storing the "juego de armas

de la artilleria", that is, utensils pertaining to the artillery. The tiled roof magazine was too close to the artillery batteries. It did not need repairs, and the powder was very well kept due to the cobertize. Because of the bad weather and salty air, the tile roof required 2500 tiles for its repair¹⁵.

Engineer O'Daly, on June 10, 1765, stated that the powder magazines of El Morro and San Cristobal had capacity for 3,000 quintals of powder. The magazine of El Morro had a tile roof of hovedilla, that is, a roof formed with vaults resting on beams¹⁶.

The plans of El Morro of 1742 and 1765 show the magazine described in 1731, near the present kitchen court area.

After 1773, all the buildings of the lower patio of the Fort disappeared. When the high wall on the south of the patio was built, excavations around the area showed that all the fortifications below the slope of the promontory had been built on top of a coarse stone bed. The surface of this bed was covered with "weak and sandy soil."¹⁷

The following is a quotation from William Muller's classical work.¹⁸ Muller was an instructor of military sciences at the University of Göttingen and a prolific writer of the late eighteenth century, whose books were used as works of reference.

"Powder magazines are usually made, with a due regard to the preservation of the powder, and so as best to prevent the danger that might arise from the accidental bursting of a shell within the works. These powder magazines are square holes, dug in the earth, of about six to eight feet every way. In each of the four corners, there stands a wooden pillar, with boards behind to prevent the earth from falling in.

They are covered over with beams, rafters and fascines, and above these with earth, closely beaten down, to the height of one or two feet, to protect them from shells. The entrance is secured by a strong door and a flight of steps leads into the cavity.

Powder magazines are generally situated on the side opposite to that where the attack is expected to be made, at about twenty-five feet distant from the battery."

Excavations

Building 1: The initial excavation of this area was a five foot trench that was extended across the front of the kitchen vault. In this trench a wall later designated as wall 3 was encountered and in the subsequent tracing of this wall an outline of a building emerged. This building was designated as building 1 (Pl. 15). It was composed of two rooms with three types of walls being represented in the

NOTES

1. Plan of Antonelli, 1589
2. A Dutch map of 1625.
3. Sketch of 1582 showing old tower and Floating Battery, Archivo General de Indias, Patronato 175, Ramo 41.
4. Salazar map showing hornwork of El Morro.
5. SD-156-24
6. SD-156-26.
7. SD-156-22
8. SD-156-25.
9. Archivo General, Mejico, R. C., vol. XII, Exp. 83.
10. SD-157-29.
11. SD-157-29.
12. SD-158-35.
13. SD-159-39.
14. SD-2499.
15. SD-2500-4.
16. SD-2501-17.
17. SD-2510-46.
18. William Muller, The Elements of the Science of War, containing the modern, established, and approved principles of the theory and practice of the military sciences... (London, 1811, 3 vols., I, 336-337).

structure. The inside east-west dimension was 43.80 feet and the north-south dimension was 39.40 feet. The east-west outside dimension is unknown due to the fact that wall 4 extended beyond the limits of the excavation (Pl. 13, Fig. 22). When excavation was discontinued wall 4 was seven feet wide. The north-south outside dimension of building 1 was 51 feet. The top of the walls of building 1 were from ninety-one-hundredths of a foot to two and two-tenths of a foot below datum.

Building 1 was for the most part in the courtyard area but did extend under the floors of the kitchen and the latrine areas. The present drainage system for the courtyard area, constructed in the late eighteenth century, ran obliquely through building 1 in a northwest-southeast direction. The main drain, a vaulted brick structure was about six feet thick with an outside dimension of four feet (Figs. 15, 25).

The eastern room of building 1 was cleared out from the northern side of the vaulted drain to the north wall of building 1. The fill in this room was composed of sand, rough sandstone, dressed sandstone, pockets of red clay, tile and brick fragments and sandstone chips. The majority of the fill however, was sand. The floor was discovered at a relative elevation of 87.35 feet or 10.65 feet below the top of wall 1-A. (A temporary bench mark was established on top of the stairwall at the base of the stairs leading from the kitchen courtyard area to the main ramp.)

The northern wall of building 1 was designated as Wall 1A and Wall 1B even though both sections were constructed at the same time and were made of the same materials since the interiors differed in detail of surface treatment.

The exterior surface of this wall (wall 1A and 1B) was unfinished with rough stone protruding from the wall matrix (Pl. 9, 10). The thickness of this wall varied from two and one-half feet to four feet. In general, wall 1A, for

the most part, was thicker than wall 1B. The variation in thickness of wall 1A was one foot.

The interior of wall 1A was composed of dressed-stone of medium size ranging from one and eight-tenths of a foot to two and two-tenths of a foot plus or minus five-tenths of a foot (Pl. 16). The dressed-stones were laid in a reddish colored mortar. This mortar was also smeared over the stone covering about two thirds of the stone faces.

Wall 2 (the east wall) and wall 3 (the interior wall) butt up to wall 1. Wall 2 also butted up to wall 5. Wall 4 (the west wall) is a continuation of wall 1 being built at the same time without interruption in the pouring of the masonry.

The interior of walls 1B and 4 were faced with plaster that covered bricks set on edge in a dark reddish mortar (Pl. 14). Wall 2 in the west room also had this feature running ten feet from the interior of wall 1B.

Wall 2 was a three and four-tenths foot thick masonry with both sides being faced by brick. There was no evidence of plaster on either side of this wall. The brick courses were English Bond. There was red clay between the bricks which could easily be removed with the fingers. On the interior of wall 2 were two rows of four rectilinear openings irregularly spaced on a horizontal plane. These holes ranged in dimension from thirty-three-hundredths of a foot by three-tenths of a foot, to thirty-five-hundredths of a foot by four-tenths of a foot.

The top row of these openings was ten feet above the floor while the bottom row was six feet from the floor. Three pair of these openings were perpendicular one to the other but one set had the top opening offset eight-tenths of a foot to the south.

In the opposite wall (interior of wall 3) there was only one row of rectilinear openings having the same range of dimensions as those in wall 2. This row was irregularly

spaced on a horizontal plane and occurred five and nine-tenths of a foot from the floor.

The rectilinear openings had been filled with gray clay. It was assumed that these openings were placed here originally in order that wooden racks of one type or another could have been constructed. Either after construction or later it was decided to do away with this feature so the holes were plugged (Pl. 16, Figs. 23, 24).

Wall 3 was the same type of construction as wall 2. However, it differed in that the side to the west (interior wall of west room of building 1) was plastered. Wall 3 had the same thickness as wall 2, being three and four-tenths of a foot thick. As has been mentioned above, the northern ten foot section of this wall's face, in the west room of building 1, was finished in the same manner as the interior of wall 1B.

Wall 4, as has already been described, was a continuation of wall 1. Its thickness was undetermined except in the southwestern section of the wall where it proceeded at an angle toward the southwest corner of building 1.

Wall 5 was a dressed-stone wall eight and three-tenths of a foot thick and occurred under the kitchen and latrine floor. From the evidence that was present this wall appeared to have continued on to and maybe under the present eighty foot courtyard wall. In the kitchen area on the interior side of wall 5 there was a rectilinear hole six-tenths of a foot by seven-tenths of a foot that penetrated the wall for a distance of four feet plus (it went further but this was as far as could be cleaned out). Also on top of this wall, in the kitchen, a sloping trough had been cut that was one foot wide, three and three-tenths of a foot long and was one foot deep at its lowest point.

The floor of building 1 was well worn and irregular. It was composed of red clay with a moderate amount of sandstone chips and brick aggregate. The floor was nine-tenths of a

foot thick. It was a relatively soft floor as it could be easily penetrated with a pick.

Underneath the floor bedrock was encountered at a relative elevation of 79.60 feet or 14.70 feet below the general courtyard surface.

Wall 8 was a dressed-stone wall that butted up to wall 4 at a 110 degree angle. Since this wall is under the west wall of the kitchen, only face could be examined. The exposed face was plastered and it made up to the plaster on the interior of wall 4. The exact relationship of this wall to building 1 is unknown.

Summary of Building 1: It appears that building 1 was constructed after an area had been leveled by filling and trimming the sandstone surface.

Since the excavated room did not have any doors or windows and the exterior of wall 1A, 1B and 6 had unfinished faces, it seems that this was a two story structure and after the first floor was built, fill was brought in to bring the grade up to the top of the first story. This story then became a basement. The west room of building 1 may have been a cistern since the walls were plastered and wall 8 may have some function in the cistern arrangement.

Due to the thickness of wall 5, it appears that this was part of an earlier retaining wall and that building 1 was made up to it.

During the later expansion of the fort, this building was destroyed. The top floor was removed and the basement area filled in. The time period of this change was probably when the present ramp was constructed.

Wall 9 was a brick wall one and eighty-five-hundredths of a foot thick and extended from the corner of the west wall of the kitchen, butting up to the front of it, across the courtyard to the opposite casemate wall. This wall divided the courtyard into two sections and was still standing during the 1925-30 period.

Building 2: Walls 6 and 7 formed the northeast corner of building 2 (Pl. 11). These walls were four and three-tenths of a foot thick and were made of carefully selected and placed, but undressed, sandstone rocks of a relatively small size (a diameter of about four-tenths of a foot). Wall 6 continued into Vault 3 and either turns north just in front of the forge or terminates. The excavations were not made this near the forge because of the danger of damaging this feature. Vault 3: The main feature of this vault was a brick forge or oven (Pl. 19, Figs. 19, 20). At the time of excavation, this area of the floor had the appearance of a brick rubble area. The forge was constructed below the level of the floor in the same manner as the hot shot oven of the water battery. The forge was located at the rear of the vault with one of its sides being tangent to the back wall (Fig. 17). Arched openings occurred on two sides of the forge that allowed for a good draft and the removal of ash. The fire box was a little more than a foot and one half square and was set forty-five-hundredths of a foot above the arched openings. The forge was constructed of brick. The exterior was faced with flat tile that was plastered over with a yellowish plaster.

In order to place the forge in this location it was necessary for the builders to cut through the vault footing.

The vault footing was made of yellow mortar with brick used as an aggregate. Before the footing was poured the area was leveled. At this time undisturbed red clay was exposed. The footing was poured to a thickness of one and four-tenths of a foot extending out from the wall three and two-tenths of a foot.

Bed rock was encountered below the red clay stratum and a yellow sand stratum at a relative elevation of 93.94 feet (Pl. 21, Fig. 18).

Wall 6, as has been noted, extends into the vault area and either stops or turns to the north before it reaches the forge.

Vault 4: The only feature that was found in Vault 4 was a trench seven feet by two, and three and two-tenths deep. This trench was located two feet from the back wall and two feet from the north wall of the vault (Pl. 18, Fig. 21).

The function of this trench is unknown. It was dug into sterile red clay having vertical sides.

The cultural material came only from level 1, which was one and forty-five-hundredths of a foot deep, and from the fill of the trench. The greatest number of artifacts from the kitchen and kitchen courtyard came from vault 4. There was a total of 271 coins found in this area. It was quite surprising to find so many coins, mostly copper, in such a restricted area.

Since so many coins were found, it was suggested that the trench was a latrine trench and the coins had fallen out of the pockets of the soldiers. However, due to the nature of the other cultural material and the relative equal distribution of the coins throughout the area, the latrine theory probably is incorrect.

Under the cultural yielding stratum red clay was present. Bed rock was encountered at a relative elevation of 93.56 feet.

Kitchen Stove: The stove in the kitchen area had, before examination, a cement veneer that completely covered it except on the top where it had been broken exposing the firebox area that was subsequently filled with recent trash.

The cement was removed revealing a structure made of brick. The firebox area was plastered. Iron straps were placed at irregular intervals six-tenths of a foot above the firebox base. These straps were not of uniform width and varied from fifteen-hundredths of a foot to twenty-five-hundredths of a foot in width (Pl. 20, Fig. 31).

There were three openings into the firebox each being seventy-five-hundredths of a foot wide. On the left side of the stove was an enclosed area that gave access to the firebox

that may have been part of a draft system. At eight-tenths of a foot from the floor on the left hand side of this stove was a three-tenths of a foot by one-half foot rectilinear opening that connected with the enclosed area mentioned above. The right top side of the stove was completely enclosed and this area was not disturbed.

Nineteenth Century Bucket Flush Toilet: In cleaning out from behind wall 5 in the kitchen an opening was discovered that extended from the kitchen to the latrine going through the wall that separated the kitchen from the latrine. This opening contained nineteenth century glass bottles and fragments of cast iron sewer pipe.

In checking this opening from the latrine side, it was necessary to pick a hole through the latrine floor. The opening made through the cement floor exposed a cast iron nineteenth century bucket flush toilet.

The toilet was made in two sections. The top part was cone shaped and was supported by two beams, one on either side and the top of this part was flush with the floor level of the latrine.

The bottom section was basin shaped having four lugs on its base that fitted over a centered supporting beam. The beams were twenty-two-hundredths of a foot square.

When in position the top section extended a short way into the bottom section forming a water trap. This metal toilet overflowed into the latrine drainage trench that emptied into the main courtyard drain when a bucket of water was used to flush it.

Eastern Kitchen Courtyard Wall Footing: In order to investigate the footing under the eighty foot wall in the courtyard, a five by ten foot trench was dug to a depth of six feet. This footing was found to be vertical with no offset to compensate for the thrust of the batter wall. The footing was made up of rough stone masonry with relatively large stones being used. That the masonry was built up in two foot

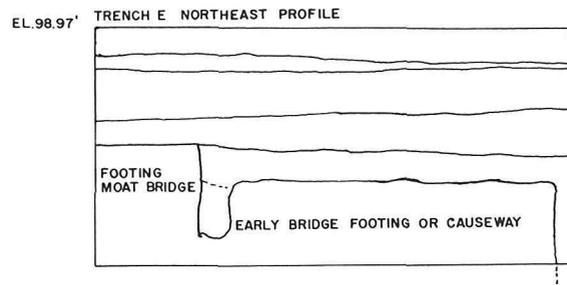
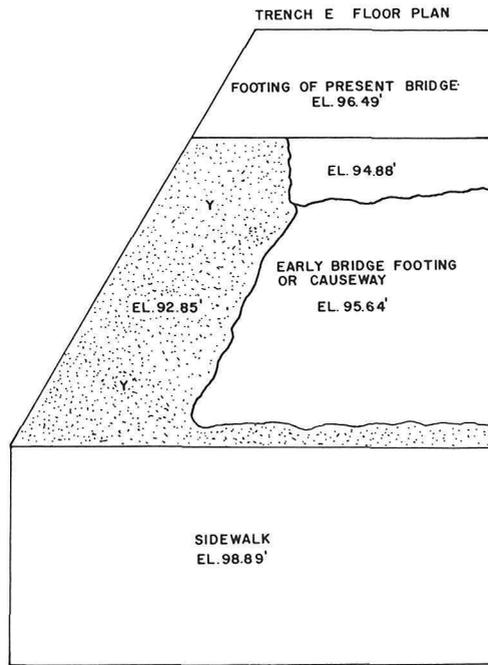


