archeological excavation

CHESAPEAKE AND OHIO CANAL

LOCK 35 DRY DOCK

NATIONAL HISTORICAL PARK

MARYLAND / W. VIRGINIA / WASHINGTON, D.C.

United States Department of the Interior

DENVER SERVICE CENTER - NATIONAL CAPITAL TEAM
NATIONAL PARK SERVICE
WASHINGTON, D.C. 20240

IN REPLY REFER TO:

SEP 17 1979

H3015-DSC-TNC

MEMORANDUM

To: Chief, Branch of Historic Preservation, Midwest/Rocky Mountain Team, Denver Service Center

From: Acting Chief, C & O Canal Restoration Group, National Capital Team, Denver Service Center

Reference: Chesapeake and Ohio Canal National Historical Park, Pkg. No. 176, Palisades District, Archeological Research, Dam 3 Area, Restoration of Historic Structures

Subject: Transmittal of Archeological Report

Enclosed for your files is a copy of the report entitled "Archeological Excavations at an Historic Dry Dock, Lock 35, C & O Canal." This report has been reviewed by all concerned National Park Service offices. As other archeological reports complete the review process, you will receive them.

Please address any comments or questions you may have to:

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ARCHEOLOGICAL EXCAVATIONS

AT AN HISTORIC DRY DOCK, LOCK 35

C & O CANAL

by

David J. Meltzer

DENVER SERVICE CENTER
NATIONAL CAPITAL TEAM
BRANCH OF HISTORIC PRESERVATION
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
DENVER, COLORADO

March, 1979

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ACKNOWLEDGEMENTS

Many persons contributed to this report and I would like to thank them here. Douglas Comer, Senior Archeologist of the Denver Service Center's National Capital Team and Principal Investigator for the project, provided me with the opportunity to do the excavations and carry out the analysis and report. His aid and direction, and especially his confidence, are appreciated.

My co-workers in the field, Suzanne Siegel, Paul Inashima, and Karen Deighan were careful, took good notes, and performed capably even on those awfully hot days. Staff Archeologist John Pousson, under whose general guidance the Summer 1977 excavations were conducted at the Dam 3 area, provided intellectual and practical assistance when needed. He also ventured forth one amazingly hot and oppressive day to aid me in doing some test excavations when I am sure his better judgment ruled against it. Dawn Cifani performed a detailed historical analysis on the more esoteric artifacts recovered.

Harlan Unrau, Historian for the Chesapeake and Ohio Canal Restoration Group of the National Capital Team, Denver Service Center, was both on paper and in person an invaluable aid to my historical research.

I am grateful to Beth Hartzell, Mary Patterson, and Clifford Stein, graduate students in the Department of Agronomy, University of Maryland, for their aid in my soils analysis.

I reserve the largest bouquet for Suzanne who performed beyond the call of duty in all phases of this report.

ABSTRACT

The National Park Service, in compliance with Section 106 of the Historic Preservation Act of 1966, assessed the significance of cultural resources in and around an historic dry dock adjacent to Lock No. 35 along the Chesapeake and Ohio Canal. The project was undertaken by archeologists of the National Capital Team, Denver Service Center. During a three-week survey and excavation of the dry dock and an adjacent stone foundation, sufficient area was excavated for purposes of determination, delineation, and assessment of the existing cultural resources. Further, specific questions were addressed regarding the dry dock and foundation's dates of construction, specific functions, and duration of use through the application of a variety of analytical techniques. It was determined that use of this area as established by the General Land Use Plan for the C & O Canal National Historical Park will not negatively impact the cultural resources.

INTRODUCTION

Archeologists of the Cheapeake and Ohio Canal Restoration Team undertook excavations on an historic dry dock and structural foundation which were adjacent to Lock No. 35 along the C & O Canal (mile 62.33) (see Figs. 1 and 2). This was part of the National Park Service's effort to comply with the National Historic Preservation Act of 1966 (P.L. 89-665, especially Section 106) throughout the planning, development, and management of the C & O Canal National Historical Park. These excavations which took place between May 31 and June 23, 1977, are the subject of this report.

The General Use Plan for the C & O Canal Park (Parsons 1976) is based on a five-part zoning system which delineates areas of the Canal with regard to their desired park activities. These range from "complete restoration with high density visitor activity (Zone A, e.g., the Great Falls Tavern Museum)" to "remote natural areas with a very low density of visitor use (Zone E, e.g., Paw Paw Bends)." The dry dock is within Section 14 which begins at Lock No. 32 and extends to Lock No. 36 (300 yards up canal from the dry dock); Section 14 has been designated Zone B status, a "Cultural Interpretive Zone."

Zone B areas are recognized to contain historical resources, though are often neither as accessible nor to be as developed as a Zone A property. In fact, "the higher (visitor) density of Zone A is deemed to be incompatible with the desired mood of Zone B (Parsons 1976:22)." The objective of Zone B will be to introduce the visitor to towpath use with a lesser degree of historic interpretation; the expected duration of visit is one to three house (Parsons 1976:22).

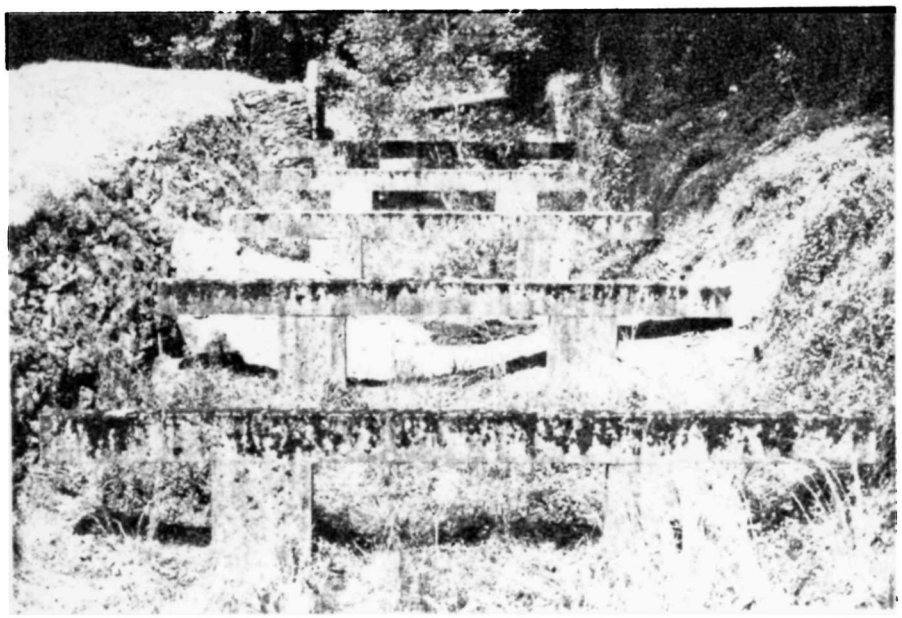


PLATE 1 VIEW OF DRY DOCK LOOKING WEST (UPCHAL): THE MOUND OF EARTH IN THE CENTER OF THE DRY DOCK IS FROM THE TRANSECT TRENCH.

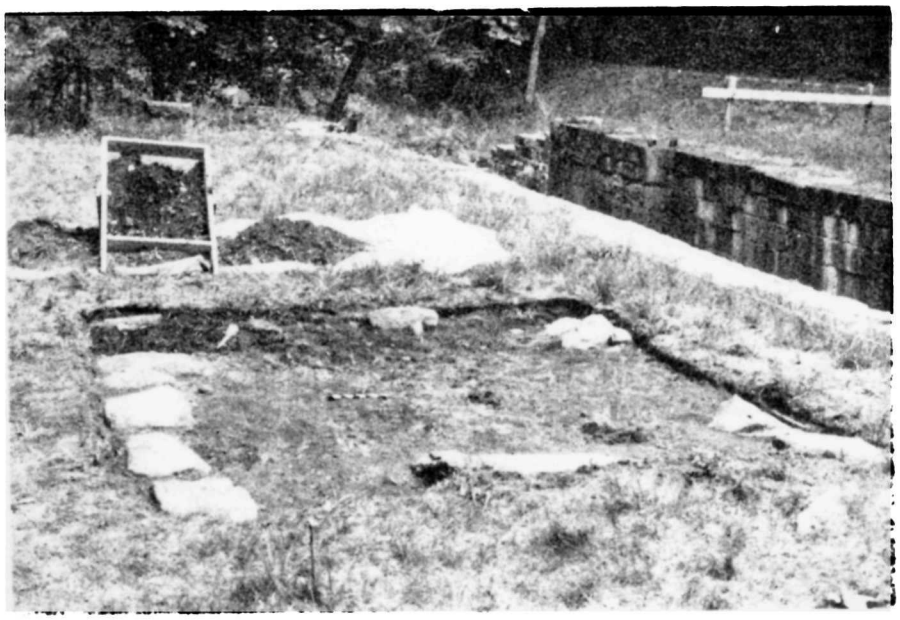
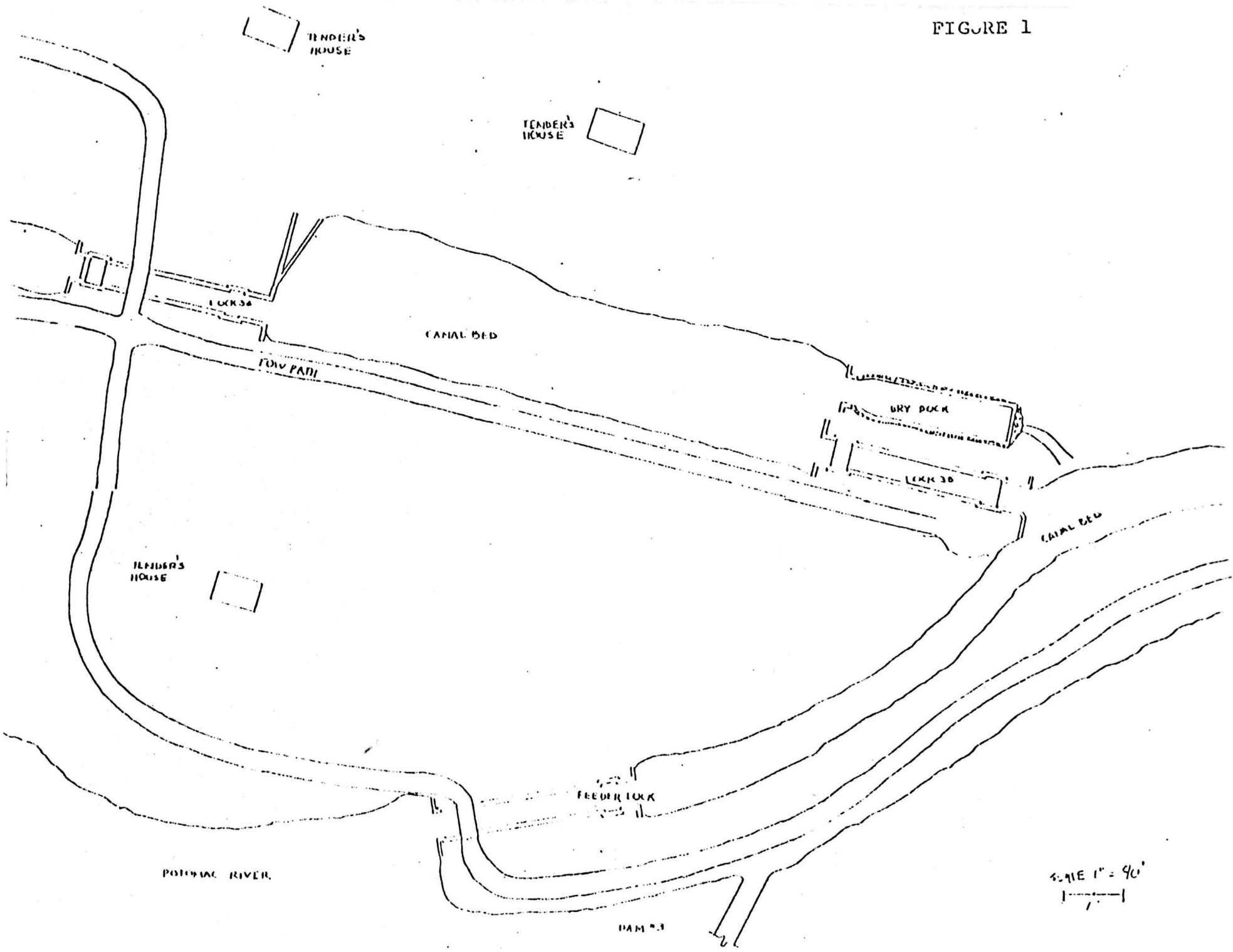


PLATE 2 VIEW OF FULLY UNCOVERED FOUNDATION STONES LOOKING EAST: LOCK 35 IS ON THE RIGHT.

FIGURE 1


TENDER'S HOUSE
TENDER'S HOUSE
LOCK 36
CANAL BED
TOW PATH
DRY DOCK
LOCK 38
CANAL BED
TENDER'S HOUSE
FEEDER LOCK
POTOMAC RIVER
DAM #3
SCALE 1" = 40'

However within the General Plan, there is some confusion regarding the exact whereabouts, and therefore zoning status of the dry dock. In Section 15 of the General Plan, the dry dock is specifically listed as an historic resource in association with Locks No. 36 and 37, a Zone D area (Parsons 1976:60). As mentioned above, the dry dock is adjacent to Lock No. 35 and clearly within Section 14. The implication of this error is that a property clearly in Zone B might be treated as if it were in Zone D (which is a remote zone whose objectives are low density use, similar though not as extreme as Zone E). In this report the dry dock is treated as having Zone B status.

These excavations were undertaken to aid park planners in making more specific land use decisions by assessing archeological resources which might be impacted by development of the area. This study was also carried out to enrich the Park Interpretive Program (which provides Park visitors with a more meaningful learning experience), to contribute information to the historical record, and to contribute to our knowledge of historic lifeways, which are a large part of our national heritage.

The dry dock at Lock No. 35 is the only structure of its kind remaining on the C & O Canal. It is located on the berm side of the canal and parallels the Lock approximately twenty-one feet from its edge. The dry dock is 108 feet long, twenty-three feet wide across the top of the walls, and eighteen feet wide across the floor. It is surrounded on two sides and the down canal end by eight-foot rubble stone walls. At the upper end is a 14½-foot wide entrance which connected the dry dock with the canal. This entrance housed some form of stop gate. At the down canal end, there is an opening which was once controlled by a water

control valve or gate. There are six concrete cross stanchions placed at equal distances (fifteen feet) along the 108-foot length which served to support the barges (see Figure 2 and Plate 1).

The foundation remains excavated are the remnants of a small (eleven foot by twelve foot) structure located on the land between the lock and the dry dock. The foundation stones are visible on the ground surface, though no other structural parts remain (see Plate 2).

What follows then will be a report on the historical, archeological, and pedological materials examined at the dry dock and adjacent area at Lock No. 35. The data will be described and analyzed in the light of some specific questions. These include:

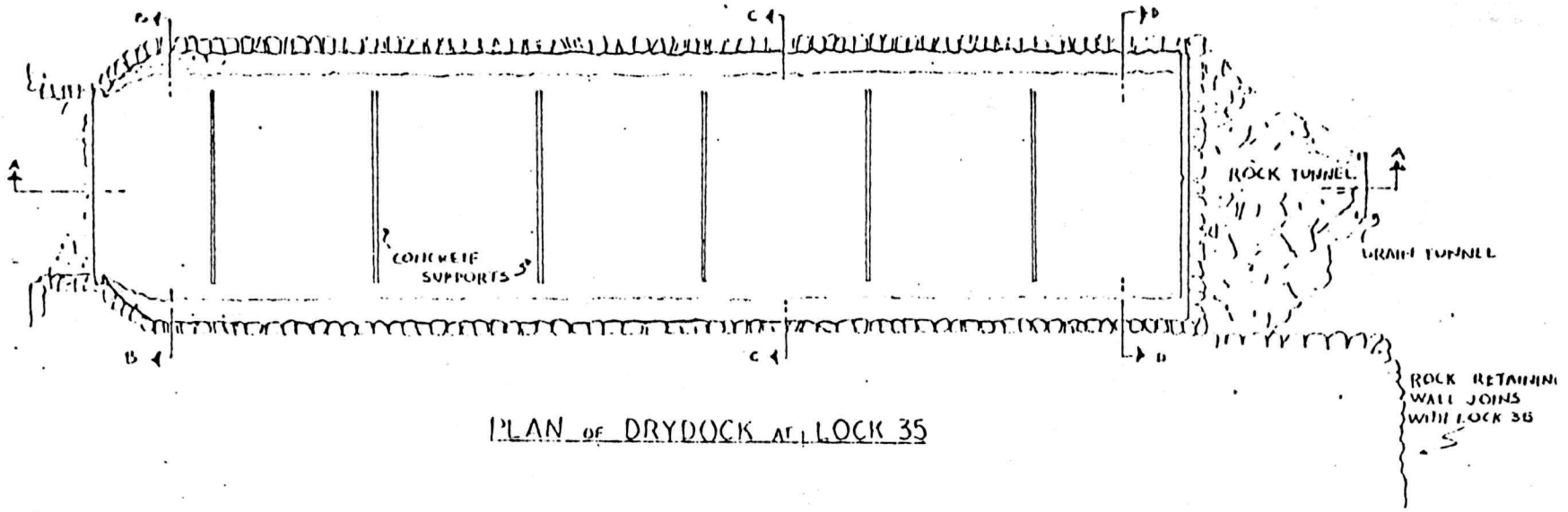
1. What was the probable construction date of the dry dock?
2. What were its general or (if any) specific functions?
3. Is the now standing structure the original structure?
4. What was the function and relation (if any) of the foundation remains found between the lock and dry dock?
5. What was the probable date of construction of the foundation?
6. How recently were both these structures used?

This is obviously not an exhaustive list. However, these questions point the way to some voids in our knowledge of historical canal use, as well as serve as a foundation for the formulation of other questions.

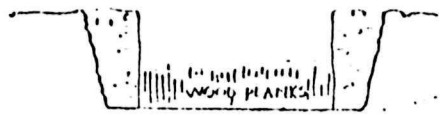
This report is divided into eleven sections including an introduction and acknowledgements, with the addition of a bibliography, appendices, and plates. A summary of the history of dry docks along the Canal is presented in Section 4, as well as the historical information about this particular dry dock.

Information is also given regarding the history of the structural foundation remains excavated. Section 5 offers an explanation of the function of both the dry dock and the structural foundation on the basis of historical and archeological data. Section 6 describes the excavation strategy utilized, as it was reflective of the specific questions listed above and of some general archeological concerns. Section 7 describes and attempts to interpret the features found during the course of the excavations. Sections 8 and 9 are the artifact and soils analysis respectively. The character of these sections is more interpretive than descriptive; the actual data will be presented in the form of appendices at the end of this report. Section 10 will be a summary and conclusions; Section 11 will discuss recommendations for mitigating adverse effects to resources.

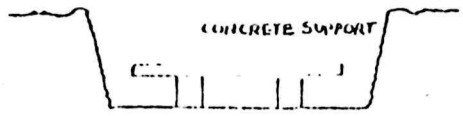
FIGURE 2



PLAN OF DRYDOCK AT LOCK 35

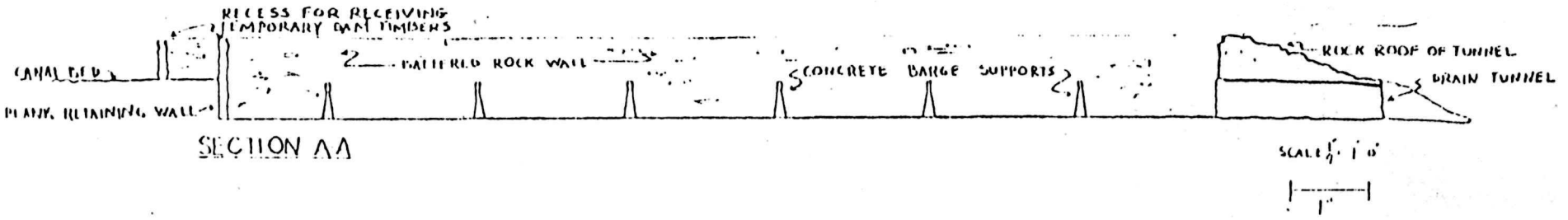


SECTION B-B



SECTION C-C

SECTION D-D



SECTION A-A

HISTORICAL BACKGROUND - SECTION FOUR

Historical information on dry dock construction and use is limited mostly because the dry docks were not a part of the Canal Company operations per se. Rather, dry docks were the responsibility of particular individuals who leased the rights from the Canal Company to construct and operate them. Therefore, mention of dry docks was generally only made when a particular contract for construction was let. Unfortunately the dry dock we are dealing with is not mentioned in the records at all (therefore our first question regarding its probable date of construction).

There is information to be gained from the historical record, at least with regard to the use, and perhaps more importantly the functional context, of the dry docks within the operation of the canal. What follows then is a summary of Unrau's (n.d.) discussion entitled "Provisions for the Repair of Boats." This material is part of the general Historic Resources Study of the C & O Canal prepared by Unrau. This will be followed by a summary of my own research on this particular dry dock.

Dry docks were generally not built for some twenty to thirty years after the construction of the canal had begun. However a need for them was recognized early on, and there had been an attempt by the Canal Company Board of Directors in July of 1831 to somehow provide for their construction. Their suggestion, though, was deemed "inexpedient" by a committee of engineers in August of 1831.

Yet the problem of keeping suitable craft on the waterway remained, so in 1833 "it was determined that the Resident Engineers select a suitable spot on each residency for a dry dock and recommend a plan for their construction (Unrau n.d.:83)." Because no construction plans or contracts

for these dry docks were mentioned, it is not known how many of these structures were actually constructed.

Dry dock construction was not mentioned again in the Canal Company records until October of 1847.

> At that time the Board authorized John Moore, the lock tender at Georgetown, to build such a structure near Lock number 1 under the direction of the Chief Engineer. Moore was to operate the dry dock 'at the pleasure of the Board' with 30 days notice required for abrogation of the least (Unrau n.d.:85).

Shortly thereafter (November 1847) Owen Ardinger was given permission to construct a dry dock on the berm side of the canal near Williamsport. It is interesting to note that some fifteen years later Charles Embrey and Son were granted the right to build a dry dock in the same area. This seems to suggest that the first was never built.

In later years, after 1851, the Canal Company increased its control of boats on the canal. On at least five occasions between 1851 and 1889 they required the registration, and consequently the examination of all canal boats. This precipitated the need for dry docks and small boat yards in order that any boat not meeting the Company requirements might be repaired or refitted. In keeping with the notion of dry docks as private enterprise, the Canal Company had lease arrangements prepared for the construction of dry docks, warehouses, and wharves along the canal. These were to be constructed contingent upon permission being granted to build by the Chief Engineer, subject to the approval of the Board of Directors.