Figure 13



0.00' 1.00' Figure 14

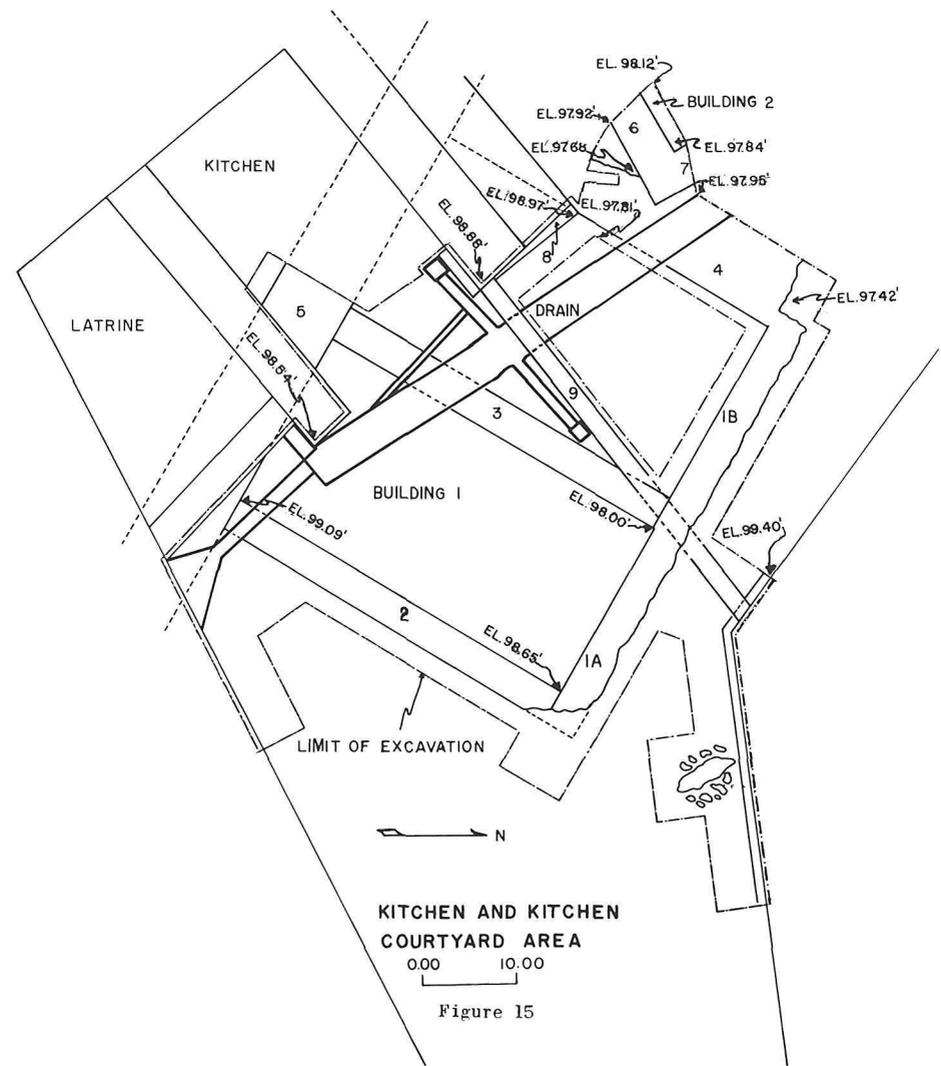


Figure 15

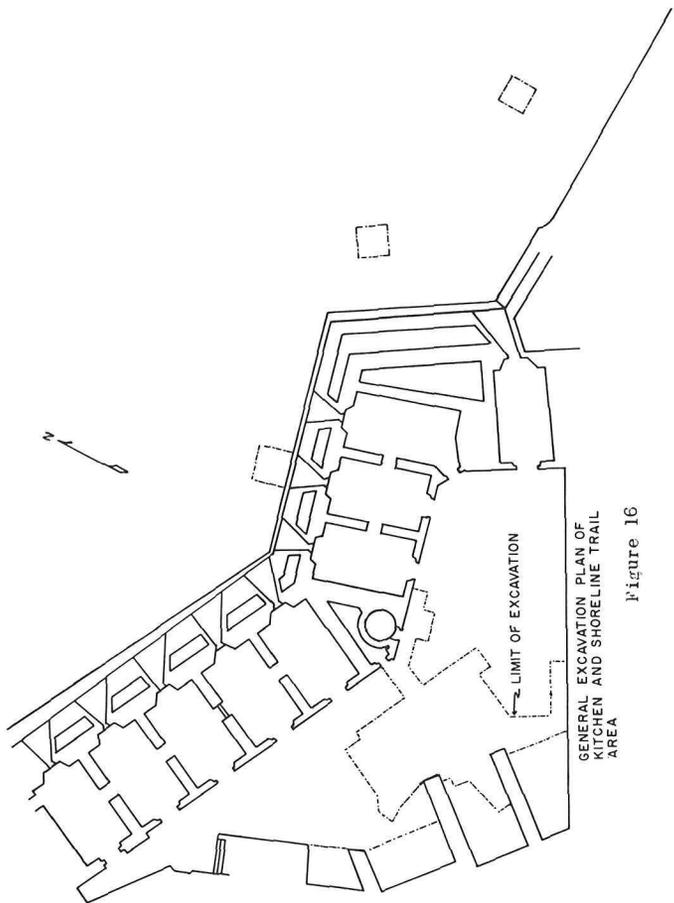


Figure 16
GENERAL EXCAVATION PLAN OF
KITCHEN AND SHORELINE TRAIL
AREA

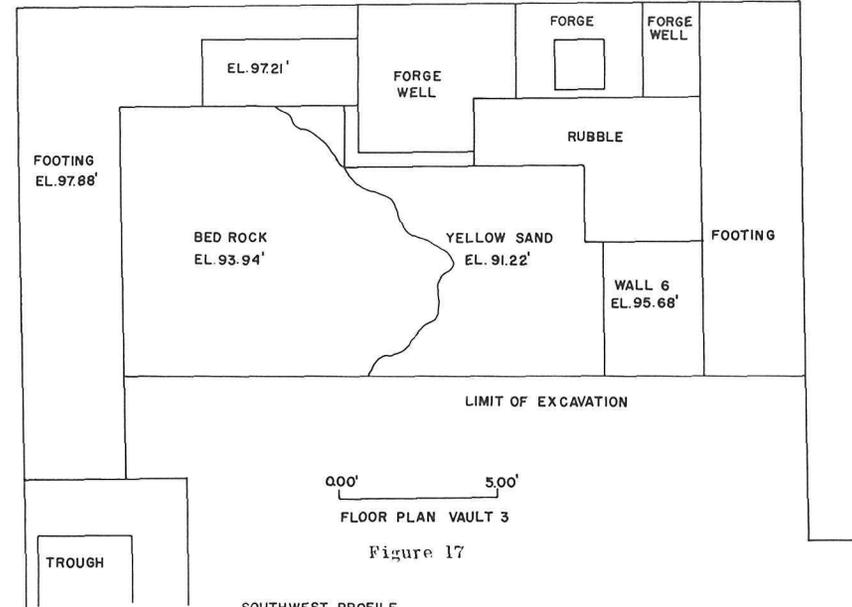


Figure 17

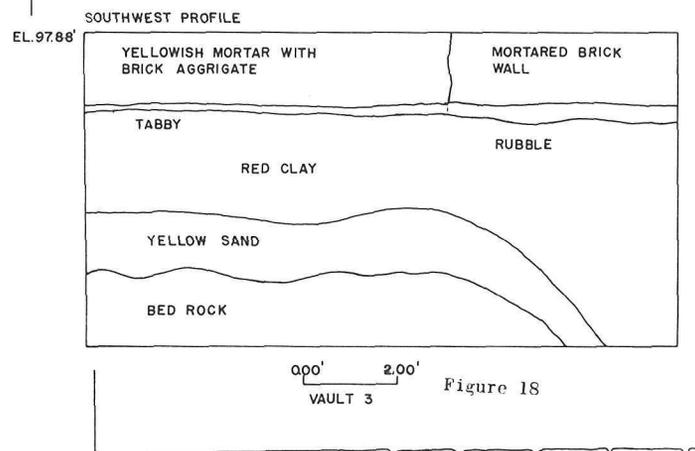


Figure 18

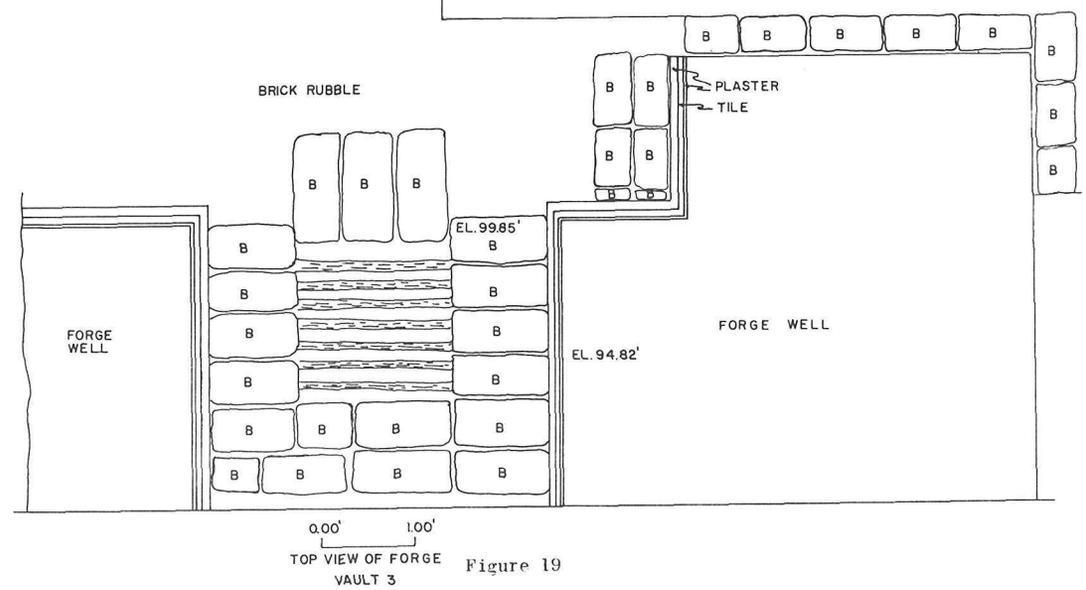
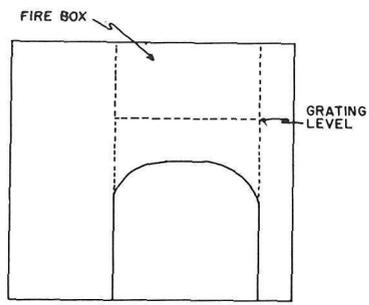
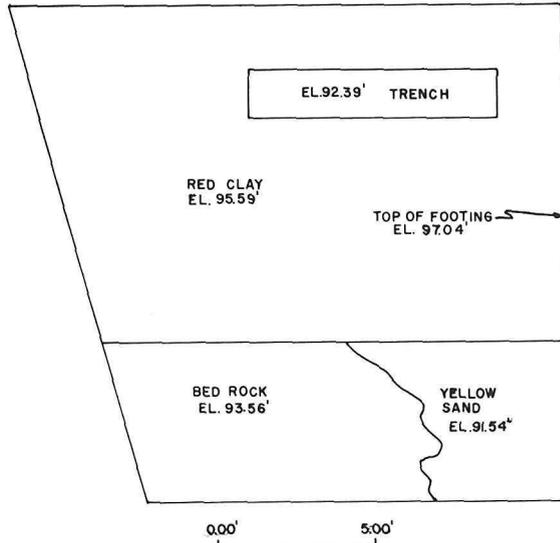


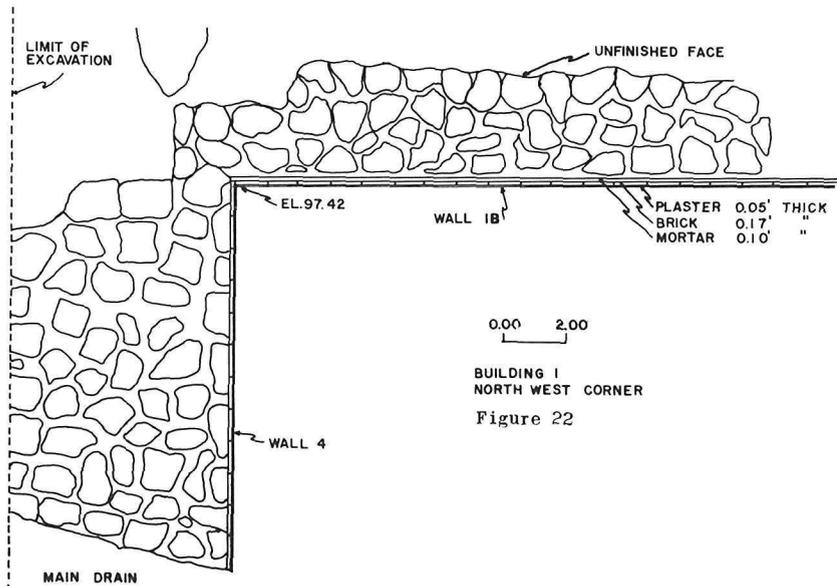
Figure 19



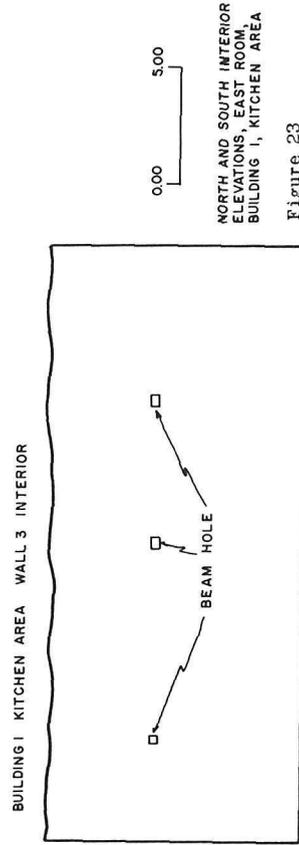
FRONT ELEVATION OF FORGE Figure 20
VAULT 3



FLOOR PLAN VAULT 4 Figure 21



BUILDING 1
NORTH WEST CORNER
Figure 22



NORTH AND SOUTH INTERIOR
ELEVATIONS, EAST ROOM
BUILDING 1, KITCHEN AREA
Figure 23

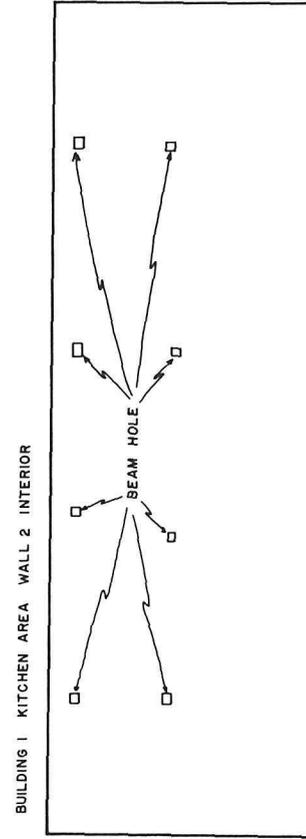


Figure 24

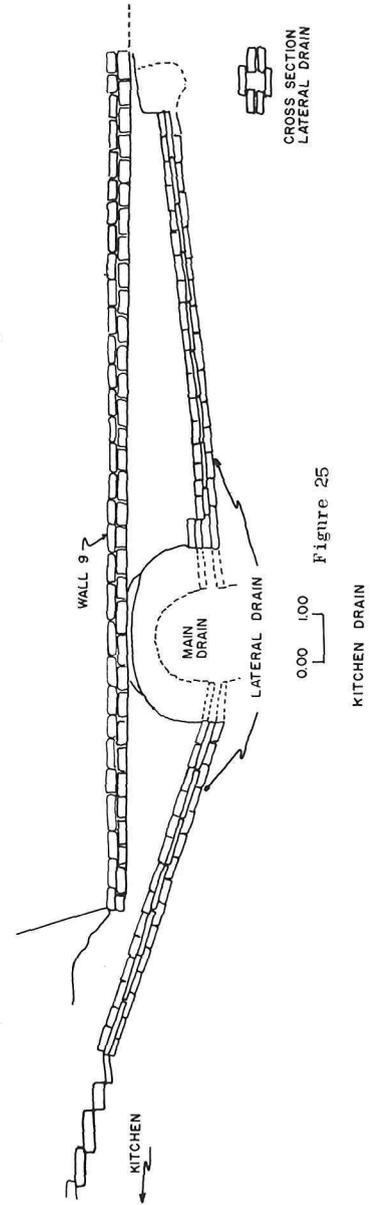
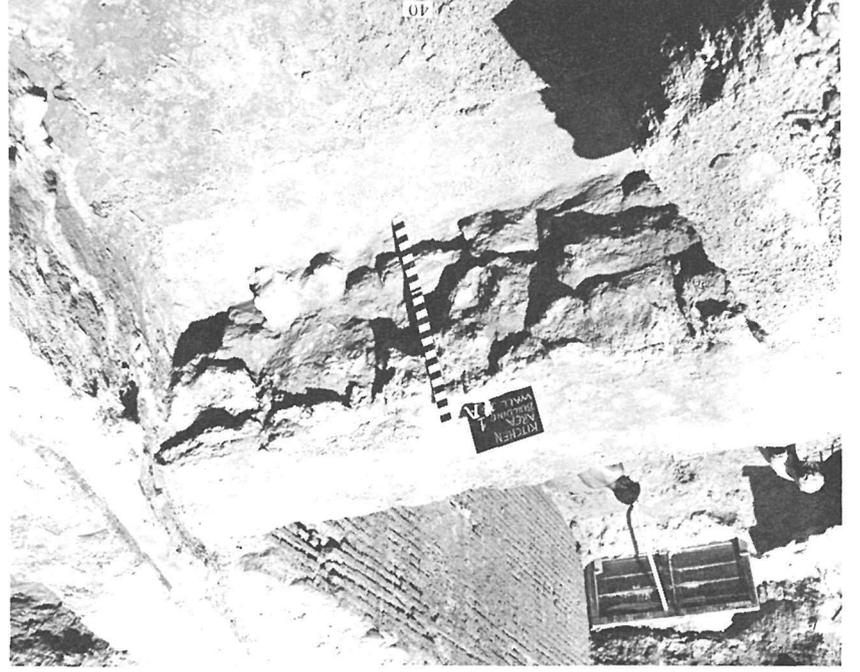
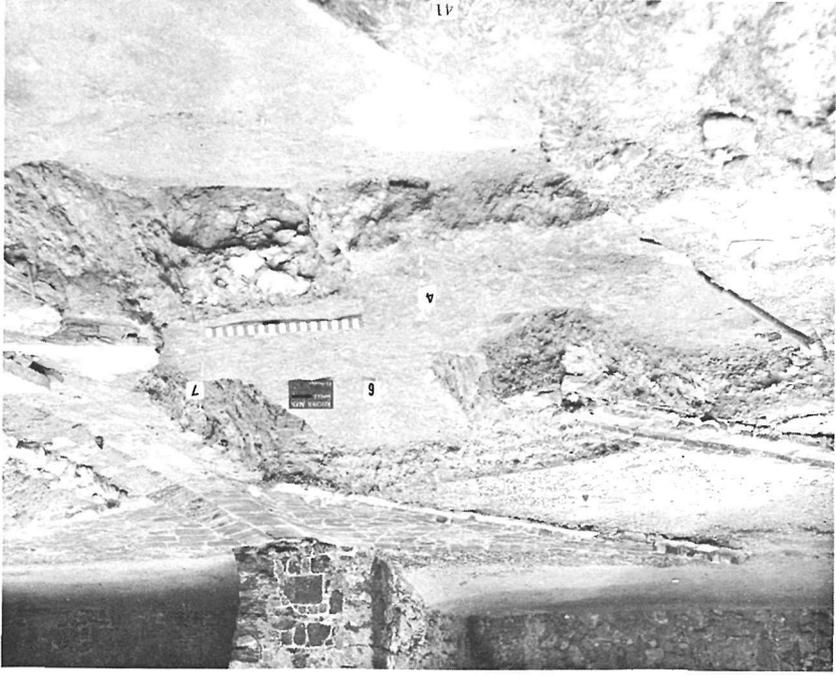
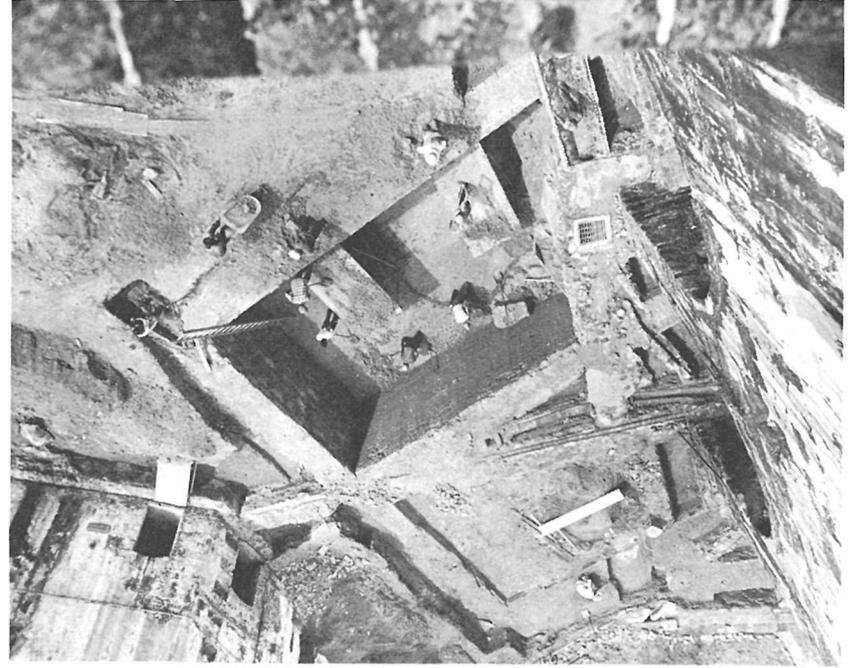
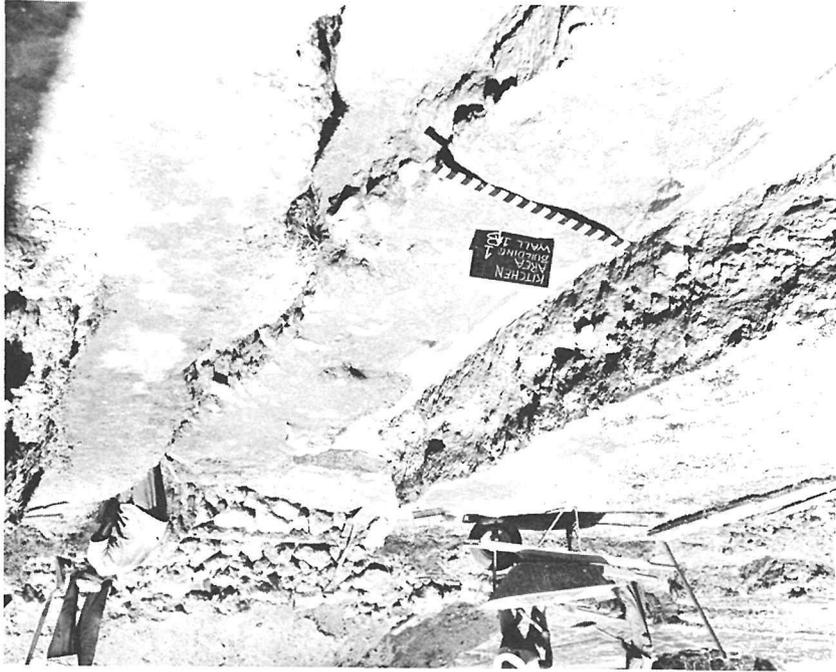


Figure 25



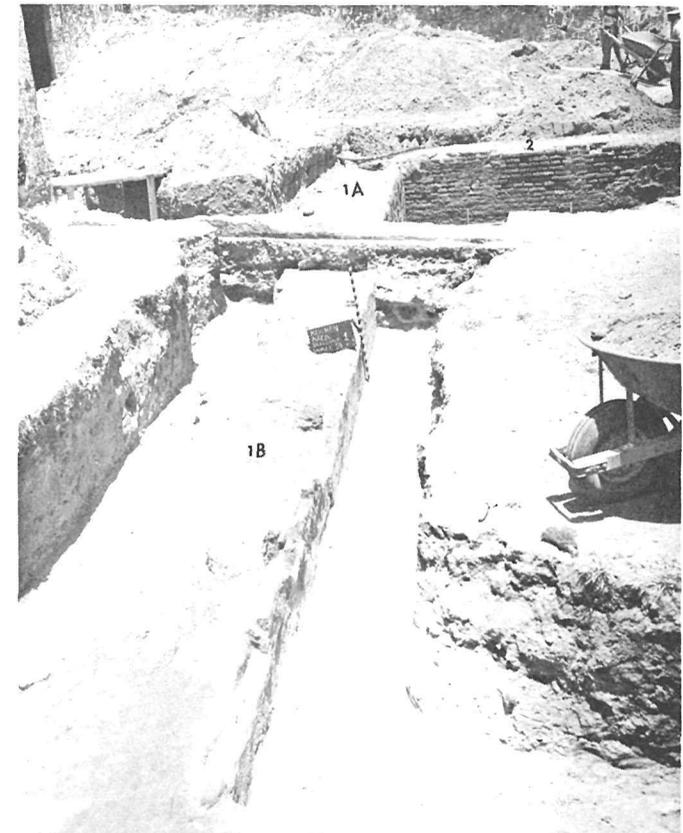
11. ABOVE: KITCHEN AREA, BUILDING 1B.
 10. BELOW: KITCHEN AREA, WALL 4 OF BUILDING 1 AND WALLS 6 AND 7 OF BUILDING 2.

10. ABOVE: KITCHEN AREA, BUILDING 1.
 9. BELOW: KITCHEN AREA, SEASIDE OF WALL 1A.

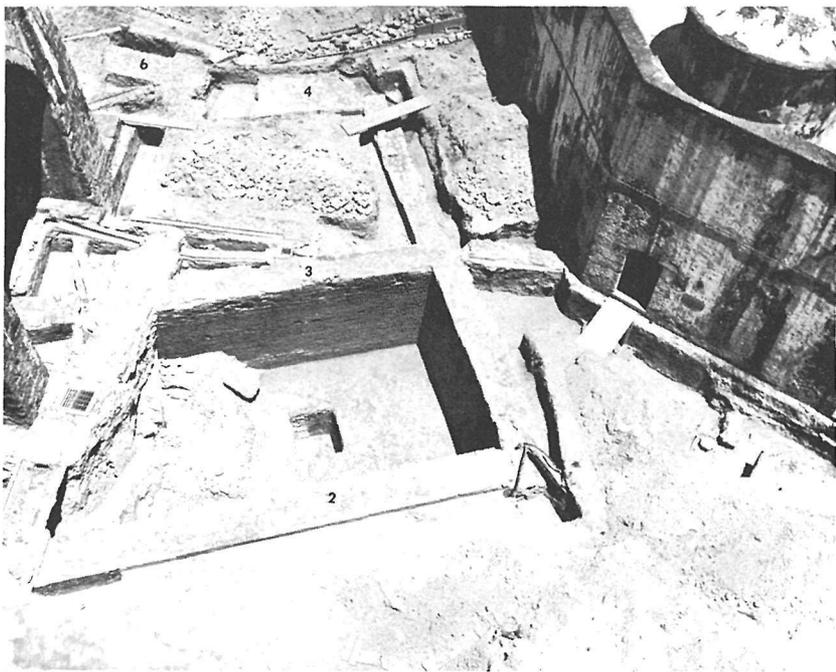




12. ABOVE: KITCHEN AREA, BUILDING 1, WALL 3.
 13. BELOW: KITCHEN AREA, WALL 4 OF BUILDING 1 AND WALL 6 OF BUILDING 2, VAULT 3 IN BACKGROUND.



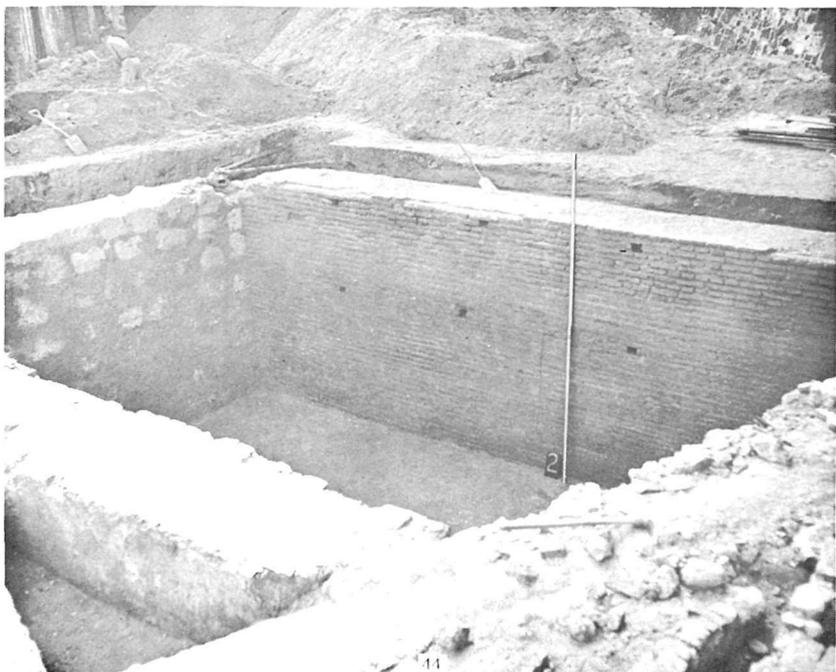
14. KITCHEN AREA, BUILDING 1, WALL 1B. INTERIOR FACED WITH BRICK.



17. ABOVE: KITCHEN AREA, BUILDING 1;
16. BELOW: KITCHEN AREA, BUILDING 1, WALL 2.



18. ABOVE: KITCHEN, WALL 3;
18. BELOW: KITCHEN AREA, WALL 4.



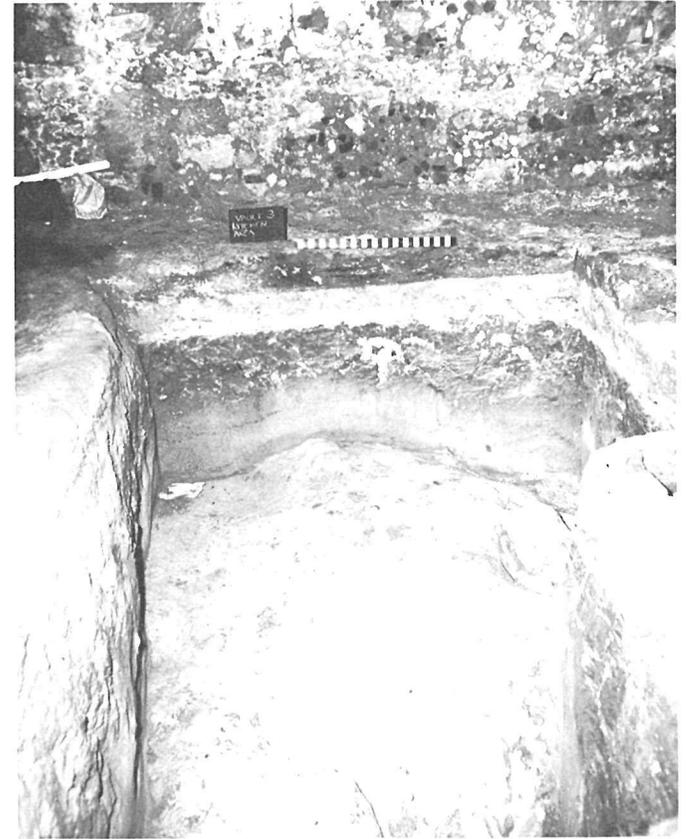
11



15



19. ABOVE: KITCHEN AREA, VAULT 3 SHOWING DOOR.
 20. BELOW: KITCHEN STOVE.



21. KITCHEN AREA, VAULT 3 SHOWING BUDDOCK.

sections was indicated by remnants of the form marks that were still present.