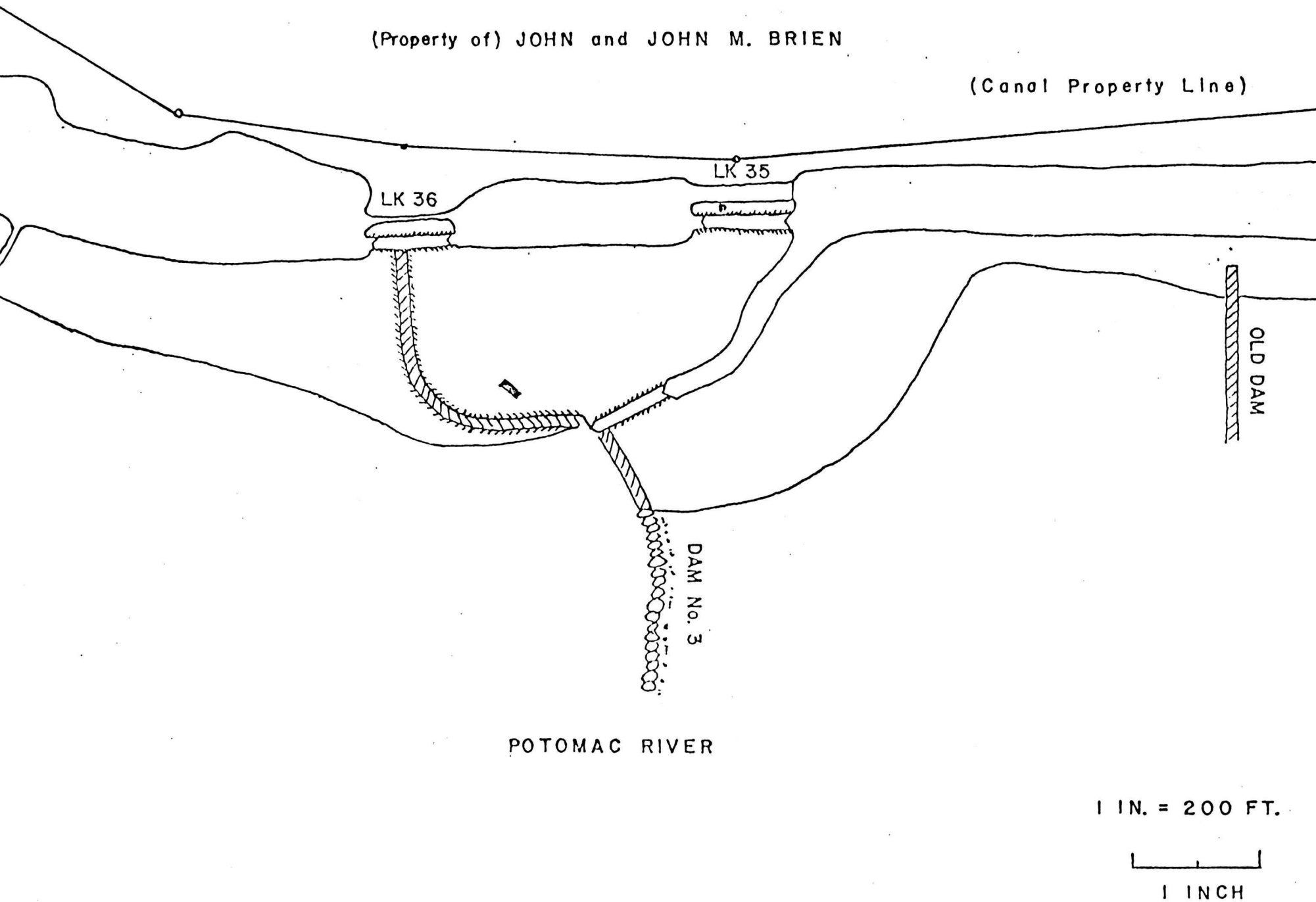
In all, there were at least six dry docks <u>contracted</u> to be built along the canal between 1851 and 1889: 1) in September 1854 at Locks

No. 45 and 46, 2) in September 1855 at Lock No. 47, 3) in May 1862 at Lock No. 44, 4) in April 1864 at Lock No. 14, 5) in November 1872 at Lock No. 25 -- Edward's Ferry (this dry dock was built by the Superintendent of the Monocacy Division -- that is, by the Canal Company -- for a sum "not to exceed $100;" only after its completion was it leased to a private individual, Colonel E. V. White of White's Ferry), and 6) in November 1875 where there is reference to the records to a dry dock "in the rear of Lock number 10." No further information is given regarding its or any of the others' construction.

According to Unrau there is no information of any other dry docks being built after 1889, when the canal changed hands. Yet what of the dry dock at Lock No. 35? Cross-checking the historical record provides the following information. The dry dock at Lock No. 35 is not on the list of structures along the Canal prepared in 1890 when the Canal went into receivership. However, there is a feature the size and shape of the dry dock shown on the "Property Map of the C & O Canal" prepared by B. F. Mackall between 1894 and 1896 (see Figure 3). I am hesitant to state unequivocably that the feature on the map is a completed dry dock, since Mackall does not show the feature as being stone lined and since he omitted the up canal construction and gate on the dry dock. It might be suggested that at the time it was under construction, regardless, the feature on the map is obviously more than simply a bypass flume and does show some sort of barrier at the down canal end.

To determine whether the existing structure is the original structure is complicated and is related to the question of its date of construction. As the dry dock now stands, there are six concrete stanchions which supported the barges after the water had been drained from the dry dock.

FIGURE 3


(Property of) JOHN and JOHN M. BRIEN
(Canal Property Line)
LK 35
LK 36
OLD DAM
DAM No. 3
POTOMAC RIVER
1 IN. = 200 FT.
1 INCH

There has been speculation that if there were wooden supports originally, then the dry dock might predate the early 1870s (the earliest use of cement on the canal -- Unrau, personal communication). This speculation, in the form of two separate hypotheses, is not altogether guesswork but is derived from observations made at the dry dock.

The first hypothesis is that two twelve inch by twelve inch indentations in the north and south dry dock walls (at the east end of the dry dock) were originally the housings for twelve inch by twelve inch timbers some twenty feet long which lay across the dry dock and supported the barges. This hypothesis can be ruled out if one considers two factors. One, it would have been inexpedient to plant a twenty-foot timber a minimum requisite one foot into the wall. In the event it broke, it would have been impossible to replace without tearing out and relaying the dry dock. Second, there is only visible evidence of two indentations with no sign of any others. The remainder of the dry dock wall is intact without anomalies (e.g., a filled-in or collapsed indentation).

The other possibility is that there were wooden structures similar in form which preceded the concrete ones. Persons affiliated with the C & O Canal National Historical Park have noted that oftentimes when a wooden structure along the Canal was replaced by a cement one, the cement structure imitated the original wood structure. This retention of "mental templates" is not unusual; witness the early automobiles designed like horse-drawn carriages. Applying this to our situation we might expect to find archeologically some sort of post mold or support structure which might indicate the base of a wooden stand. Anticipating evidence to be

presented later, one such feature was found (see discussion, Section Seven, Feature No. 2) which, it was thought originally, could have served that purpose. However, subsequent testing for matched or adjacent features was not successful, and this hypothesis was also rejected.

We might, therefore, conclude that the structure as it now stands is the original structure, and consequently that the dry dock was probably built during the last decades of the nineteenth century, probably in the mid-1890s as the historical research suggests. This of course means that the dry dock was built after the canal passed hands to the Baltimore and Ohio Railraod. This is quite interesting since the railroad company probably was not particularly concerned with keeping viable craft on the waterway because the Canal still represented competition with them for the Cumberland coal. Eventually the railroad company was required by court order to keep the canal in operation and show a profit; otherwise, they would be perpetuating a monopoly. The Baltimore and Ohio resorted to a "shadow company" in January 1894 to take over the operation of the Canal. This corporation, the Chesapeake and Ohio Transportation Company, provided the boats and promised an annual profit for the canal (a large percentage of which undoubtedly went back to the mother company, the Baltimore and Ohio). It is, in fact, more likely that during the tenure of this company (and not the Baltimore and Ohio), when there was an effort being made to produce a profit, the dry dock was built. This corresponds closely with the date of construction arrived at from the other evidence.

Only a small amount of historical information can be offered concerning the structural foundation found between the dry dock and the lock. There is no structure listed on the 1890 property/structures list. However, since its probable function was more temporary than permanent (see the discussion is the following section), the possibility exists that the structure did predate 1890, but was not considered important enough to place on the structures list which dealt mostly with locks, lockhouses, and related structures. In any event there is a structure shown on the Mackall map and though its location is now as exact as could be hoped for, it is probably the same structure.

The structure also appears on a 1920 photograph of the Lock No. 35 area in which it seems to be sporting a fresh coat of paint (see Plate 3).

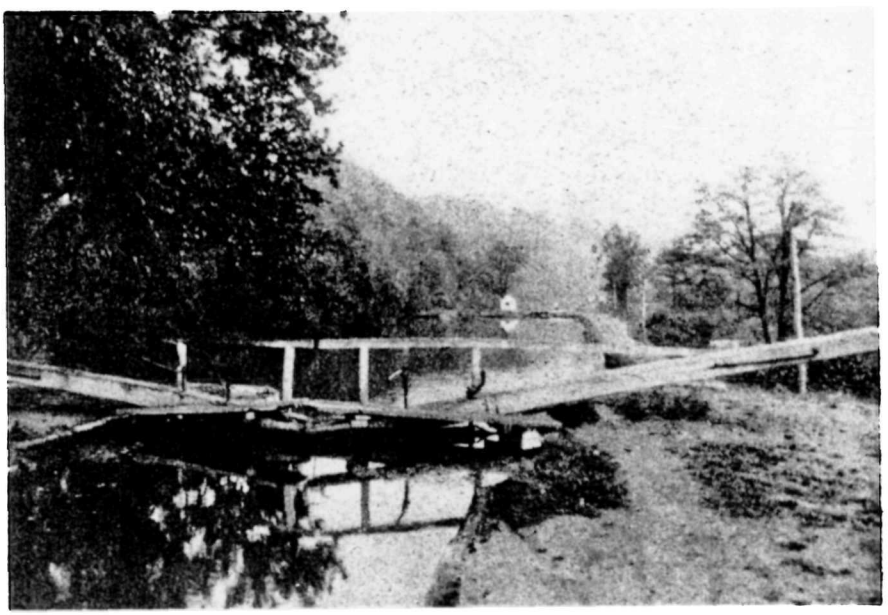


PLATE 3 1920 PHOTOGRAPH OF LOCK 35 AREA: THE STRUCTURE IS VISIBLE IN THE CENTER, THE DRY DOCK (FILLED WITH WATER) IS ON THE LEFT.

From series of photographs made by The Consolidation Coal Company, circa 1920.
Obtained Fall 1965 from Smithsonian Museum of History and Technology, Curator of these photographs: Dr. John N. Hoffman.

108. Lock 35 & 36, Harper's Ferry Dam and Feeder

ACTIVITY AREAS - SECTION FIVE

In this section, I will briefly outline the probable historical function of the dry dock and the adjacent structure (foundation).

Since the dry dock was connected with the canal, a boat in need of repair could simply divert its path (15°) and float through the open stops gates into the water-filled dry dock. Once in, the stop gates would be closed and the water control valve covering the drain hole at the down canal end would be opened. As the water drained out, the boat would gently settle onto the concrete supports which kept the boat some four feet off the floor of the dry dock, thus exposing the bottom for repairs. When the repairs were finished, the drain hole was closed; the stop gates opened; and the boat was lifted off the supports and floated back onto the Canal.

The repairs at this dry dock, according to Thomas Hahn (1972:13) consisted of tarring and tinning. Evidence of at least the former is still visible in the bits of tar on the dry dock wall and occasionally on cobble found on the dry dock floor. Yet our archeological evidence also points to a more extensive or "heavy-duty" refitting of boats. This is suggested by the large amount and size of the anils found in the excavations. As will be treated more fully later, 924 nails and nail fragments were found in the nine percent of the total dry dock basin that was excavated; of those classified by size -- pennyweight -- eighty-three percent were greater than 16d.

If it is logical to assume that this dry dock was the only remaining structure of its kind between the boat yards of Cumberland and Georgetown

because it was built after the flood of 1889 which probably devastated the ones built twenty years prior to it, then it is logical also that it should have had to take on more than superficial repairs (i.e., tarring and tinning).

The structure, of which the foundation remaining was excavated, seemingly had a number of interrelated functions. The structure may have been a lock keeper's "wait house" (or "watch house" or "dog house") of the sort common near the locks. That is, the structure served as a temporary shelter for the lock keeper in times of inclement weather when it was inexpedient for him to return to his lockhouse. In this case the lockhouse is located some 300 yards up canal, and more importantly uphill.

Recovered archeological evidence suggests that the structure also served as a tool shed for a variety of implements; those recovered include a gaff pole for moving logs, a two-pronged pitchfork for moving hay (perhaps for the mules), various nuts and bolts, and a large (four-foot) valve key.

Finally it is not inconceivable that the structure could have served as a storehouse for the tar and nails used in the dry dock operation. Again, this has been indicated by the archeological evidence (see discussion, Section Seven, Feature No. 5).

EXCAVATION STRATEGY - SECTION SIX

The excavation strategy utilized, though inductive, aimed to satisfy the following requirements: 1) to provide a significant archeological sample of the entire dry dock basin, 2) to enable the delineation of the soil profile over the entire basin which would in turn facilitate comparative artifact analyses from one end of the dry dock to the other, and 3) to provide for the recognition of construction features and artifact patterning.

At the foundation area the excavation strategy aimed to provide for the complete recovery and recognition of all artifacts and historical features in and around the foundation.

Our first concern was to establish a grid over the entire area of the foundation and dry dock basin. This was done to impose a systematic control on the excavations by providing the means for the immediate spatial delineation and recognition of areas during analysis, as well as serve as a point of reference for artifacts and features.

The grid was laid parallel to the Lock No. 35 north wall, since it was in an approximate east to west line. A starting point for the sampling grid was arbitrarily chosen five feet north of the lock wall at the up canal end. This point, the datum stake, was then given exact coordinates with reference to the Lock. From the datum, a line which paralleled the lock was sighted 105^{o} east of magnetic north; stakes were placed at ten-foot intervals for forty feet along the line. Two stake lines were then laid perpendicular to the first line, these extending from the lock wall to the northern edge of the dry dock wall. This resulted in a grid system which could be tied into the compass points

(grid north was 15° east of magnetic north), but also simultaneously (and more importantly) fitted over the historical structures (see Figures 4 and 5).

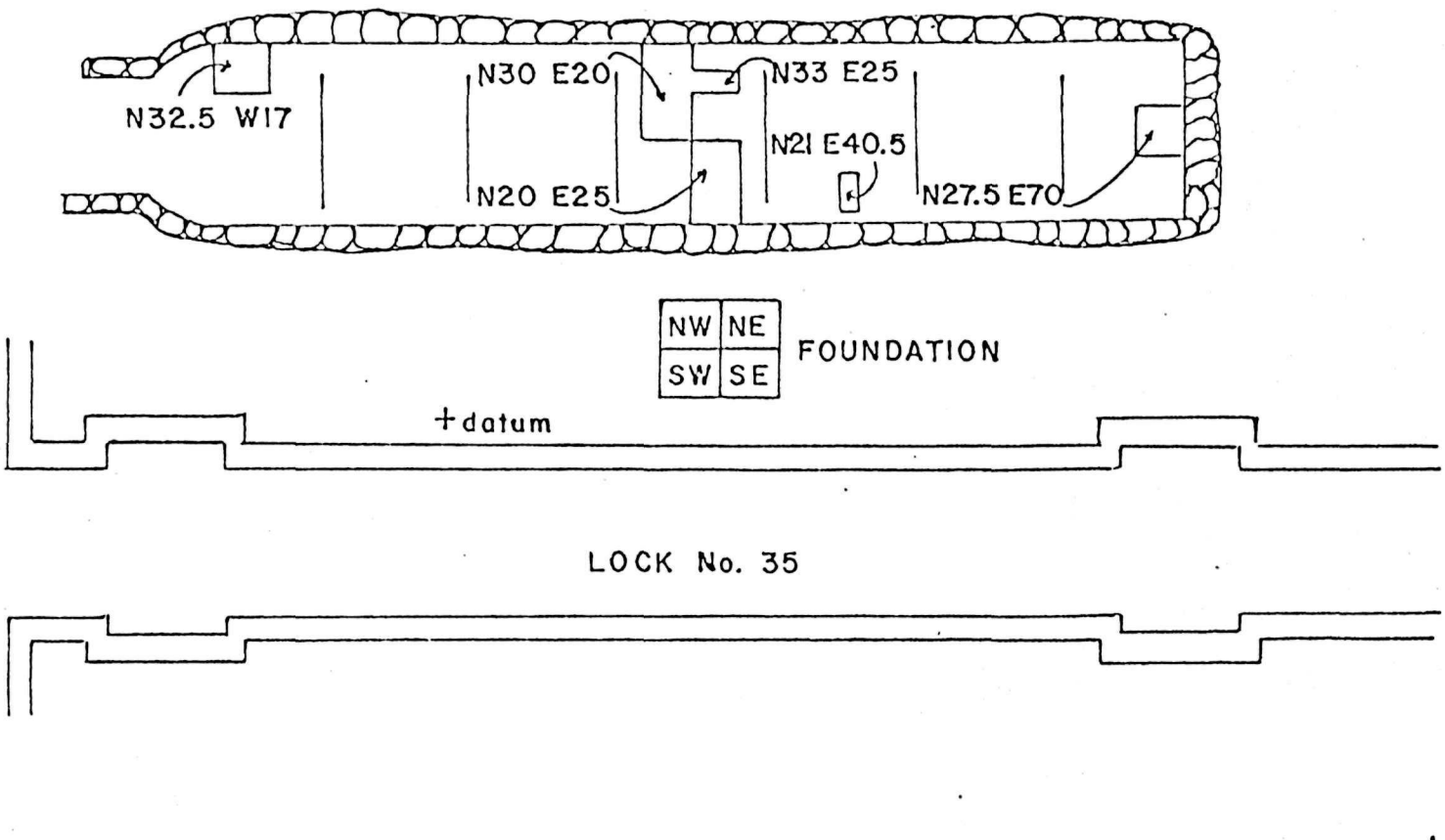
DRY DOCK EXCAVATIONS

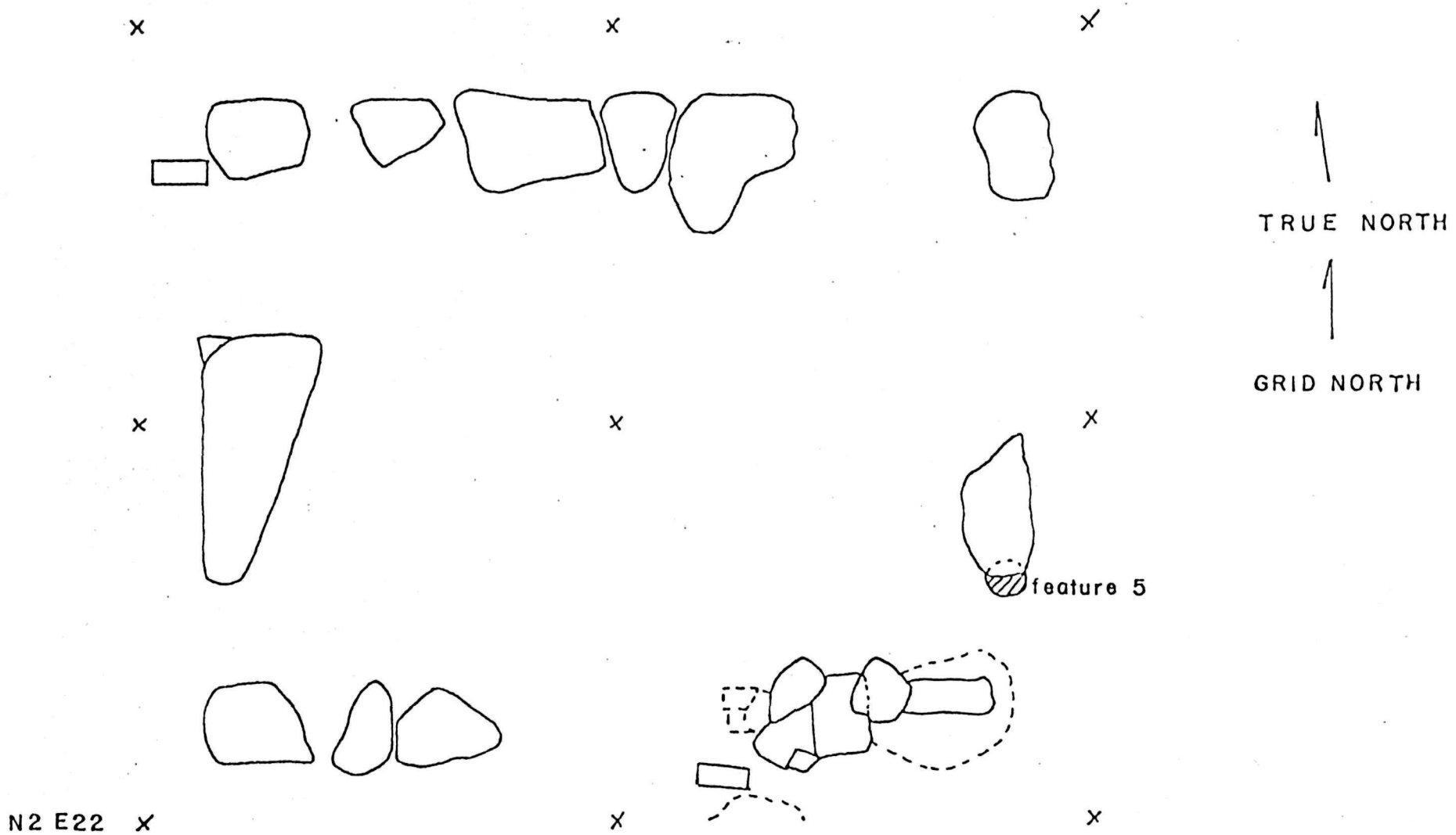
Our next concern was then to reveal, through excavations, the soil profiles and any artifact patterning in the dry dock basin. It was thought that this could best be done by a complete transect trench across the width of the basin, so the area was first divided into two excavation sections in the approximate center of the dry dock. The squares, N20 E25 (a five foot by eight foot area) and N30 E20 (a five foot by ten foot area), were offset to avoid any nonrandom cultural patterning on the suggestion of John Pousson.