THE WATER BATTERY

Historical Notes on the Floating Battery by Ricardo Torres Reyes

The following summary of known history of the Floating Battery or Low Battery of El Morro, as it was officially called, indicates the constant changes which modified the physical appearance of this site through the centuries. (This area is also known as the Water Battery and is so indicated in the archaeological sections.)

The suggestion to fortify the point of the promontory (el morro) goes back to 1537. Construction was authorized in 1539 to build a tower. In 1543, 1546 and 1550 the fortification of El Morro is only mentioned casually, in connection with its lack of artillery.

In 1554 it was described, for the first time, as a tower and bastion. It is an established fact that the tower was built first and later on a bastion or platform was added at a lower level.

The first definite reference about the Floating Battery was one of October 8, 1559, when Governor Diego de Caraza wrote that he had fortified the point, at a lower level than the tower, using "lime, stone and opening seven embrasures towards the sea."¹ In 1556, Governor Bahamonde de Lugo suggested that the artillery which was emplaced in the tower should be moved down to "a flat platform with a half parapet," but it is not known if he referred to an already built platform.²

In a memoir of 1582, El Morro was identified as a fort which had a platform with six pieces of artillery.³ In a sketch of the same date, the platform was shown in a semi-circular shape, with two sets of stairs leading up to the tower.⁴

Governor Menendez de Valdes, in a letter of 1582, states



22. ABOVE: KITCHEN AREA, CASEMATE FOOTING.
23. BELOW: WATER BATTERY, GENERAL VIEW LOOKING NORTHEAST.



that El Morro had a low platform on top of a rock, with three cannon.⁵ In another letter of the same year the Governor reports that the platform was placed "on a large rock that looked as if it had been hand made."⁶

The military engineer Juan Bautista Antonelli, in 1589-91, designed a new Floating Battery, and apparently in a new location. He gave instructions to level off the rocks below El Morro, located on the harbor side of the point, to form the platform with a parapet without embrasures.⁷ This could mean that the original battery was located towards the northeastern part of the point and not too close to the sea.

Sometime during 1589-1591, Governor Menendez destroyed the old Floating Battery because it was "out of proportions," and did not fit the specifications for the new Battery according to the design of Antonelli.⁸

During 1593-1597, Governor Suarez Coronel was already working in the new Floating Battery. The weather of March was so stormy and the sea so rough that the water washed out more than "60 rocks which weighed more than twenty quintals" apiece. The platform was being built according to the "order and instructions" left by Antonelli. To recover the rocks from the sea it was decided to "chain one rock with the other, so that the force of the sea could not carry them without fetching away the whole platform together."⁹ This statement by Suarez Coronel could mean that he was leveling off the natural rock formation mentioned by Antonelli in 1589-91, by filling the uneven areas with huge rocks quarried in the neighborhood.

Governor Juan de Haro, in 1625, informed that "on the low platform is being built an esplanade of beams" to emplace the artillery, because the old ones (beams) were not useful.¹⁰ Twenty-six years later the Battery, which had five cannons, was in great need of repairs.¹¹ In 1673, "the concavities of the low battery, produced by the action of the sea, were filled in and heavily pressed down."¹² From 1698-1703, instructions

were given and building materials were gathered "to build the esplanade and parapet of the low battery," using lime and hewn stones.¹³

These are the most direct references which we have found concerning the Floating Battery. The plan of El Morro of 1742, shows the western side of the Battery projected into the harbor entrance. The plan of El Morro by Engineer Mestre, of 1787, showing the fort essentially as it is today, presents the Battery reduced in size. The northeastern part was closed with a semi-circular buttress wall without embrasures for protection from the northeastern waves and winds. In the plan of 1742, this buttress wall was marked very faintly, the same as in another plan of the fort of 1765. This means that between 1765-1787, the easternmost flank of the Floating Battery had been sharply cut off and rounded. Between 1742-1765, the western side of the Battery was cut off in the same shape as it appears in the plan of 1787. The number of embrasures in the Battery between 1742-1787, will give a general idea of its reduction in size during this period:

1742: 10 embrasures
1765: 6 embrasures
1787: 7 embrasures

According to a description of El Morro, of 1846, the Floating Battery was "8 varas" (1 vara is equivalent to 32.909579 inches) above sea level. It has a halfmoon shape with a parapet without embrasures. It has capacity for four cannon which had to be mounted on Gribeauval carriages because the parapet was two and one half varas high. In other words, the ground floor of the Battery was five and a half varas from sea level. On the northern side it had a "macize" (solid) of octagonal shape "of enough thickness to" protect this side from flanking fire.¹⁴

A hot shot furnace and the macize appear in the scale model of El Morro, of 1847. They are also shown in different maps of the end of the nineteenth century.

NOTES

1. Archive General de Indias, Santo Domingo, 155-7, hereafter, the documents cited from this archive will be cited as AGI-SD.
2. Ibid; 158-8
3. Cayetano Celly Teste, Boletín Historico de Puerto Rico (San Juan, Puerto Rico, 1914-1927), 14 vols., I, 87.
4. Sketch was drawn by nephew of Ponce de Leon, and a copy is in the Library of SJNHS.
5. AGI-Indiferente 1887-37.
6. AGI-SD 168-101.
7. Ibid; 155-5.
8. Ibid; 155-3
9. Ibid; 155-16
10. Ibid; 156-21.
11. Ibid; 156-25.
12. Ibid; 157-29.
13. Ibid; 163-69.
14. National Archives, D. C., Record Group 186.

Excavations

Before excavations were begun in the Water Battery, an examination of the surrounding sandstone was made. It was known, as pointed out by Mr. Torres, that through time many structural changes had occurred in this area. To the south of the existing structure the sandstone, it was noted, had been trimmed over a relatively wide area. At the base of the parapet the sandstone had also been leveled. These conditions indicate that the Water Battery, at one time, extended further in both of these directions. The A. D. 1768 map shows that at that particular time, there was an extension to the north. This extension included a domed shaped structure that served as a powder magazine or living quarters for the Water Battery crew.

The Water Battery, at time of excavation, contained three gun traversing track trenches with two posts for each gun mount (Pl. 24). An additional pair of post occurred on

the northern end of the battery but the track trenches had been destroyed. It appears that since these traversing guns were installed, the Water Battery had been shortened on the north side. The two posts of the north gun mount are at present so close to the north wall that the gun would not have a very great traverse.

Mr. Torres mentioned above the use of Gribeauval carriages. A description of the Gribeauval carriage was found in Jorge Vigón's Historia De La Artilleria Española. 11, pp. 326-327. Below is Mr. Torres' translation.

"In 1792 the Gribeauval Carriages were introduced into Spain and were extensively used in America during the first half of the 19th Century. In the field pieces, the mounting consisted of a marine carriage superimposed on a frame with grooves through which the wheels moved. The head of the frame was attached to the edge of the horizontal esplanade with a pin which functioned as an axis for moving the frame without the aid of a tackle; this was an easy operation because the frame had a wheel on its tail. With the use of this frame, it was possible to emplace the pieces as high as it was necessary to fire over the parapet and to move the frame according to the direction of the target. The Gribeauval carriage used in fortifications was similar to the Coast carriages which fired in Barbette, but its frame had no wheels on the rear because its tail was fixed on the ground by means of handspikes, and the head pin of the frame served as an axis. The superimposed carriage had two wheels in front and one on the rear, between the brackets. The rear wheel moved along the tail groove and the front wheels through the lateral grooves of the frame."

From the above evidence it appears that the traversing gun platform tracks date from the early nineteenth century.

The traversing track trenches in the Water Battery were cut into an already existing floor.

Upon excavation of floor A the remains of a hot shot oven (Feature 1) were located in the south section next to the fort wall (Pl. 26, Fig. 27). The hot shot oven dates from the time that floor A was laid being built into this floor.

The remains of the hot shot oven included the ash pit, grate and an ash removal section. The ash pit was basin shaped and was covered with 27 iron rods. These rods were fifteen hundredths of a foot in diameter and made up the fire grate. In front of the ashpit, and connected to it by a brick arched passage, was a sunken rectilinear ash removal area four feet by four feet, and one and seventy-five-hundredths of a foot deep. This area was lined with red flat tile that had been plastered over.

To the south and tangent to the hot shot oven grate there was a rectilinear brick faced rubble filled structure whose function is unknown. At right angles to this was Feature 2, also with an unknown function. Feature 2 was a brick arched structure that has a span of two and four-tenths feet. The area in which this arched structure existed was cut out of bed rock and is chronologically associated with Floor A.

Resting on Floor A was a trough with an apron that was in about the center of the parapet wall. The trough and its apron were constructed after the traversing track trenches had been cut into Floor A and its function is unknown.

Floor A was composed of sandstone chips, brick fragments, brick dust and lime (Pl. 28). It was a terrazzo floor with the quantity of the component parts varying from area to area. The floor was fifty-five-hundredths of a foot plus or minus five-hundredths of a foot thick and was level to one-tenth of a foot. Between floor A and the next lower floor there was a yellow sand fill that varied from two tenths of a foot to one half of a foot thick. The second floor was designated as B1 and it was composed of ground sandstone and lime. This floor

slopes from the fort wall to the parapet, being seven-tenths of a foot higher next to the fort wall than at the parapet.

The next floor encountered was B2 and it was composed of the same materials as floor B1. Between floor B1 and floor B2 there was no fill. The exact variation in thickness of floor B2 is unknown. This floor was laid over a very uneven surface and where the thickness was observable a variation from one-tenth of a foot to one foot was noted. Also in some of the area excavated floor B2 was not present. In this floor occurred three sleepers. These may have been the remains of the work done in 1625 by Governor Juan de Haro (see Torres above). The difference in elevation of floor B2 between the fort wall and the parapet was one and twenty-four-hundredths of a foot. This would be enough slope to take care of the recoil of the cannon.

Floor C was only exposed in two areas: by the arched wall niche (Feature 3) and by the southernmost wooden traversing gun post mounts. Under Floor C by Feature 3 bed rock occurred.

The wall niche, Feature 3, (Pl. 25) was located in the east wall of the Water Battery twenty-three feet south of the northeastern corner of the Water Battery. The existing evidence at time of excavation, that indicated a niche was present, included a brick arch and an opening one foot by two feet. At one time the niche had been completely sealed with masonry composed of brick fragments and rough and dressed stones of various sizes. The mortar to seal the niche was of the same consistency as that used for floor A. It was noted that the top of the arch was smoke blackened.

The arch was cleared out down to floor A and was excavated inward to a maximum of two and three-tenths of a foot. At this point a wall that had been plastered over was encountered. This wall was composed of the same materials as floor A. The plastering had been done after floor A had been laid. The plaster covered the vertical sides, the floor

and the rear of the niche. No plaster was noted on the arch itself.

The dimensions of the niche after excavation were as follows: It was three and six tenths of a foot from the highest point of the arch to the top of floor A. At the level of floor A the niche was five feet wide. The depth of the niche from the face of the fort wall was two feet on each side and two and three-tenths of a foot in the center. The rear of the niche was curved. The relative elevation in the center of the niche, on top of floor A was 99.43 feet.

Floor A, in the niche, was removed and remains of an iron plate were found on top of floor B1. The function of the niche is unknown.

A wall, Feature 4, was discovered running perpendicular to the fort wall. This wall was one and four-tenths of a foot thick and was traced to within one foot of the gun traversing track trench in floor A, or a distance of 18.70 feet. The wall was traced no further because it was decided the traversing track trench should be preserved.

This wall rests on floor B1 and butts up to the main fort wall. The wall was made of dressed stone and was plastered on both sides. The function of this wall is unknown.

A posthole was found in floor A three and one half feet from the main fort wall and sixty-two-hundredths of a foot north of the south wall of the Water Battery. This posthole had a diameter of seven tenths of a foot and a depth in excess of one and eight tenths of a foot.

Parapet Wall: The parapet wall at the time of excavation was faced with cement one-tenth of a foot thick. The thickness of this cement covering varied from place to place by five-hundredths of a foot. It was decided that an examination of a cross section of this wall might give information that would be of value for interpreting the development of the Water Battery. An eleven foot section, twenty-three feet from the southwest corner of the Water Battery was opened (Fig. 29).

It was discovered that two periods of construction were evident. The first period was represented by a wall three and seven tenths of a foot in width made of dressed stone. On the seaward side the dressed stones were two feet thick while on the fort side the dressed stones were only sixty-five-hundredths of a foot thick. The area between the two dressed stone courses was filled with rough stone mamposteria. In order to strengthen this wall, at a later date, it was widened, from the inside, to a width of seven feet. During this second period of construction both rough stone mamposteria and cut stones were utilized.

A course of dressed stones one and five-tenths of a foot thick was laid with its front plane being three and four-tenths of a foot away from the front plane of the original wall. The area between the two walls was then filled with mamposteria. The use of mamposteria went to a height of two and eight-tenths of a foot, above which a horizontal course of dressed stones was laid. The next and last course was composed of relatively thin capping stones.

The original, or first, wall was associated with either floor B1 or B2. A drain penetrated the wall in the area of excavation and in its cross-section floor A was not in evidence. In the drain there was a step down from that part of the drain under the second wall to that under the first wall.

Due to the smallness of the opening, it was impossible to excavate and determine the relationship of the floors to this wall.

In the eleven foot section no evidence of gun embrasures were located.

The only artifacts found in the Water Battery excavations came from the hot shot oven or from the dust that had accumulated on top of floor A. All of this material dated from the nineteenth or twentieth century.

SHORE LINE TRAIL

When it was determined that there was no stratigraphy present in the kitchen area it was decided that some testing in the area outside of the fort along the Shore Line Trail might be productive.

Three five foot squares were excavated but the findings were disappointing. The area did not yield any great depth of cultural deposit and there had been recent disturbance in the area that resulted in nineteenth or twentieth century materials being found in all levels.

The kitchen area, outside of Vault 4, yielded very little in the way of cultural materials. Therefore, it was believed that the garbage and refuse must have been taken out of the fort by the entry door to the north of the kitchen area and dumped. This evidently did happen but the material was carried farther than where the excavations were made.

It appears that the sea escarpment at an earlier date extended farther seaward. Through time this area was eroded away and the cultural materials were washed into the ocean. The present exposed base sandstone with its pits and gullies are a favorite "treasure hunting" area for the Fort Brooke children. Since so much cultural material has come from this area it appears that extensive erosion has taken place in the last three hundred years.

SUMMARY AND CONCLUSIONS

El Morro, as its name indicates, was built on a headland. This headland was made up of sandstone that was covered in places with yellow sand and pockets of red clay. The surface was irregular and a ridge ran from the present Water Battery and followed a line northwest by southeast that includes the area of the present main ramp.

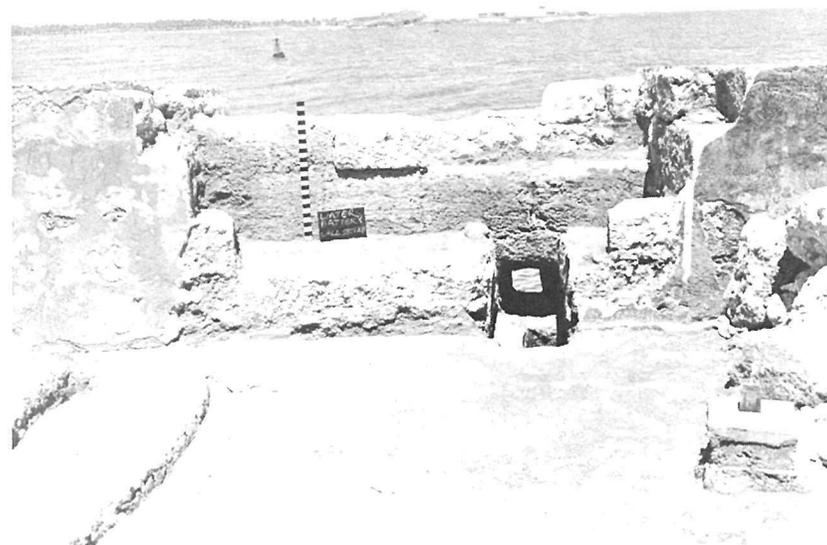
As the fort developed it was necessary to cut away and fill in various places to obtain level areas for casemates, bastions and other structures. The process of cutting away



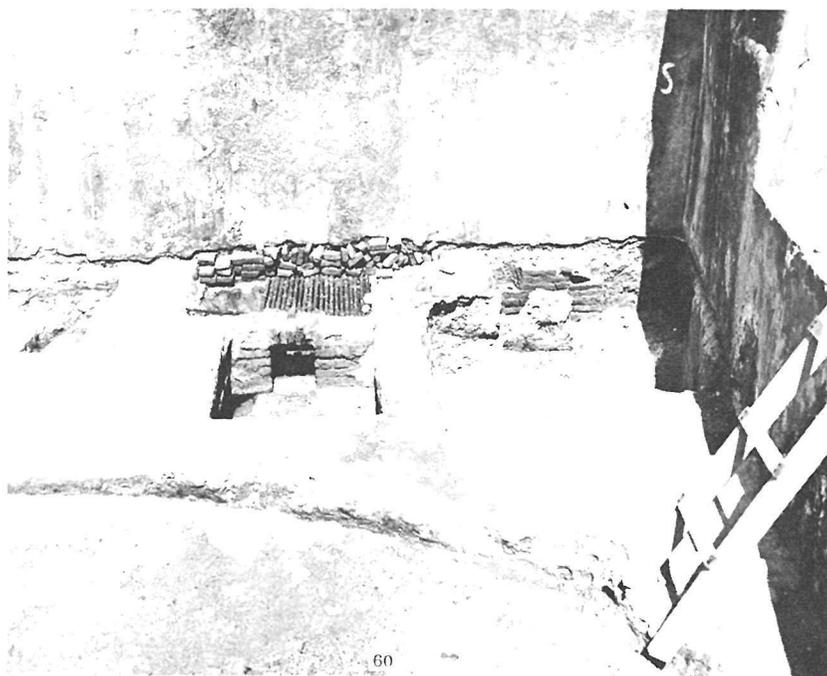
04. WATER BATTERY, GENERAL VIEW LOOKING SOUTHWEST.

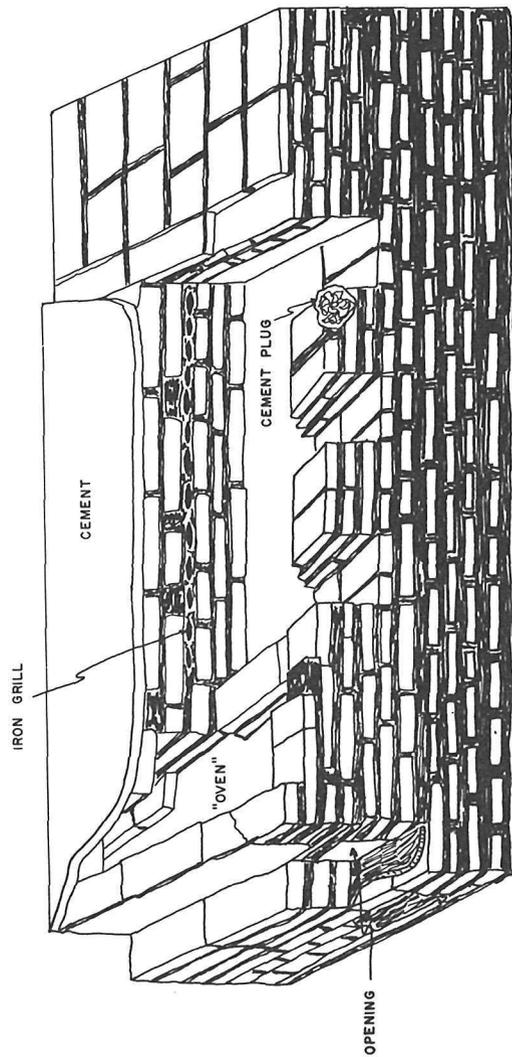


59. ABOVE: WATER BATTERY NICHE AFTER PARTIALLY CLEANED BUT BEFORE REMOVAL OF FLOOR 1.
 26. BELOW: WATER BATTERY, HOT SHOT OVEN.



60. ABOVE: WATER BATTERY, PAPALET TALL.
 28. BELOW: WATER BATTERY SHOWING FLOOR LEVELS.





KITCHEN STOVE
0.00 1.00
Figure 31

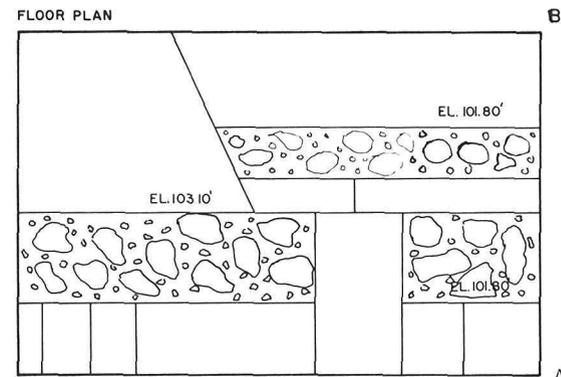
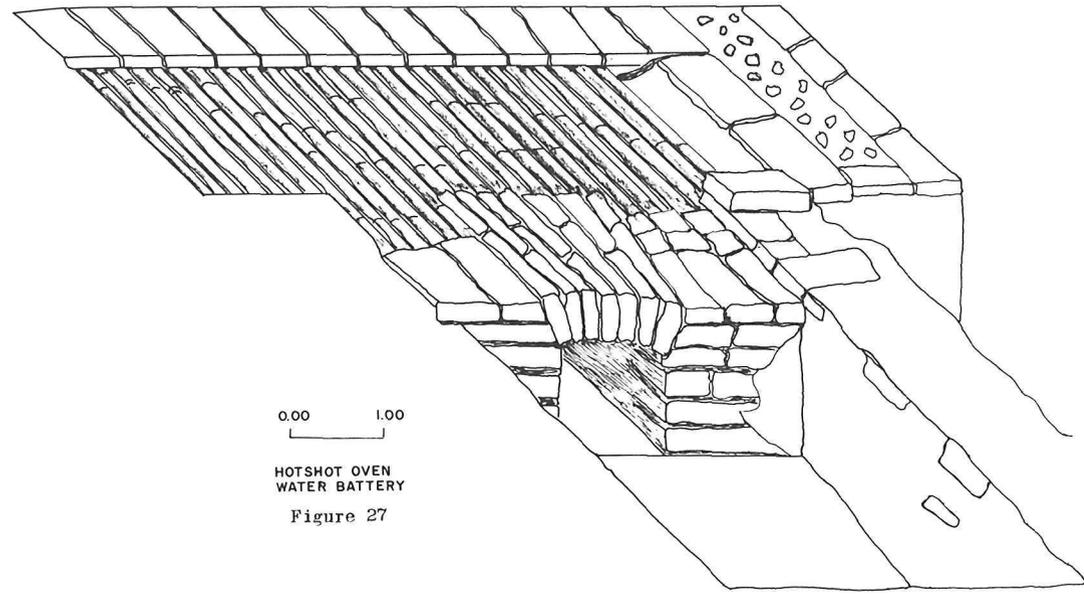


Figure 28
EAST ELEVATION

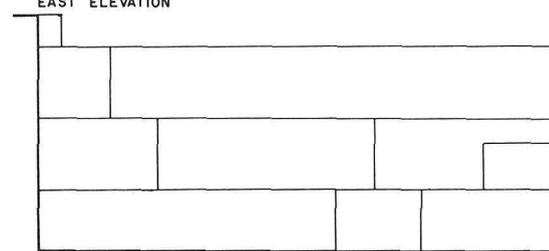


Figure 29

WATER BATTERY PARAPET SECTION

0.00' 1.00'

NORTH PROFILE

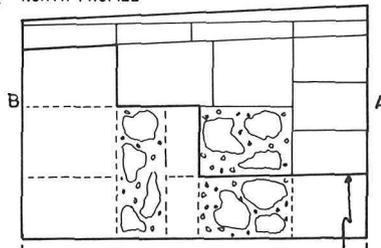


Figure 30

and filling removed much of the artifactual stratigraphic evidence one would normally find. Since in some areas, like the kitchen courtyard, the amount of fill was over ten feet, the opportunity of obtaining cultural materials without a major excavation would not be possible.

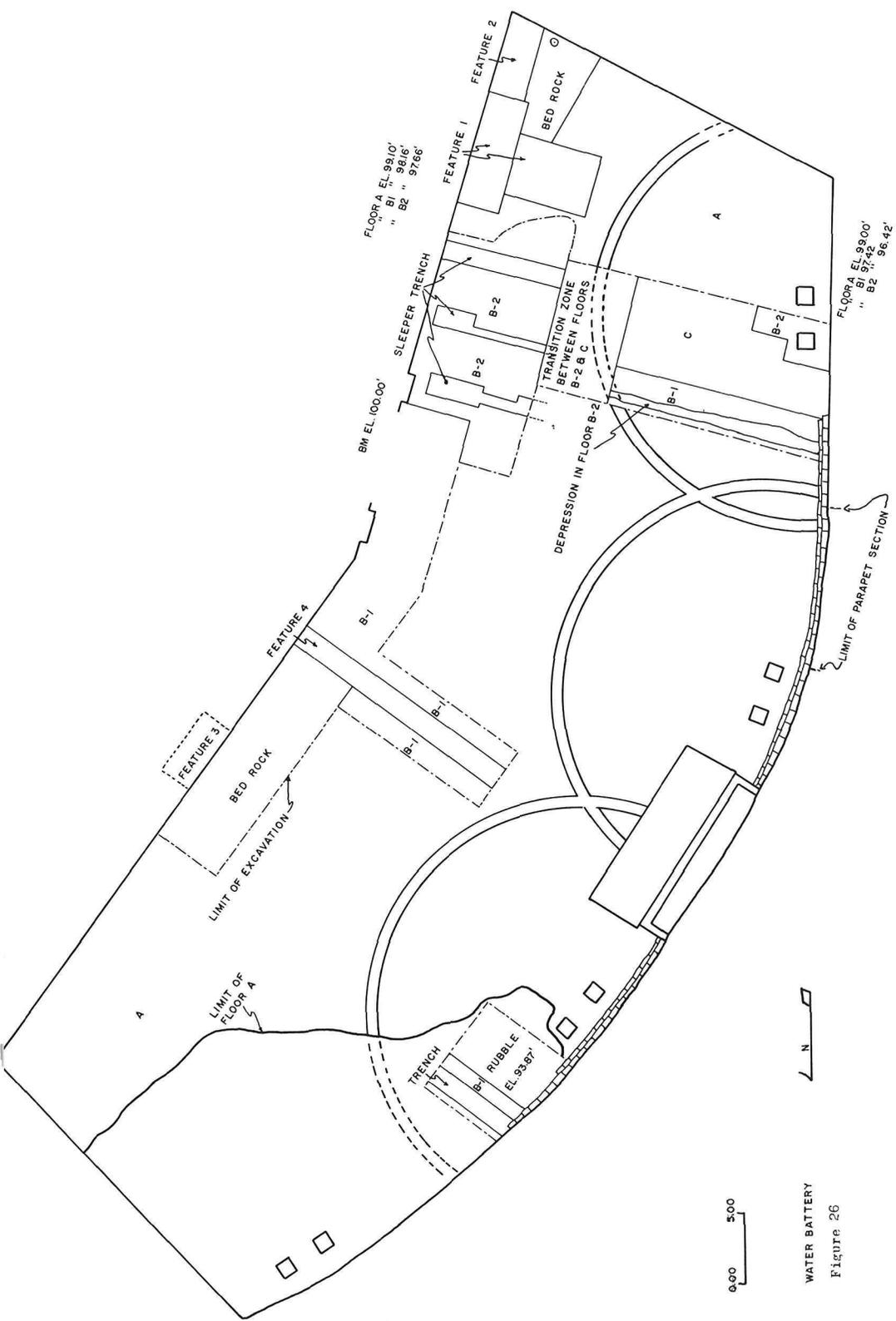
In many Spanish-colonial sites the cultural material found underneath floors has helped establish the date of the various floors that often were superimposed one upon the other. At El Morro the only superimposed floors occurred in the Water Battery. However, no cultural materials were found between the floors. The floor in the kitchen was laid over sterile soil as was the floor of Building 1.

The only opportunity of developing a chronological sequence seems to be through combining the historical approach, both documentary and architectural, with the relative structural evidence brought to light through archaeological techniques. However, if sealed areas, such as stairways, rooms and tunnels, are subsequently found that do contain artifacts, rather close dating might be accomplished.

The excavations substantiated what the historical documents intimated as to the complexity of the structural alterations of the fort through time. Various types of building techniques were used in the various areas including vertical mamposteria, mamposteria with batter, vertical coursed masonry, and coursed masonry with batter.

The present scarp and flanking battery walls are resting on chronologically earlier mamposteria walls. From the excavations it was discerned that the flanking battery embrasure was not evident in the existing wall face. However, a vertical wall of unknown function occurred in the scarp wall adjacent to the junction of the scarp wall and the flanking battery wall. This vertical section was constructed at a later date than the coursed masonry scarp wall with batter.

The present sally port facade, a relatively recent addition, rests on a footing that appears to have been at the same level



WATER BATTERY
Figure 26

as a former "causeway". The evidence for the earlier causeway or moat bridge pier came from Trench E.

From time to time fill was brought in and deposited in the moat. The greatest period of fill was put down after the present exposed scarp and flanking battery walls with batter were constructed.

Below the kitchen courtyard the remains of two buildings were located. These buildings were demolished when the existing main ramp was constructed. The function of these buildings is, at present, unknown.