N20 E25 served as the control square to establish typical soil stratigraphy, depth, and artifact patterns in the basin. Therefore, the square was dug in .1 foot increments. In this, as with all the squares, the excavation proceeded in adherence with the soil levels; if a soil change was encountered, the immediate level was completed and another stratum and level were designated.

All soil materials excavated were either trowelled carefully or shovelled and screened. This option was utilized throughout our excavations as it became evident that one was as equally reliable as the other, though circumstances often dictated which was more expedient. When the foundation was later excavated, we recognized that we were dealing with a more shallow, more artifact-rich area and therefore we carefully trowelled and screened all soil materials to enable the best possible recovery.

SITE PLAN of EXCAVATIONS





FOUNDATION at DRY DOCK

Once the transect trenches had been completed, each excavated to a depth of at least 1.7 feet below the surface, we opened a five foot by five foot square and a five foot by six foot square at the east and west ends of the basin respectively.

The five foot by five foot square, N27.5 E70, was placed directly in front of the drain hole of the dry dock. The square was placed there because it was hypothesized that the artifact patterning or soil horizonation might differ owing to the square's location and the obstacle of the wall.

The five foot by six foot square, N32.5 W17, was placed in the northwest corner of the basin just east of the stop gate constriction and south of the dry dock wall. This was done in order to examine the sill in the constriction and to look for a possible builder's trench associated with the sill.

Finally, two other units, N33 E25 (5 foot by 2½ foot) and N21 E40.5 (2 foot by 3½ foot) were opened. These were opened explicitly to test the hypothesis of whether wood structures, similar to the existing concrete ones, had at one time been in the dry dock. The placement of these squares were determined by the location of Feature No. 2 which had seemed to represent the base for a wooden structure. That is, squares were dug directly north of the Feature at a point where a matching feature might be expected and east of the Feature where an adjacent feature might be found.

In total there was 164.5 square feet of area excavated within the dry dock basin, an area of approximately 1,750 square feet. This translates to a sampling coverage of 9.4 percent of the total area. This is a substantial proportion, though statistical generalizations could not be drawn for the

entire area of the basin since it was not selected randomly.

FOUNDATION EXCAVATIONS

The presence of the foundation between the dry dock and the lock was first recognized as a number of large, flat rocks seeminly in a square pattern barely exposed on the ground surface. The first task undertaken was to carefully excavate the top .1 foot of soil and soil material overlying the rocks of the foundation. It was felt that by uncovering the stones in the foundation and ampping and photographing them, the better picture of the extent of the foundation would enable the formulation of a better plan for its excavation. This proved to be the case and once it was completed, the grid system was imposed on the foundation. This was done in such a way as to place the excavation units directly over the foundation yet allow an overlap of approximately .7 feet beyond the outer edge of the foundation. The result was an area eleven feet by twelve feet which was then divided into four five foot by six foot quadrants excavated consecutively. Each quadrant was excavated to at least .5 feet below surface, though the artifacts were largely absent below .3 feet.

As mentioned above, we attempted to maintain tight control over the artifact recovery. Subsequently all materials were trowelled and screened and all excavation levels were dug in .1 foot increments. The percentage of foundation area excavated was (theoretically) one hundred percent.

SURFACE COLLECTION

During the course of the excavation, one surface collection was undertaken. It was done for two reasons. First, the area surface collected was disturbed and slumping. Artifactual materials could therefore be seen

without removing the top layer of sod. Second, a recent rain had further increased the visibility of artifacts. It was therefore expedient to recover the materials found within the dry dock basin and at the foundation. The area surface collected was approximately five feet by ten feet and was located at the down canal end between the dry dock and the lock wall. The coordinates of this unit were N5 E70.

The collection was moderate success since it recovered nails and spikes in excellent condition; this was unfortunately not the situation with the dry dock basin artifacts.

FEATURES - SECTION SEVEN

During the course of excavations, anomalies, whether archeological or pedological, were occasionally noted. These were designated as features and numbered sequentially.

There were a total of six features designated: four in the dry dock basin and two in the foundation. All six were artificial, as opposed to natural features.

Feature No. 1 was first found in Stratum A, Level 2 (.25 feet to .50 feet) below surface of Square N30 E20. It was noticed that in the northwest corner of the square several nails were appearing together. In the next level down (.50 feet to .70 feet below surface), there was a marked increase in the number of nails found in that four-foot square area, so it was designated a feature. The artifacts were mapped and photographed.

In total, there were thirty-eight nails and three nail fragments. Twenty-nine of the nails were 30d (pennyweight), one of the most frequently recovered sizes of nails in the dry dock (see discussion, Section Eight). There was no evidence of an associated soil change.

Beyond the obvious supposition that the nails were related to the dry dock use, it can also be suggested that their deposition was contemporaneous and perhaps even the result of one individual. In other words, it would seem unlikely that such a concentration was produced by more random means such as flood action or more random deposition general maintenance activities.

Feature No. 2, discussed briefly in the previous sections, was found in the southwest corner of N20 E25. The feature was a flat, roughly

circular rock approximately .8 feet in diameter. It was found lying horizontally 1.7 feet below surface and was covered with a thin layer of mortar. There was an associated dark brown clay deposit which extended directly northward about .75 feet from the feature. This differed from the surrounding Stratum C matrix. The feature was photographed (see Plate 4).

No explanation was (or is) offered for the associated soil change. However, it was suggested that the feature itself was once the base for a wood support, similar in form to the existing concrete ones. To test this hypothesis, two squares were opened. One was opened directly in line (northward) with Feature No. 2 under the assumption that there would have to have been a second support for a wood beam. The square was placed at a distance (two feet) from the north wall of the dry dock equal to the distance (two feet) that the feature was to the south wall. No similar feature was found. A second square was then opened fifteen feet to the east of Feature No. 2, again the same distance off the south wall. Fifteen feet was chosen because it is the distance between the concrete stanchions as they now stand. Again no similar feature was found.

Therefore, owing to the absence of other similar features where one might deduce their presence, this hypothesis could not be accepted. An alternative explanation is that the feature was the base support of a ladder or platform used to get in and out of the dry dock or to stand on when repairing the sides of the boats. This is tenable since, from the floor of the dry dock, it would be difficult to reach the upper sides of the boats.

PLATE 4 VIEW OF FEATURE #2

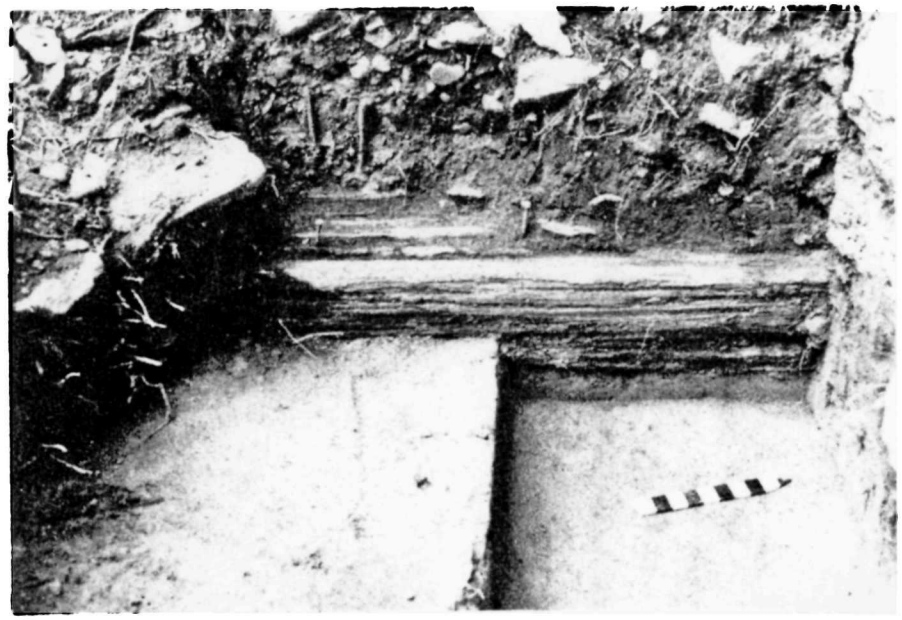


PLATE 5 VIEW OF FEATURE #3 LOOKING WEST

Feature No. 3 was a large section of a wooden beam lying horizontally and parallel to the entrance sill at the up canal end of the dry dock. The beam itself was not uncovered until .6 feet below the surface; however, a series of nails set directly into the wood were noted in the ground at a depth of .3 feet below surface. The wood beam was approximately .9 feet wide, .75 feet high, and at least three feet long (unexcavated areas cover the potential remainder). There was an associated soil change which is dealt with in some detail in the section on soils. Photographs were taken of the feature (see Plate 5).

There are two equally tenable possibilities regarding this feature: 1) it was the remains of the stop gate at the entrance to the dry dock; 2) it was a part of the sill construction (i.e., the sill was built up against the beam). The soils data produced some evidence which seems to confirm the latter hypothesis (see discussion, Section Ten).

Feature No. 4 is at the opposite end of the dry dock from Feature No. 3. The feature is the base of the dry dock's drain hole and consists of a wooden board overlying a stone and rock sill. On the ground surface in front of this structure, there is a depressed area most likely the result of the water which once funneled through the drain. Correspondingly, there was a relatively high number of artifacts found just in front of the feature in all levels of the square. The feature extended from the ground surface down to the base of excavations (two feet below surface). That the artifact concentration was probably the result of water transport is also evidenced by their condition. Most often the artifacts were cemented together in a coarse matrix of gravel, sand, and rust.

It is suggested that the feature is part of the original construction of the dry dock drain, and as such it exhibits historical construction techniques (see Plate 6).

Feature No. 5 was a cache of nails found in the southeast quadrant (N2 E28) of the foundation in Stratum A, Level 3 (.3 feet below surface). The feature consisted of twenty-seven wire nails, thirteen of which were 40d (pennyweight), eleven of which were 8d. There were also five modern, machine-cut nails (cf. Nelson 1968), four of which were 20d in length. The nails were all found under and adjacent to the foundation stone in the northeast corner of the quadrant (see Figure 5). The nails were almost all lying perpendicular to the east wall of the quadrant in one large pile. The only discerable association to this feature was a large (7 inch x 5 inch x 2 inch) piece of coal lying just east of the feature.

Their concentration suggests that this was not simply the material remains of a collapsed structure, but rather a more conscious nail storage. The size of the nails suggests that these were associated with the use of the dry dock (the relation of nail size to function is dealt with in more detail in the artifact analysis section that follows).

Feature No. 6, the last of the designated features, was an area of anomalous soil found under the foundation stones in the southeast quadrant of the foundation. This was the only area in the foundation where the foundation stones were not resting directly upon Stratum B soil materials. Instead, the soil was very dark brown, almost black, sandy loam with large percentages of what was thought at first to be coal and shell fragments. The soil structure was granular.

PLATE 6 VIEW OF FEATURE #4 LOOKING EAST THROUGH THE DRAIN HOLE OF THE DRY DOCK

Artifacts found in the feature which were roughly circular in shape (1.6 feet to 2.0 feet in diameter) were two whole bricks, a large (.65 feet by 1.0 feet) flat piece of metal (function unknown), seventeen wire nails and machine-cut nails, and one large bolt. The artifacts appear to be more corroded than those from the remainder of the foundation.