In the excavations of vault 3 a forge was discovered. Also it was noted in this area that bedrock was relatively close to the surface.

In vault 4 a trench of unknown function was located.

It has been established from the historical documents, that the water battery had undergone great changes. The area included in the water battery has become smaller through time probably due to storm wave action. Four floor levels were discovered along with the remains of a hot shot oven. The thickness of the parapet wall represents two periods of construction. The second period doubled the width of the wall with dressed-stone and mamposteria being used in the construction.

The excavations have extended our knowledge of El Morro but it is obvious that more work will have to be undertaken before a comprehensive picture of the fort's development is established.

APPENDICES

Cultural Materials of El Morro

A reliable stratigraphic sequence was not obtained in any of the areas excavated. In the Water Battery no artifacts were found except nineteenth and twentieth century materials. In the moat and the kitchen, disturbances were mainly caused by structural changes that occurred through time. The moat, at various periods, was intentionally filled and even after the present level was established there was much disturbance. In portions of the kitchen area, after 1742, during a period of expansion of the fort, ten feet of fill was brought in. After the present level was established the area was kept relatively clean of trash.

Therefore, a description of all the cultural materials has not been attempted in this report. A complete listing of the artifacts is included in the tables. The following discussion is concerned mainly with previously undescribed earthenware types and certain glass specimens.

Ceramics

The ceramic complex, for the most part, from El Morro included types that have been found in other Spanish-colonial sites in the Western Hemisphere.

It was noted that there were relatively fewer majolica sherds recovered at El Morro than from excavations in residential sites of St. Augustine, Florida and the 17th century mission sites of West Florida. The majolica sherds from the moat made up 4.31% of the sherds. Of these majolica sherds plain white were the most abundant and made up 1.23% of the total sherd count and 28% of the majolica sherds, being twice as numerous as any other single majolica type.

The dominant earthenware types were El Morro ware, making up 25%; Rey Ware, 6.55% and Moat plain, 2.31%. It is believed that these types were made in Puerto Rico, but to date their value, if any, as time markers is unknown.

Other major types include Creamware (10.20%), Delft (4.68%), Painted White ware of the 1820-40 period (4.99%) and Boneware (12.80%).

Earthenware from the excavation, aside from the already established named types, were classified as follows: Three types were given the formal names, mentioned above; El Morro Ware, Rey Ware and Moat Plain. Minor types were simply named Polychrome, Cream, Gray, Brushed and Red Filmed. These names were given in order to facilitate the handling of the material.

El Morro Ware

Manufacture: The vessels were thrown on a potter's wheel.

Paste: The paste is moderately compact and medium in coarseness. The tempering material is composed of fine particles of sand of medium amounts. The clay appears to have been wedged since there are few air holes. The color of the paste is an orange-red or buff color. The vessel thickness is variable from three millimeters to eight millimeters.

Vessel Form: Plates, wide mouth jars and shallow bowls, with or without strap handles.

Surface Treatment

Finish: The surface is fairly smooth. It was probably sponged and some of the sand temper was left half exposed. "Throw marks" are evident on some of the pieces.

Glazing: A very thin lead glaze is present on some of the vessels while some were left unglazed. It was noted that on several sherds both glazed and unglazed areas appeared.

The glaze ranges in color from transparent to deep brown, including various shades of red and green. the surface of this type has a medium reflective surface.

History

Place of Manufacture: This type of ware is common to both Puerto Rico and Cuba. The sherds from El Morro are

assumed to have been made in Puerto Rico.

Chronological Range: This ware was established early, probably by the AD 1550-1600 period but the beginning date is unknown. It is made at the present time in relatively small amounts.

Rey Ware

Manufacture: The vessels were thrown on a potter's wheel.

Paste: The paste is compact and fine in texture. The tempering material is made up of finer sand particles than in El Morro Ware. The color of the paste is a buff or orange-red color. There is more uniformity of paste color in Rey Ware than in El Morro Ware. The thickness varies from three millimeters to twelve millimeters.

Vessel Form: Plates, shallow bowls, wide mouthed jars and pitchers.

Surface Treatment

Finish: The surface is very smooth, having been carefully sponged. Since the tempering is very fine it did not protrude as did the coarser sand in El Morro Paste.

Glazing: A medium thickness of lead glaze is present. The glaze is on the exterior and/or on the exterior and interior.

The glazes run in color from a dark brown to light brown, reds, yellows and yellow oranges. Polychromes occur where yellow stripe designs are put over the brown. This type of Rey Ware is very similar to European Peasant Ware.

Rey Ware has a very high reflective surface.

History

Place of Manufacture: It is assumed that this ware was made in Puerto Rico and Cuba. It occurs as a minority ware in historic sites in St. Augustine.

Chronological Range: It is believed that this type starts about the middle of the eighteenth century and con-

tinues up to the present.

Moat Plain

Manufacture: It is not certain whether or not this type was thrown on a potter's wheel or was made by another method. All of the sherds recovered were relatively small and throw marks were not present.

Paste: The paste is moderately compact and coarse. The tempering material is quartz sand, from one to five millimeters in diameter, and mica. The exterior color ranges from gray to buff while the interior is black. This ware closely resembles in texture, color and tempering the Florida aboriginal Swift Creek Ware.

Vessel Form: From the sherds recovered the forms include shallow bowls and plates.

Surface Treatment: The surface is moderately smooth with occasional small bumps that are caused by the larger quartz tempering particles extending above the surface of the vessel. No surface decoration or appendages are present.

History

Place of Manufacture: Unknown although it is probably an indigenous ware.

Chronological Range: Unknown.

Minor Ceramic Types

In order to facilitate the handling of the sherds various groupings were given names but this does not mean that they have, at present, the status of definite pottery types. The terms used to distinguish these sherds were based on color or surface treatment. It was felt that the sample was not adequate to set them up as definite types. These categories include:

Cream Earthenware: A thin, fine paste ware with no surface treatment other than smoothing, being unslipped and unglazed. The paste is cream in color and the form is unknown.

Gray Earthenware: A hard, fine paste ware that is unslipped and unglazed. Most of the sherds are plain but some have incised geometric decorations and/or appliqued strips that are incised or punctated. On the interior throw marks are present. The forms found include botijo and small mouthed jars.

Brushed Earthenware: A medium grained paste with fine sand tempering. The paste is black and the exterior is brushed while the interior is simply smoothed. The vessel forms include wide mouthed jars and bowls.

Red Filmed Earthenware: This ware has a similar paste to that of the brushed ware but is red in color. The surface is red painted with finger impressions occasionally occurring on the shoulder and lip of the bowls. Bowls are the only forms known at the present time.

Polychrome Earthenware: This type has a hard compact reddish paste. The vessel thickness ranges from five millimeters to twelve millimeters. The surface is lead glazed with yellow, brown and green glazes that are applied in a haphazard manner. Portions of some of the vessels are unglazed. The forms include shallow bowls and narrow mouthed jars.

Orange Earthenware: This is a mica tempered fine paste ware. Occasionally the exterior surface is red painted. The forms of this type are unknown.

Pipes: There were very few kaolin pipe bowls and stems found. In the moat area seven stem fragments and one green glazed kaolin pipe bowl were found (Pl. 29, K). A nineteenth century kaolin pipe occurred that has a bas-relief geometric design covering the bowl (Pl. 29, A). This pipe was buff in color.

Clay elbow pipes were found that were larger than the kaolin type of pipe. These had a rectilinear clay stem and bowl or a rectilinear bowl and a rounded clay stem. The clay stem was generally somewhat shorter than the bowl. These pipes were of a yellow ocre color with

some having a reddish cast (Pl. 29, C-H).

The clay stem was elongated by the use of a reed or wooden stem. Some of the pipes were decorated by very fine incising and/or punctating (Pl. 29, H). The place of manufacture of these pipes is unknown.

Another type of earthenware pipe was one that resembles in general shape the kaolin pipe but is somewhat larger (Pl. 29, B). It is a black mold-made pipe but is equal armed and the stem hafting area is similar in detail to the above mentioned buff pipes.

Gaming Disc: The gaming discs were made from majolica, bone-ware and transfer ware sherds. The diameter ranged from fifteen millimeters to eighteen millimeters.

Cut Tile Disc: This disc was cut from a flat tile twenty-six millimeters in thickness. The disc was fifty-nine millimeters in diameter. The function is unknown.

Cut Brick Disc: This disc was forty-one millimeters thick and 13.7 centimeters in diameter. The edges of the disc are irregular and rough. On one side of the disc, in its center, was a circular hole thirty-one millimeters in diameter and twenty-one millimeters deep. The function of this is also unknown.

Glass: Although many fragments of glass were recovered, there were relatively few pieces that were large enough to determine the objects' forms. Also, much of the glass was nineteenth and twentieth century Spanish Glass and earlier British bottles.

The best collection of glass came from Vault 4, of the kitchen area. In this area were found sections of drinking glasses, bottles, porróns, a "tear vial," and bottle stoppers. It was hoped before excavations were begun in El Morro that a stratigraphic sequence would be present that would give an evolution of Spanish bottles from the sixteenth to the nineteenth century. No such stratigraphic area was found and therefore the material

presented includes the pieces from various time periods.

The material described below all came from the Vault 4 excavation.

Drinking Glasses

Plain Clear Glass: Nine bases of plain clear glass drinking glasses were found that ranged in diameter from thirty-one millimeters to forty-nine millimeters in basal diameter (Pl. 30, N-P).

A pont mark is on the center of each base and in order to have the glass set level the base was ground smooth. The basal thickness varied that with the narrower diameter being thicker. Also the two glasses with the smallest base diameter contain a bubble that has caused the interior of the base to be convex. One bubble is sixteen millimeters in diameter and the other is six millimeters in diameter.

PLAIN CLEAR GLASS

Specimen Number	Diameter Base	Thickness Base at Center	Height
1	0.425 Cm.	0.900 Cm.	-
2	0.490 Cm.	0.550 Cm.	-
3	0.405 Cm.	0.800 Cm.	-
4	0.360 Cm.	0.230 Cm.	-
5	0.310 Cm.	0.220 Cm.	0.700 Cm.
6	0.430 Cm.	0.580 Cm.	-
7	0.420 Cm.	0.500 Cm.	-
8	0.370 Cm.	0.680 Cm.	0.640 Cm.
9	0.360 Cm.	0.940 Cm.	0.655 Cm.

Fluted Clear Glass Drinking Glass: Four examples were present. The base is of the same type as for the plain clear glass drinking glasses. The difference between the two is that this type had fluting. The fluting either ran vertical or had a slight curve from the base to the lip. The flutes are evenly spaced but the distance from land to land or groove to groove have a variation. Also the height of the lands differ. The number of flutes per glass on the available specimens varies

from ten to thirty-three. The height of the lands have a range from two to five millimeters. The distance from land to land ranges from five to ten millimeters (Pl. 30, M).

Thin Pale Green Glass: This type of glass was not found in quantity and it resembles Venetian glass. Of the specimens large enough to determine size, this type was formed into porróns and bottles. Fragments of pistons from five porróns and the necks from four bottles were recovered. The pistons' walls were thicker than those of the necks of the bottles. The range in thickness was from three to eight millimeters. It should also be noted that the kick-up was generally as thin as the body of the vessel. The pont scar was not great, as a clean break was made (Pl. 30, D, G-H, K).

It is believed that the objects made with this type of glass were luxury items and not common utilitarian materials.

Miscellaneous Glass Objects from Vault 4:

Ground Glass Stopper: The stopper was 66 millimeters long with the stopper handle being 42 millimeters and the portion that fitted into the bottle neck being 24 millimeters (Pl. 30, I).

"Tear Glass": A small globular vial 39 millimeters tall made from clear glass that had a thick white exterior patina (Pl. 30, L).

Unknown Object: This light green glass object is 19 millimeters long. Its function may have been a decoration for a stopper to a small vanity vial (Pl. 30, J).

Bottle Necks: There were three small bottle necks, 17 millimeters in diameter, of clear glass with heavy white patina. These necks were grooved with the grooving having a gentle spiral to the right. Just below the lip was an applied circular glass strip four millimeters in diameter (Pl. 30, F).

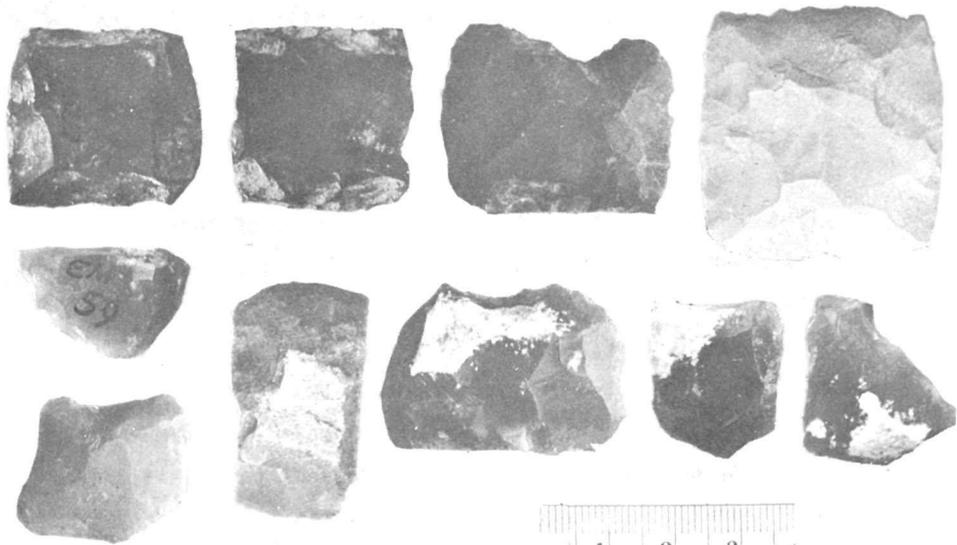
Gun Flints: Six complete gun flints and six fragments were found. For the amount of excavation this was a very small number, especially since this was in a military post. Three whole gun flints were black, being the typical English type. One whole and five pieces were light brown in color. The largest flint, of those represented in this sample, was made of less pure flint and was gray in color (Pl. 29). This flint measured 35 millimeters by 35 millimeters.

Miscellaneous Artifacts: The non-ceramic artifacts, other than those mentioned above, were not unique or distinctive, nor did they especially reflect materials that are generally associated with the military. Military materials did include brass regimental buttons, chapes, (Pl. 31 J), fuse lighters, musket and pistol balls, gun flints, cannon balls, bar shot, buckles (Pl. 31, A-F), a rapier end, a sword blade end and a bayonet blade end. Of these materials none occurred in numbers and some were only represented by a single specimen. This assemblage, although from a military establishment, was the same as occurred in the domestic complexes of Spanish St. Augustine, Florida. The coins and regimental buttons are to be included in a special forthcoming report.