The depth of the feature (it appeared at .5 feet below surface and disappeared at 1.9 feet below surface), its circular shape, and the anomalous soil suggests that Feature 4 was a pit of some sort. Evidence from the soils analysis has shown that the material thought to be coal fragments were not nor was it charred wood. The feature may be a trash pit filled with organic material, which also might account for the condition of the artifacts.

ARTIFACT ANALYSIS - SECTION EIGHT

The analysis of artifacts from the dry dock and foundation was carried out to provide an inventory to aid in site interpretation and to enable the testing of specific hypotheses regarding the supposed function/use of the excavated area.

Utilization of the artifacts for dating purposes was not of primary concern except in specific instances. This was mostly because the overwhelming majority of artifacts were nails, all of a modern variety (cf. Nelson 1968). In fact, compared to the approximately 1700 nails and nail fragments, there were 239 window and bottle glass fragments of which only three yielded dates of any sort. Of the remaining artifacts, some thirty in total, only three yielded approximate dates while two coins gave specific dates. Regardless, an examination was made of all artifacts which might potentially provide historical dates.

The analysis of the artifacts was done in two parts. First was an inventory of all recovered artifacts including a description and measurement. In the case of the nails, each individual nail was noted as either a wire or machine-cut nail, measured, and classified by pennyweight (length). This task was often difficult since most of the nails from the dry dock basin were extremely corroded and in poor condition. Therefore, in order to maintain uniformity in the analysis, all nails under two inches in length and/or those obviously broken or whose original size was not discernable were tabulated as nail fragments. Also, if a nail was slightly more or less in length than particular pennyweight, it was rounded down to the closest smaller pennyweight and counted. Logically this is acceptable since the nail measurements, if consistently rounded down, would

not alter the results of the statistical analyses performed. Nail corrosion was not a problem in the artifacts recovered from the foundation.

The remaining (non-nail) artifacts were also inventoried, and those which could potentially yield historical information were forwarded to Dawn Cifani who did the second part of the analysis, a more detailed historical research.

A representative sample of nails was conserved by electrolytic reduction to remove corrosion and then prevented from further corrosion by a rust inhibitor, CRC, and lamp black. Finally a barrier solution of KRYLON was applied to keep moisture out. There was also conservation of of a selected number of metal artifacts having intrinsic interest. Coins, pipe stems, bottle glass, bricks and most nonmetal artifacts were all carefully cleaned and examined.

NAILS

The tabulation of all the nails and nail fragments from the foundation and the dry dock by size (pennyweight), stratum, and square are presented in Appendices 1 and 2. Presented herein are some relevant statistics regarding the nail patterning, and some hypotheses about that patterning.

Of the 924 nails and nail fragments found in the dry dock basin, we were able to classify 303 of them on a pennyweight basis. An additional thirty-six were greater than the largest pennyweight size of 60d. The remaining 585 were nail fragments, either less than two inches or broken and unclassifiable.

That a formidable sixty-three percent of all the dry dock nails recovered were fragments is surprising, though understandable in light of two factors: 1) preservation of the nails in the basin was very poor, especially since the soils were often inundated with water, thereby leading

to corrosion; 2) since the dry dock was a construction site, one expects to find a large portion of broken nails.

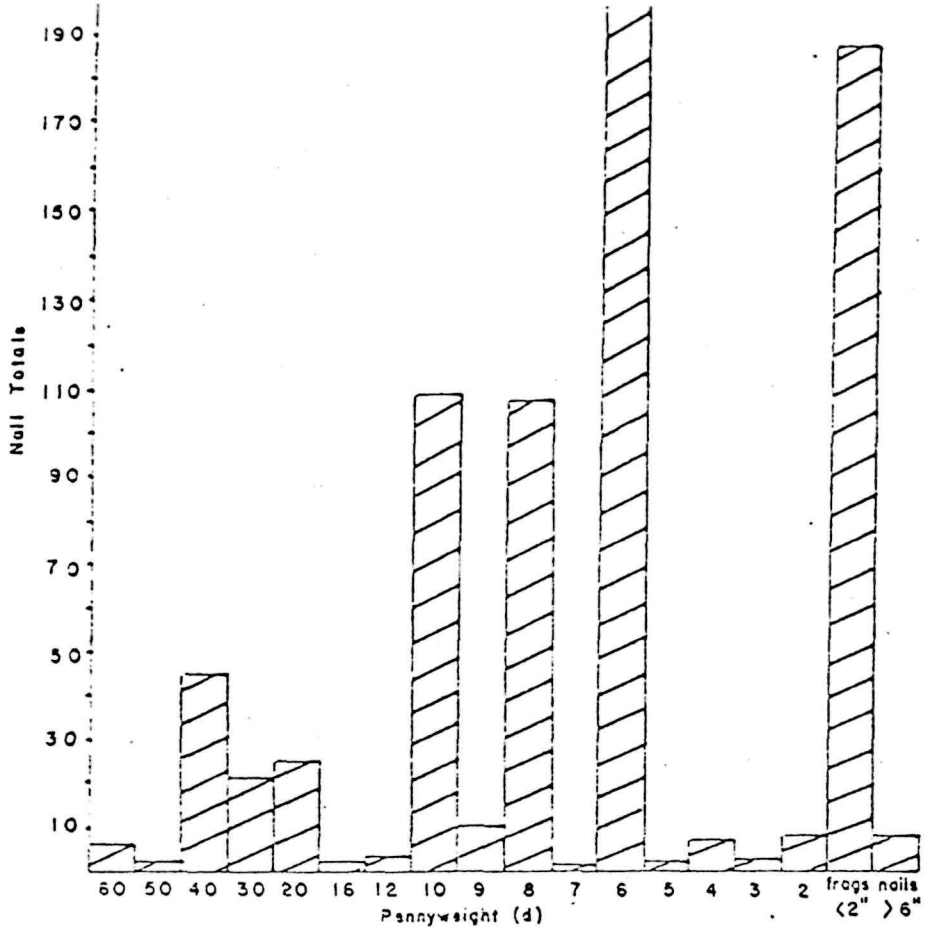
Of more interest however is the pattern that emerged when classifying the nails. That is, of the 303 nails typed on a pennyweight basis, ninety-three percent (282 nails) were equal to or greater in size than 10d (three inches in length). The lengths 20d, 30d, and 40d alone accounted for sixty-eight percent (207 nails), (see Figure 6 and Plate 7).

This has important implications when considering the function of the dry dock. As mentioned earlier, it was thought that only light repair work (tarring and tinning) went on at the dry dock. Yet the large size and amount of the nails suggests that more heavy-duty refitting of canal boats was also taking place.

To gain another perspective, compare the figures above with those from the foundation. There a total of 765 nails and nail fragments were recovered in an area of comparable, though not identical, size to the dry dock. However, only twenty-four percent (187) of that figure were nail fragments.

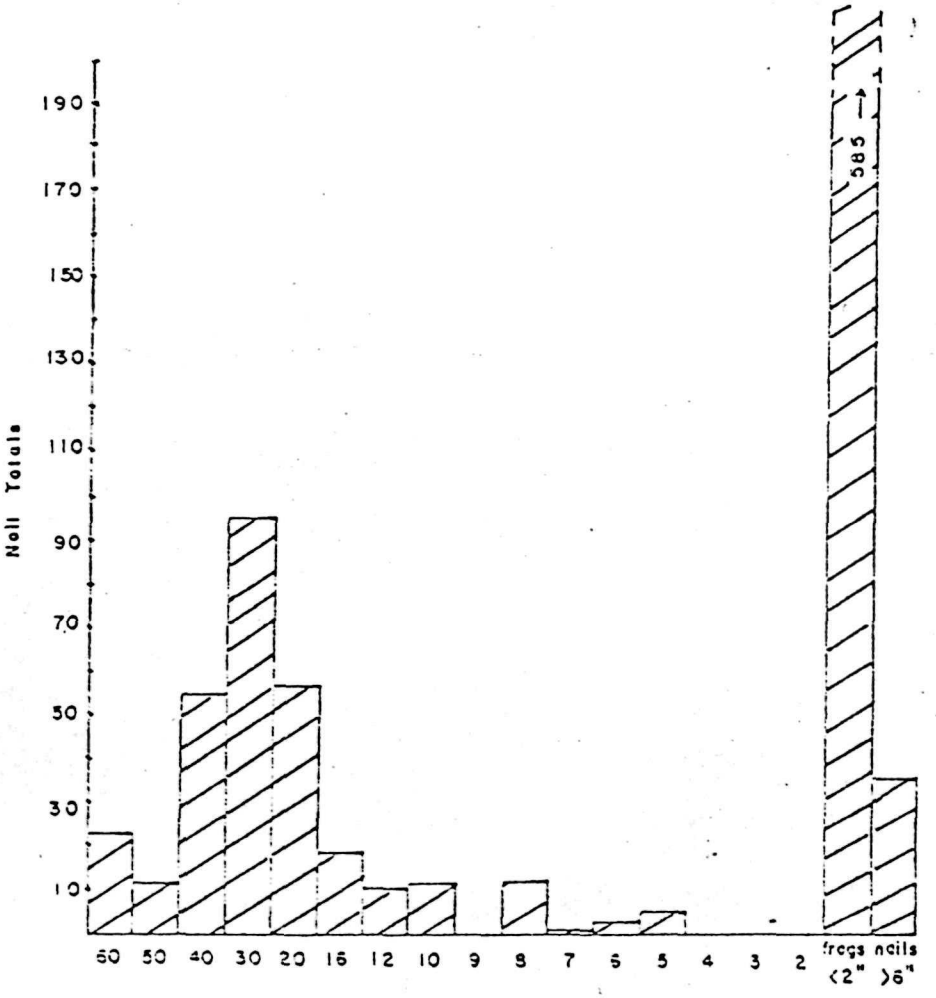
Moreover, seventy-seven percent (445) of those nails classified by pennyweight were between 6d and 10d in size. Of these, all but one percent (eleven nails) were either 6d, 8d, or 10d, 6d being the most common, 219 in all, (see Figure 6 and Plate 7). This is in accordance with what we would expect to recover of the material remains of a wooden structure, especially given the small size (eleven foot by twelve foot) of the foundation. In other words, the structure itself was rather small, and its construction did not require the use of larger nails.