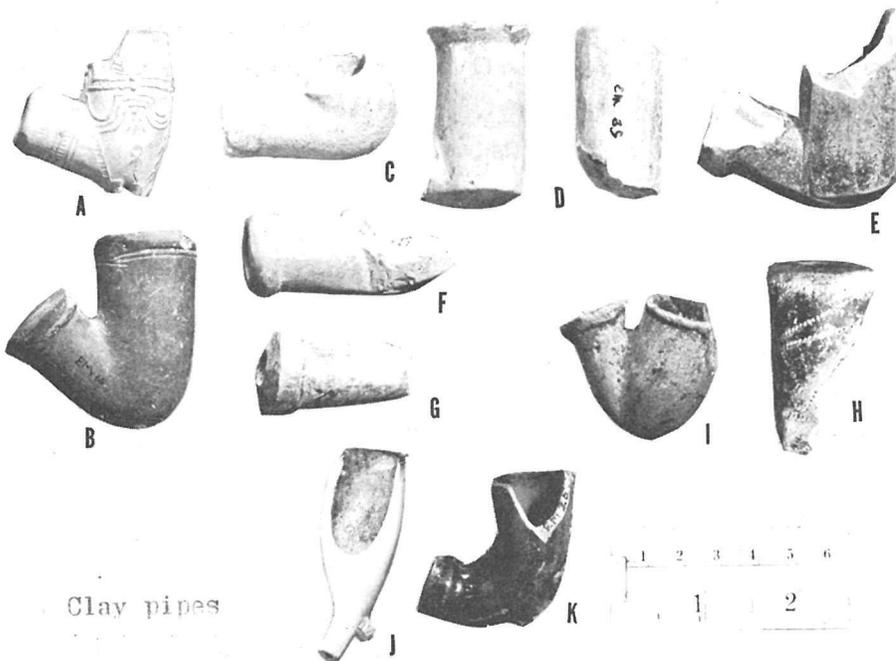
Geology

Geological observations on archaeological work at El Morro were made by Mr. Reginald P. Briggs and Ted Arnow of the United States Geological Survey. Below are excerpts from a letter sent to Mr. Kittridge A. Wing, Superintendent, San Juan National Historic Site, by Mr. Briggs on the 2nd of July, 1961.

1.) (In Trench B, the footing for the vertical section of the scarp wall and the belting are being discussed). "No great difference was seen in the nature of the rock used in the wall from the lower to the second footing and from the second footing on up. A grain size change was noted, but this could occur within relatively short distances in

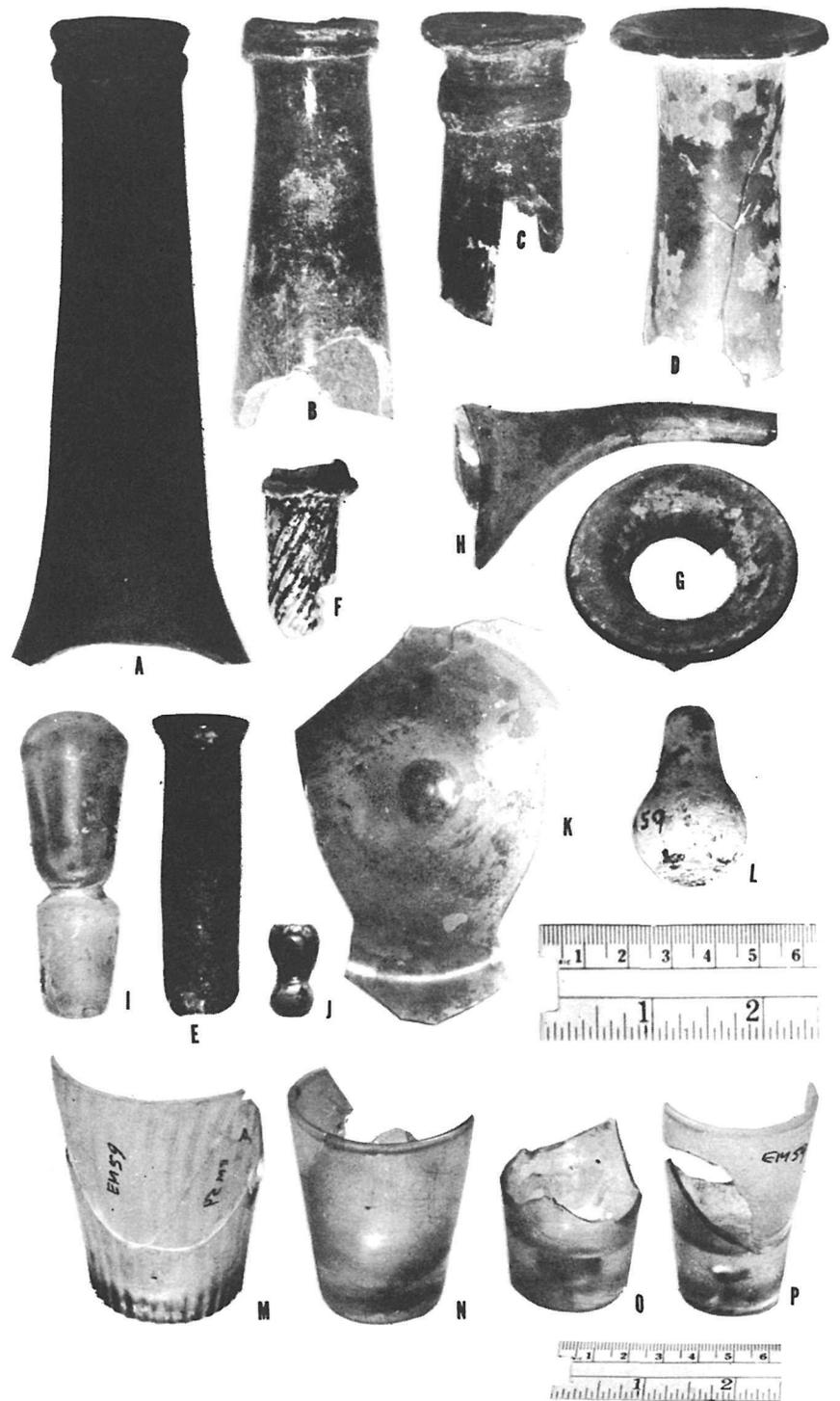


Gun flints



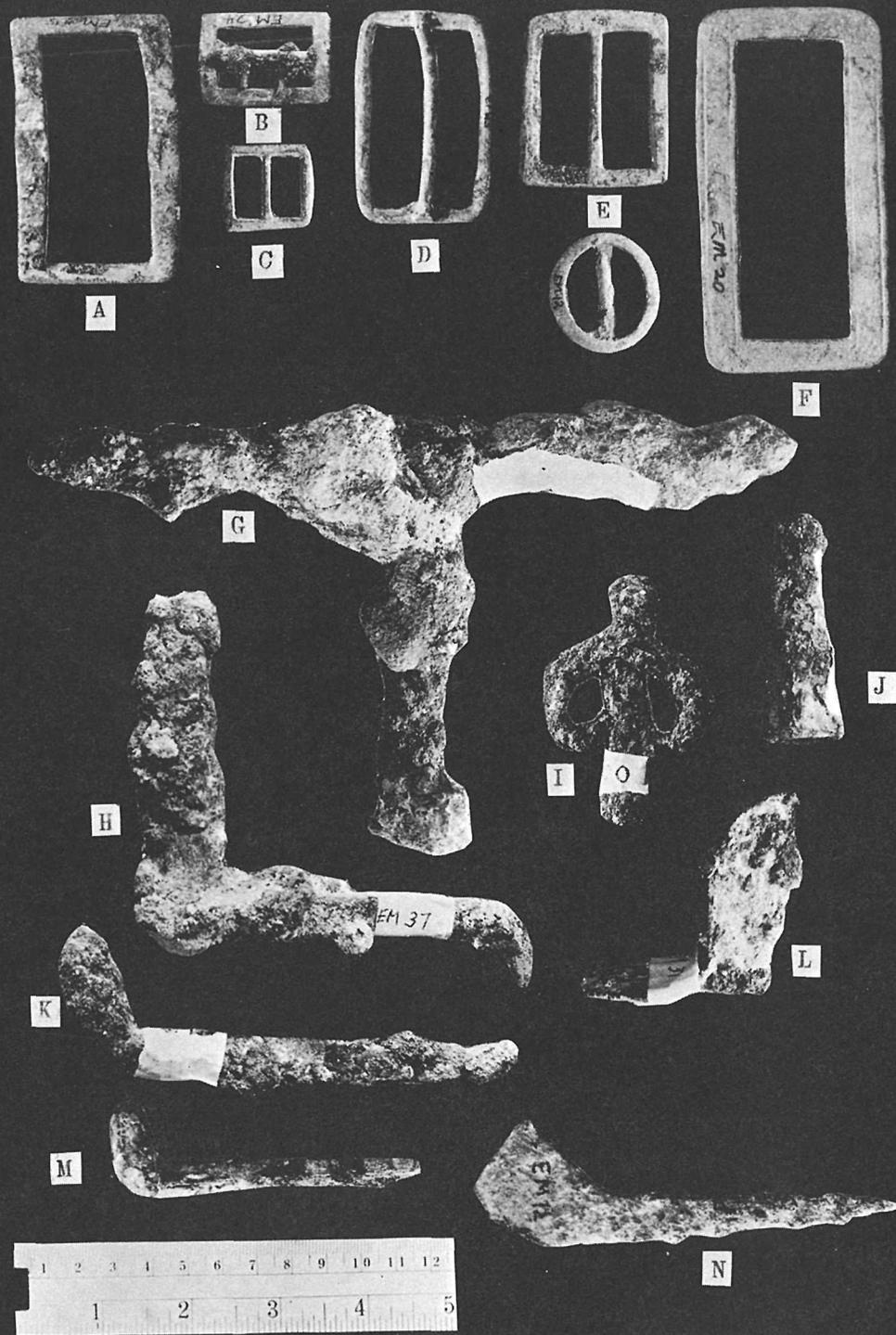
Clay pipes

Plate 29



Glass: A-F: Bottle necks, G: Bottle lip, H: Piston, I, J: Bottle stoppers, K: Bottle kickup, L: "Tear glass", M-P: Tumblers.

Plate 30



Brass: A-F: Brass buckles, Iron: G. Slide bolt, H: Pintel, I, K, M, N: Unknown function, J: Chape, L: Frizzen.

Plate 31



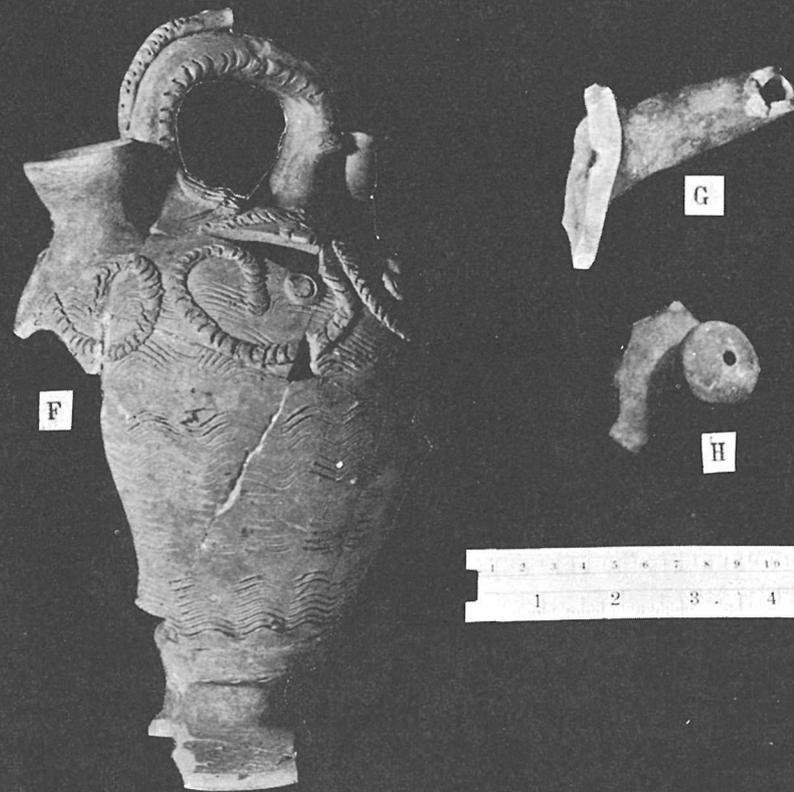
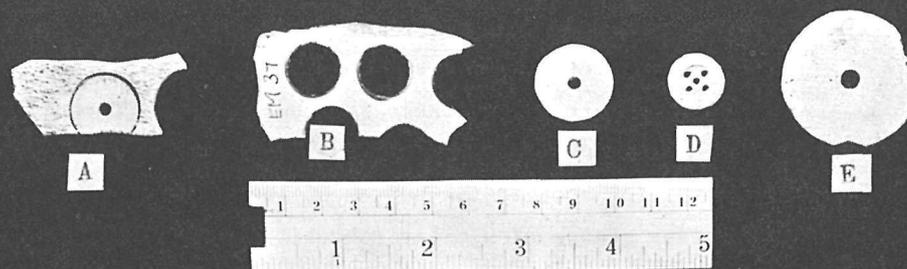
A: Brass spigot, B: Fuselighter, C, D: Silver pesos, E: Brass ring, F: Brass clip, G: Brass belt holder, H, I: Belt clasp, J: Brass ornamental object, K: Thimble.

Plate 32



Ceramic vessel of unknown origin found in kitchen courtyard area. Height 22.5 inches, greatest diameter 14.5 inches.

Plate 33



Bone: A,B: Button blanks, C-E: Buttons, Gray Earthenware: F: Botijo, G-H: Pistons of botijo.

Plate 34

the quarry from which the rock was obtained. Weathering was similar. Apparently the type of mortar used in both parts of the wall was the same; no significant differences were seen. There is, however, a difference between the rock in the wall and that at the bottom of the pit. The rock in the bottom of the pit is composed of coarser grains of similar composition, but they are much less densely packed and the cementation is irregular; local zones one centimeter more or less across being well cemented, with adjacent zones poorly cemented and highly permeable. The more closely packed material in the walls may be indicative of greater depth of burial. If this is so, it is a good possibility that it came from a moderately large quarry, likely one of those shown on old maps of the general area. The hollow ring of the rock in the bottom of the pit and ruddy nature led me to believe that the excavation had not reached bedrock. I do agree, however, that bedrock is probably only a short distance further down."

- 2.) "Water Battery: The conclusions of the archeological investigators are correct. The rock encountered in the pit in the south corner is in all respects (composition, bedding, etc.) with the rock exposed outside the wall to the southwest and is contiguous with it. Ancient excavations were made into this rock; the straight vertical surfaces would be very unlikely in natural circumstances. Too, despite their pitted surfaces, the near-vertical faces in the rocks just southwest of the battery are also likely to have been artificially dressed. The pitting on these faces is largely due to solution from rain and spray action and seemingly can occur in a very short time. The archway near the east corner of the battery exposes a 0.6m thick clay quartz sand bed over-and underlain by cal-

cite-quartz eolianite. Only surficial artificial effects were seen; the wall was probably cut vertically during construction of the battery, but the sand bed is natural. Secondary cementation of the eolianite beneath the sand bed leads one to speculate that this sand bed may have acted as an aquifer, providing a minor source of water by way of a spring to the personnel in the water battery. However, no dampness was seen in the sand bed, but this may be because the aquifer's recharge area has long since been sealed off by masonry and concrete. The pit by the archway penetrated to a bedrock floor of eolianite. Near the east corner of the battery eolianite forms a part of the wall. Here the irregular upper surface of the bedrock can be readily seen. The blocks used in the northeast bastion of the battery are of eolianite dissimilar to that in the walls exposed in the pit in the moat, but generally similar to that encountered in the bottom of the pit in the moat."