It is also interesting to note that the next largest cluster of nail



FOUNDATION Nail Totals for Strata A and B, Features 5 and 6

FIGURE 6



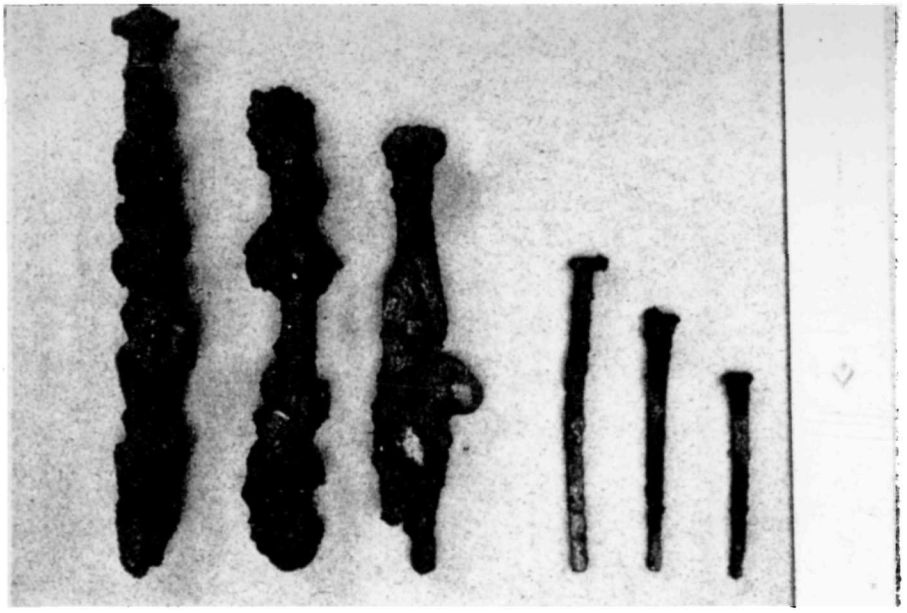


PLATE 7 COMPARATIVE PHOTOGRAPH OF THE PREDOMINANT NAIL SIZE FREQUENCIES FROM THE DRY DOCK (LEFT) AND THE FOUNDATION (RIGHT). ALSO COMPARE THE CONDITION OF THE NAILS FROM EACH

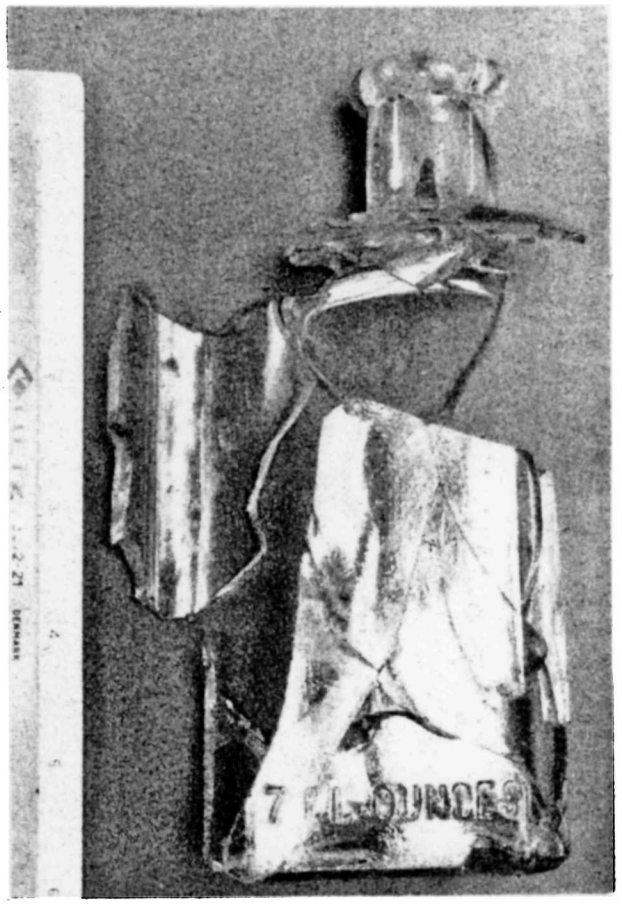


PLATE 8 BOTTLE FROM N30 E20 STRATUM 1

sizes at the foundation was between 20d and 40d in length. I suspect it is not a coincidence that the second largest length cluster at the foundation mirrors the predominant length cluster in the dry dock. This is reflective of a hypothesis, mentioned earlier, that the structure probably served as a storehouse for the materials utilized in the dry dock operation. An equally tenable explanation, however, is that this length cluster of nails is the material remains of the larger structural members of the building. It is safe to suggest that both of these hypotheses about the patterning are probably correct, but that the former is more important.

Classification of the nails beyond just their pennyweight was also done on those nails from the foundation. As already stated, the poor condition of the nails in the dry dock made it impossible to distinguish between wire and machine-cut nails.

What was discovered at the foundation was that seventy-eight percent (451) of the typed nails were machine-cut as opposed to wire nails. This serves to further confirm our suggested date of construction for the structure of at least 1896, though it does so indirectly. That is, machine-cut nails manufactured after 1830 are virtually indistinguishable from those made today; so no further information was to be gained from a study of them. However, wire nails did not appear until the latter part of the nineteenth century (Nelson 1968). Further, their replacement of machine-cut nails as the dominant form was slow, apparently because of the greater holding power of the machine-cut nails. In fact, Nelson points out that wire nails, though readily available and becoming the dominant nail used in the late 1890s, were still ignored by many builders whose preference for machine-cut nails lasted well into the twentieth

century. The predominance of machine-cut nails in this foundation is reflective either of that preference or of the unavailability of wire nails. In either case, though especially the latter, it suggests our conjectured date for the structure is probably correct.

The final analysis done on the nails was chi square test to examine whether the nail patterning was reflective of the soil strata in which it was found. Since this analysis dealt more directly with the interpretation of the soil depositional activities, it will not be discussed here but in the soils section.

GLASS

There was a total of 239 bottle and window glass fragments found in the dry dock and foundation. The tabulations of these window and bottle glass fragments by stratum and square is presented in Appendices 1 and 2. Only the dominant patterns which emerged from a statistical analysis of these fragments will be discussed here together with a short discussion of the three glass pieces which yielded historical information.

Of the 111 glass fragments found in the dry dock basin, there was a fairly even distribution between bottle glass fragments (fifty-four percent or sixty fragments) and window glass fragments (forty-six percent or fifty-one fragments).

This was not the case with the 148 glass fragments found in the foundation. There, window glass fragments accounted for almost ninety percent (133) of the total. Also, the size of the window glass fragments from the foundation was, on the average, larger than the size of those window glass fragments from the dry dock.

The obvious explanation for these patterns is that a window on the structure fell in during the razing, or perhaps during the use of the building (the latter is feasible since almost half of the window glass - sixty fragments - was found in Stratum B, the lower of the two strata. The dry dock basin had no such immediate source of window glass, and therefore its fragments are expected to be smaller and less numerous, as they were.

One might have expected that the foundation would have yielded more bottle glass than it did, and certainly more than the dry dock did, but it did not. The explanation to be offered is, again, that the structure was only a limited use wait house and storehouse whose function did not include the use or storage of bottles.

The window and bottle glass fragments in the dry dock can best be explained as a result of random deposition from a variety of sources, whether from boat or from land. Yet it would seem unwise to throw glass into a working area. Perhaps on this premise we might examine the patterning of the glass fragments by strata as an indicator of dry dock use or disuse. Of the 111 glass fragments found in the basin, seventy-three percent (eighty-two fragments) were found within Stratum A, twenty-four percent (twenty-seven fragments) in Stratum B, and the remaining two fragments in Stratum C. This seems to provide supporting evidence for the hypothesis (that will be proposed in much more detail in the soils section) that Stratum A materials were deposited in the basin during the gradual decline in use of the dry dock.

The two glass pieces, and the one near-complete glass bottle which were subject to the more detailed historical analysis, did little to confirm the above conjectures, though they did provide reasonable dates.

The bottle, found in Stratum A of N30 E20 (in the dry dock basin), is made of clear glass with diagonal corners and two seams which were erased halfway up the neck. The height of the bottle is six inches and the width is 2 3/4 inches. There is lettering on the side near the base which reads, "7 FL. OUNCES." A lipping devise was used in the manufacture of the bottle which means the bottle was made sometime after 1850 (Lorrain 1968:43), (see Plate 8).

A bottleneck and lip was found in Stratum C of N20 E25 (also in the dry dock basin) which also exhibits the use of a lipping device giving it a comparable date of manufacture with the bottle above. The use of lipping devices continued up until at least 1903 with the invention of the automatic bottling machine. It is safe to assume that their use continued sometime after 1903 (see Plate 9).

The final glass artifact is a white translucent Mason jar cap fragment found in Stratum A of N30 E20. There is lettering around the rim edge which reads "NE ZINC C." This is a glass lid for a zinc-capped jar, an artifact which appears after 1868 (Munsey 1970:46, Plate 10).

COINS

Two coins were found during the excavations. A 1907 Indian Head penny was found in Stratum B, Level 2 (.8 feet to .9 feet below surface) of N27.5 E70 in the dry dock. A 1917 "Mercury" dime was found in the northwest quadrant of the foundation in Stratum A, Level 3 (.2 feet to .3 feet below surface). Each coin, because of its stratigraphic position, serves to indicate at least a terminal date of use/occupation for the dry dock and the foundation (see Plates 11 & 12).

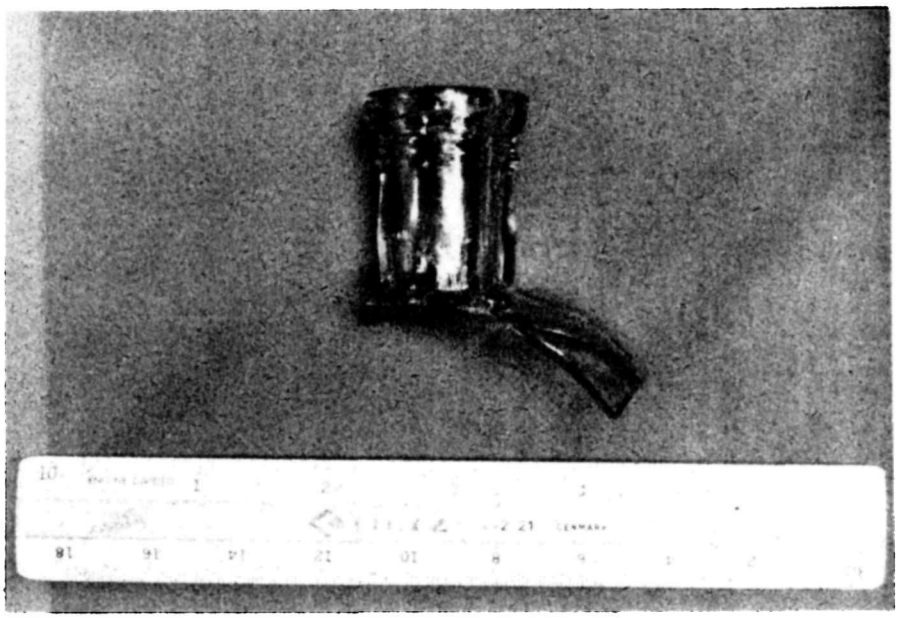


PLATE 9 BOTTLENECK FROM N20 E95 STRATUM C

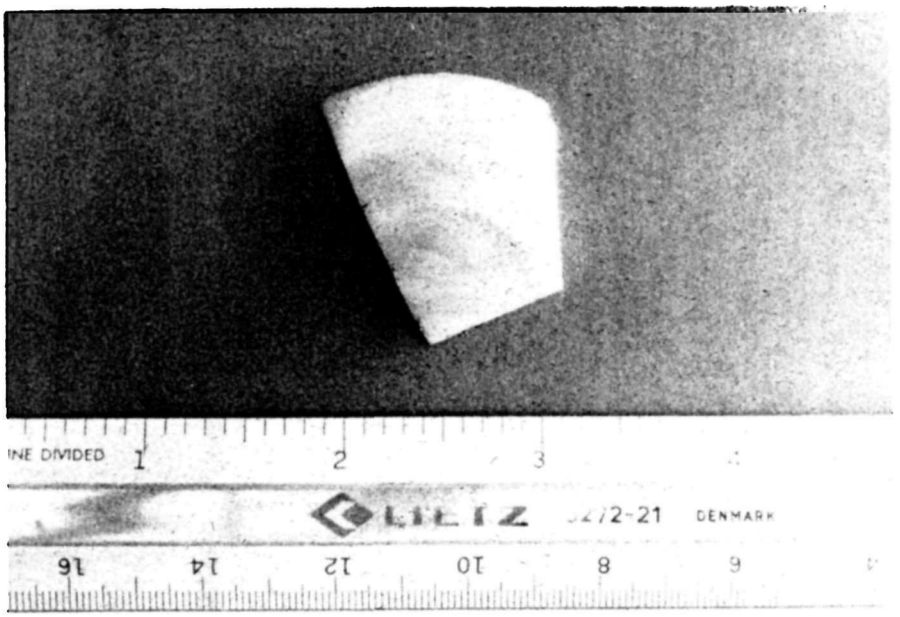


PLATE 10 MASON JAR FRAGMENT FROM N30 E90 STRATUM A

TOOLS

There were a number of tools found during the excavations at the foundation which led to the supposition that the structure as well as being a wait house might also have been a tool shed.