- 3.) "Shoreline trail: The sand bed exposed in the archway of the water battery, the bed exposed in an eroded condition between the water battery and the recent concrete stairs, and the sand bed at the base of the artificial rubble immediately east of the recent concrete stairs on the shoreline train are quite probably the same bed."
- 4.) "Pit outside the wall near the eastern entrance to the kitchen court: This pit was just begun and was not very deep when seen, but it appeared to have at its base clayey quartz sand that may be more or less naturally in place and which may represent the same sand horizon as the iron-oxide cemented clayey quartz sand exposed adjacent to large eolianite rubble west of the top of the recent concrete stairs. This is at a level higher than the sand bed referred to in "3" above."
- 5.) "General notes; Nowhere in the old walls of the fort

did we see blocks composed of rock other than the calcite-quartz eolianite that comprises, with the clayey quartz sand beds, bedrock for the El Morro area and most of San Juan Island. It would appear that the Spanish engineers were able to find sufficient relatively hard and cohesive rock for quarried block and enough softer rock for fill without going very far afield. Probably a part of the rock for the walls was taken from the excavations necessary during construction, and the remainder came from nearby quarries, such as the one by the San Juan cemetery a short distance to the east. Differences in the eolianite from one place to another are in the eolianite from one place to another are probably minor as regards the composition of the grains, though no exact analyses have been made of these. However, texture, grain size, bedding and cementation appear to vary greatly, and almost certainly made selective quarrying necessary."¹

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1. On file at the office of the San Juan National Historical Site is a publication that gives additional geological information entitled, Highlights of the Geology of El Pastillo de San Felipe de Morro, San Juan National Historic Site, Puerto Rico, by W. H. Monroe, R. P. Buggs, Ted Arnow, and Lois Arnow, 1960.

	KITCHEN COURTYARD AREA LEVELS 1 & 2 (Other than Trench G)	KITCHEN PROPER	VAULT 3		FORGE	VAULT 4		TOTAL
			LEVEL 1	LEVEL 2		LEVEL 1	LEVEL 2	
CERAMICS								
Majolica								
Columbia Plain	3							3
Ichetucknee Blue on Blue	7							7
Santo Domingo Blue on White				1				1
Aucilla Polychrome				1				1
Plain White Majolica								
Unknown Majolica	3			2	2			7
Majolica Tile	1		1					2
Spanish Ceramics								
Blue Green Basin			1		6			7
Olive jar: Early variety						1		1
Middle variety	34	2	5	3	10	17		71
Late variety	2							2
Thin	1							1
Orange Earthenware	2							2
Rey	58		12	3	1	111	3	188
Bisque Redware	1		1					2
Creamware	3		4	4	6	9	3	29
Red Filmed Earthenware	4		4	5	24	2		39
El Morro	47	2	50	14	49	214	4	380
Gray Earthenware	8		20	4	52	27	2	113
Moat Plain	28		48	10	94	17		194
Polychrome Earthenware	4		5	1	21	31	1	63
Unknown Earthenware	25	1	7	3	11	43	3	113
Tile: Barrel	21	1	4	3	4	7		40
Flat	1							1
Brick: Common	1		2		4			7
Circular (cut)	1					1		2
Other Ceramics								
Lead Glazed Stoneware (19th c.)	3							3
Delft	30	3	8		11	81	3	126
Creamware	130	1	122	42	206	54	1	556
Painted Whiteware (19th c.)	32	2	24	12	41	7		118
Willow Ware			4					4
Banded Whiteware	1		2					3
Queens Ware	1							1

Table 2

	KITCHEN COURTYARD AREA LEVELS 1 & 2 (Other than Trench G)	KITCHEN PROPER	LEVEL 1	LEVEL 2	FORGE	LEVEL 1	LEVEL 2	TOTAL
Bone: 1 hole	1				1	6		8
2 holes	2							2
4 holes	1							1
Back loop bone button							1	1
Brass	14		1		3	2		20
Plastic	2							2
Shell: 2 holes			1			1		2
Blank								
Gun Flint			1		2	5	2	10
Miscellaneous								
Plastic Screw Cap			1			5		6
Knob						2		2
Collar Button				1				1
Misc.		1						1
Bone: Spatula						1		1
Domino			1					1
Ivory Fragment						1		1
Stone: Metate						1		1
Anvil					1			1
Asbestos Fragment	1							1
Coal	16							16
Rubber: Misc.	1							1
Bone and Shell								
Cow	x	x	x	x	x	x		
Pig	x		x	x	x	x	x	
Fish	x		x	x		x	x	
Turtle	x							
Bird		x					x	
Goat			x			x	x	
Lavona Pica	x						x	
Conch					x	x		

Table 2 continued

	KITCHEN COURTYARD AREA LEVELS 1 & 2 (Other than Trench G)	VAULT 3		FORGE	VAULT 4		TOTAL
		KITCHEN PROPER	LEVEL 1		LEVEL 2	LEVEL 1	
Misc.	4				3	1	8
Silver							
Coin					2		2
Iron							
Nails:wire	43				121	13	177
wrought	12		38	21	44		196
Screw					2		2
Screw Cap					2		2
Cannon Ball	3		3	6	2		14
Bar					2		2
Pipe					3		3
Ring					2		2
Bolt	1				1		2
Spring Hinge					1		1
Clamp			1	1			2
Hook			1	1			2
Chest Handle				1			1
Shutter Pintle	3			1			4
Chain				1			1
Crimp Cap			1				1
Razor Blade (Pal type)			1				1
Grape Shot	1	2	1				4
Horseshoes(Game type)			3				3
Padlock			1				1
Barshot	2		1				3
Army Dog Tag	2						2
Key	1						1
Frizzen	1						1
Glass							
Milk	8						8
Amber	92	8		61	1	30	192
Green	409	93	298	78	76	283	1266
Clear	138	7	82	14	51	275	590
Blue	2		2				4
Ring Setting						1	1
Gaming dies						2	2
Electronic Unit						1	1

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Table 2 continued

	KITCHEN COURTYARD AREA LEVELS 1 & 2 (Other than Trench G)	VAULT 3		FORGE	VAULT 4		TOTAL
		KITCHEN PROPER	LEVEL 1		LEVEL 2	LEVEL 1	
Elers Ware					1		1
Ginger Beer Bottle	7	4	21	6	1	20	59
Sgraffito						13	13
European Porcelain	11	1		2	7		12
Chinese Porcelain	3		1				4
Electrical Porcelain	1					2	3
Featheredge	8		10	10	15	6	49
Ironstone	4						4
Boneware	47	2	37	16	41	12	155
Transferware	8		8	3	2	1	22
Clay Marble	1						1
Baked Clay Ball(1" dia.)						2	2
Pipes:Kaolin bowl 5/64 stem						1	1
Elbow(Earthenware)	3		1	1		4	9
METAL							
Brass							
Cartridges	26						26
Flange	3					1	4
Wire	2		3				5
Buckle	4		2		2	4	12
Coin	3		2		2	267	283
Nail	2		2				4
Knob	1						1
Tack			1				1
Ring			1				1
Band			4				4
Chain			2		1		3
Architectual Hardware			1				1
Thimble				1			1
Knife Handle				1	1		2
Electrical Switch Fragment						1	1
Electrical Fuse						1	1
Wing Nut						1	1
Stopper						1	1
Misc.	4					3	8
Lead							
Musket Ball				1	1		2
Bullet	52	1	2			1	56
Seal						1	1
Pipe	1						1

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Table 2 continued

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TRENCH G. KITCHEN		LEVEL	0-0.5 1	0.5-1.0 2	1.0-1.5 3	1.5-2.5 4	TOTAL
CERAMICS							
Majolica							
	Columbia Plain				1		1
	Ichetucknee Blue on Blue			2	1		3
	Mt. Royal Polychrome			1			1
	Unknown Majolica			1			1
Spanish Ceramics							
	Olive Jar: Early Variety		7				7
	Middle Variety		6		5	8	19
	Thin				7	1	8
	El Morro		6	1	7	9	23
	Moat Plain		2		3	4	9
	Gray Earthenware		4		2	5	11
	Red Filmed Earthenware				5	4	9
	Polychrome Earthenware				1	1	2
	Key		3		3	2	8
	Brushed Earthenware				1		1
	Cream Earthenware				1		1
	Unknown Earthenware					3	3
	Tile: Barrel		5	4	7	17	33
	Flat		1				1
	Twentieth Century		1	1	2	2	6
Other Ceramics							
	Delft		10	14		2	26
	Painted Creamware		26	69	4		99
	Painted Whiteware (19th Century)		9	6	5	3	23
	Banded Whiteware				37	3	42
	Ginger Beer Bottle		5		5	3	13
	European Porcelain		2	1	1	2	6
	Boneware		25		12	9	46
	Featheredge		4	1	6		11
	Transferware		7		3		10
	Salt Glazed Stoneware (19th c)		1				1
	Electrical Porcelain		3				3
	Pipes: Kaoline Bowl					1	1
	Elbow (Earthenware)		1		5	3	9
METAL							
Iron							
	Nails: wire		17			3	20
	Wrought		10		1	4	15
	Bolt		3				3

Table 3

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TRENCH G. KITCHEN		LEVEL	0-0.5 1	0.5-1.0 2	1.0-1.5 3	1.5-2.5 4	TOTAL
KEYS							
	Key		1				1
	Cannon Ball		1			1	2
	Shoe Anvil		1				1
	T-Bolt		1				1
	Cant Hook		1				1
	Lock					2	2
	Misc.		45	5	27	19	96
BRASS							
	Cartridge		5		1	1	7
	Coin		1		1		2
	Padlock				1		1
	Chape				1		1
	Military Insignia				1		1
	Buckle		1				1
	Misc.		2				2
LEAD							
	Flange		1				1
	Bullet		1		2	3	6
	Musket Ball			1		2	3
GLASS							
	Milk		4	1	1	1	7
	Amber		12		9	6	27
	Green		215	16	125	79	435
	Clear		70	13	20	14	117
	Blue		1				1
	Red		3				3
BUTTONS							
	Shell: 1 hole		1				1
	4 holes		1		4		5
	Brass					1	1
	Mother of Pearl					1	1
	Blank		2	1	3	3	9
MISCELLANEOUS							
	Bone Die		1				1
	Alabaster Bowl Sherd		2				2
	Electrical Element		1				1

SHORE LINE TRAIL	Test H					Test I				Test J			Total
	1	2	3	4	5	1	2	3	4	1	2	3	
CERAMICS													
Majolica													
Ichetucknee Blue on Blue										1	1		2
19th Century Majolica								1					1
Unknown Majolica								1					1
Spanish Ceramics													
Olive jar: Early variety						1	3						4
Middle variety			3								2		5
Late variety						2							2
El Morro						12	15				2		29
Rey						8	1	1			3	5	18
Moat Plain						2	1			1	1		5
Red Filmed Earthenware							1				2		3
Polychrome Earthenware						2				1	1		4
Gray Earthenware							1				1		2
Orange Earthenware							6						6
Unknown Earthenware						4		1		1	1		7
Brick						4	1	2		1	2	1	11
Tile: Barrel										1	3		4
Flat						1		1			12		14
Other Ceramics													
Delft											2		2
Creamware						3	1	1			4		9
Queens Ware										1			1
Painted Whiteware					1	8	2				9		20
Ginger Beer Bottle	1	1		1		2	1				2		8
Featheredge	1	1					8		1			1	12
Boneware	3					31	9				4	1	48
Transfer Ware	3	3					2	1					9
Willow Ware			1										1
Ironstone							5						5
Banded Whiteware									4				4
European Porcelain			4			10	5	4			2		26
Chinese Porcelain												1	1
Sewer Tile (20th Century)						1		2					3
METAL													
Brass													
Cartridge	2	2									1		6
Lock							1				1		1
Buckle						1	1						2

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Table 4

SHORE LINE TRAIL	Test H					Test I				Test J			Total	
	1	2	3	4	5	1	2	3	4	1	2	3		
Wire									1		2	1	4	
Pepcock											1		1	
Lead														
Collar											1		1	
Disc											1		1	
Madallion			1										1	
Misc.											1		1	
Iron														
Nails: Wire	5	2				8	11	6	1		37	4	1	132
Can	2										2			4
Safety pin	1						1							2
Screw Cap	4	1					1							6
Crimp Cap	3										1			4
Bolt			1											1
Ring			1						1					2
Bottle Opener			1											1
Pintle						1								1
Hook						1	1				1	2		5
Pipe									1			1		2
Spike								1			1	1		3
Band											2	1		3
Pinion											1			1
Hinge											2	3		5
Grate											1			1
Wire											1	2		3
Buckle												1		1
Misc.	13	4	1			3			1		61	68	4	155
Aluminum														
Box											1			1
GLASS														
Milk											1			1
Amber	1	2									1	6		10
Green	61	221	185	10	11						6	22		516
Clear	31	20	6								7	40	1	105
Blue	2													2
Ink Bottle	1													1
Marble											1			1
BUTTONS														
Brass														
							1	2						3
MISCELLANEOUS														
Rubber: Misc.	3													3

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Table 4 continued

SHORE LINE TRAIL	Test H					Test I				Test J			Total
	1	2	3	4	5	1	2	3	4	1	2	3	
Plastic:Toothbrush	1							1					2
Toy						1							1
Screw Cap						1							1
Comb						1							1
Knob										1			1
Misc.										1			1
BONE AND SHELL													
Cow				x							x		
Pig						x	x						
Livona Pica													x

Table 4 continued

WATER BATTERY

	SURFACE TO FLOOR A	FEATURE 1	FEATURE 2	TOTAL
CERAMICS				
Spanish Ware				
El Morro	1			1
Unknown Earthenware			1	1
Tile:Barrel	3	2		5
Flat			1	1
Other Ceramics				
Sponged Ware	1			1
Painted Whiteware		5	2	7
Banded Whiteware		8		8
Ginger Beer Bottle		6		6
European Porcelain		1		1
Boneware		9		9
Transferware		1		1
Salt Glazed Stoneware		13		13
Lead Glazed Earthenware		8		8
Electrical Porcelain	4			4
Creamware		1		1
METAL				
Brass				
Bullet	1			1
Collar		1		1
Nail		1		1
Band		1		1
Cartridge	158			158
Hat Ornament(Anchor)		1		1
Misc.		1		1
Iron				
Nails:Wire	35	5		40
Screw Cap	1			1
Ring		1		1
Misc.				
Lead		3	1	4
Misc.		3	1	4
GLASS				
Marble	1			1
Milk	5			5
Amber	47			47
Green	58	295	2	355
Clear	71	29		100
BUTTONS				
Brass	1	1		2
MISCELLANIOUS				
Plaster:scratched			33	33
unmarked			7	7
painted			9	9
scratched "98"			1	1
Plastic:Misc.	4			4
Rubber:Hose	1			1
Sparkplug	1			1
Electrical light bulb	1			1
BONE AND SHELL				
Cow		x	x	
Bird		x		
Levona Pica	x		x	

Table 5

NOTES IN ANTHROPOLOGY

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- No. 1. An Archaeological site in the St. Marks Wildlife Refuge. Raymond S. Price, Jr., 1952 (out of print).
- No. 2. A Stratigraphic Investigation of the Hall Site, Wakulla County, Florida. Glenn T. Allen, Jr., 1953 (out of print).
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- No. 4. "Art" as "Arting". "Art" as "An Independent Organism". Taizo Miake (out of print) 1955.

- Vol. II Florida Anthropology. Charles H. Fairbanks, ed., (Also issued in Publication No. 5, Florida Anthropological Society). 1958.
- Vol. III A Peruvian Tasseled Fabric. Ina Van Stan. 1958.
- Vol. IV The Archeology of the Childersburg Site, Alabama. David L. DeJarnette and Asael T. Hansen, 1960.
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