The most striking example is a valve key, a four-foot long iron wrench. This wrench was once used to open the valves on the lock gates; it also fits nicely over the existing bolts which hold the iron straps (which once held the lock gates) on the lock walls, (see Plates 13 & 14).

Other tools included a two-pronged (fifteen inch long) iron pitchfork and a fifteen inch long, iron gaff hook both without their wooden handles. The former is used to move hay; the latter to move logs. Both are commodities that were in use on the canal. The gaff hook might also have been used to position the boats in the dry dock. Both of these artifacts were conserved by electrolytic reduction, (see Plates 15 & 16).

CLAY SMOKING PIPES

Two clay pipe stem fragments were found: one in the dry dock basin in Square N30 E20, Stratum B, Level 1 (.75 feet to 1.0 feet below surface); the other in the southwest quadrant of the foundation, Stratum B, Level 1 (.3 feet to .4 feet below surface).

The stem fragment from the dry dock basin is approximately two inches in length, undecorated, and has a bore diameter of 6/64 inches.

The stem fragment from the foundation is decorated with two rows of oak leaves and raised ridges circling the stem. There are also lettered panels which read, "PET" on one side and "NI" on the other. Townsend in his report on the Abner Cloud House-Archeological Excavations illustrates a stem fragment with an identical marking (Townsend 1976:Plate 27)

PLATE 11 OBVERSE VIEW OF INDIAN HEAD PENNY AND MERCURY DIME

PLATE 12 REVERSE VIEW OF INDIAN HEAD PENNY AND MERCURY DIME

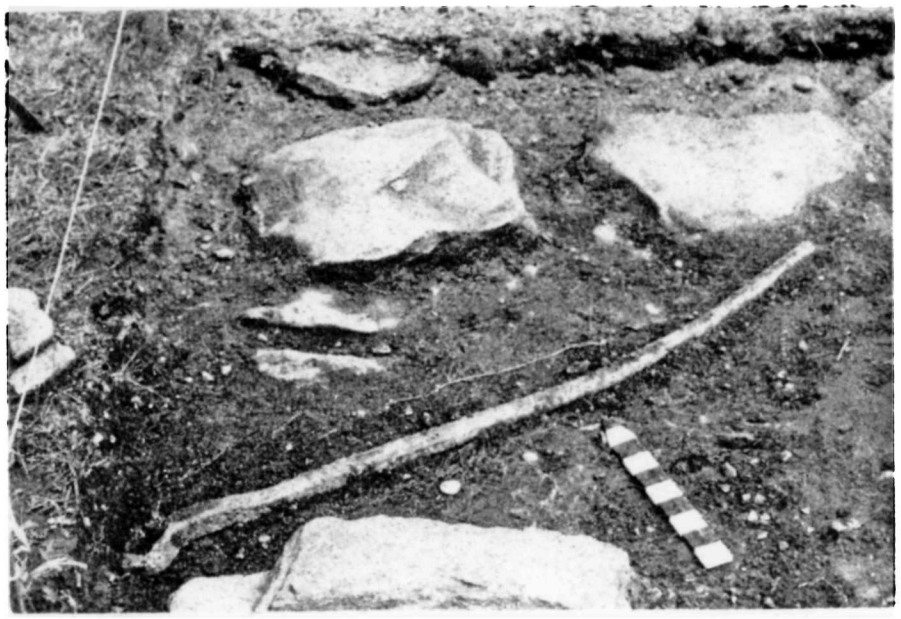


PLATE 13 VIEW OF VALVE KEY IN SITU

PLATE 14 SUZANNE SIEGEL DEMONSTRATING ONE OF THE USES OF THE VALVE KEY

and quotes Omwake (1965:130) as noting this type of pipe as a "PETER DORNI" (see Plates 17 & 18).

Peter Dorni was a pipe maker in mid-nineteenth century France whose pipes were imitated by Dutch manufacturers. It has been suggested by Omwake that these pipes were not readily available in the United States until the 1890s.

FIREARMS

The use of firearms is evidenced by three .22-caliber short shells found in the dry dock basin: two in N27.5 E70 and one in N30 E20. All were of a modern variety. Also found in the dry dock basin (in N30 E20) was a Winchester 12-gauge shotgun shell casing again of a modern variety.

Of more interest is a .38-caliber cartridge found in the northwest quadrant of the foundation (in Stratum B, Level 1). The base of the cartridge is labelled thus: "U.M.C.," ".38," "S & W." The "U.M.C." stands for the Union Metallic Cartridge Company. The "S & W" for Smith and Wesson. The Union Metallic Cartridge Company was using this stamp on its shells after 1867 and at least up until its merger with the Remington Firearms Company in 1912 (from conversations with Remington representatives, by Douglas Comer and Dawn Cifani), (see Plate 19).

MISCELLANEOUS

The excavation of historic sites usually yields substantial quantities of historic ceramics. This was not the case in either the dry dock basin or the foundation. A total of two earthenware rim sherd fragments were found, neither incongruous with our suggested dates of use and occupation of these areas (see Plate 20).

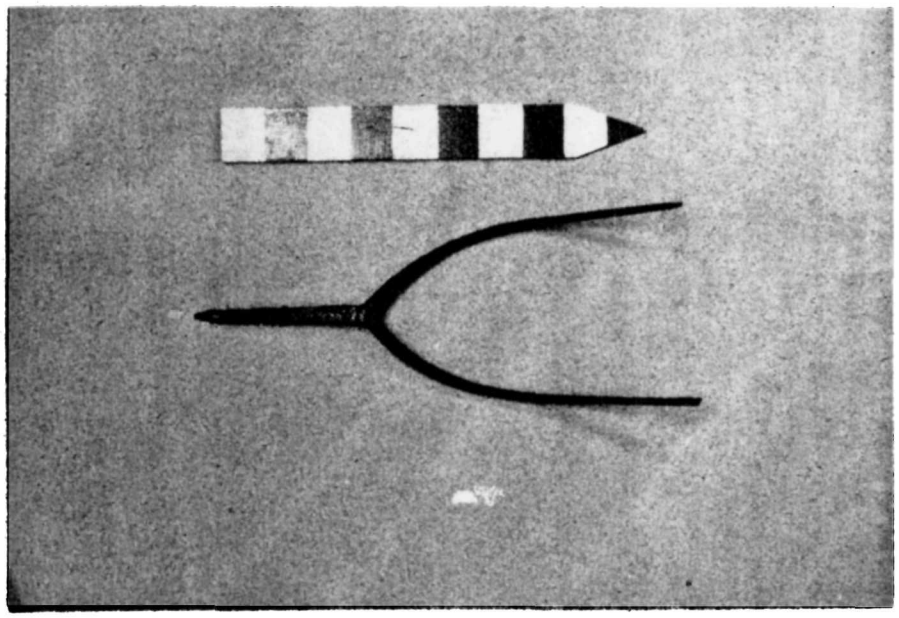


PLATE 15 PITCHFORK FROM THE FOUNDATION

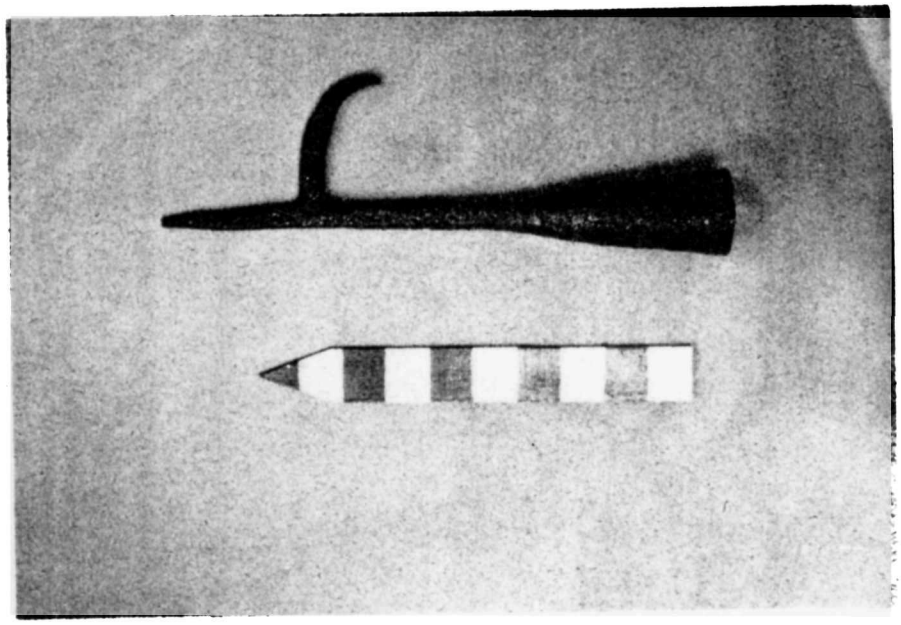
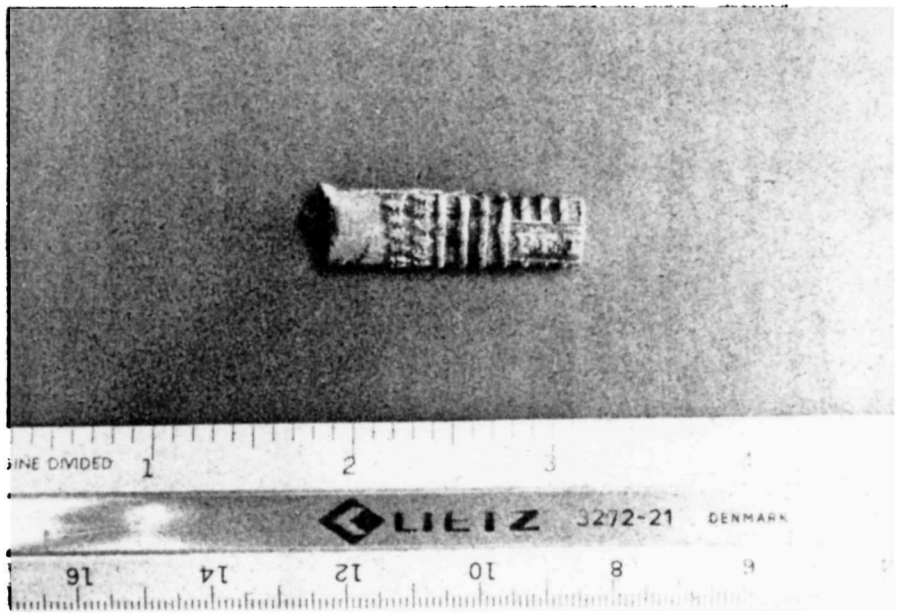
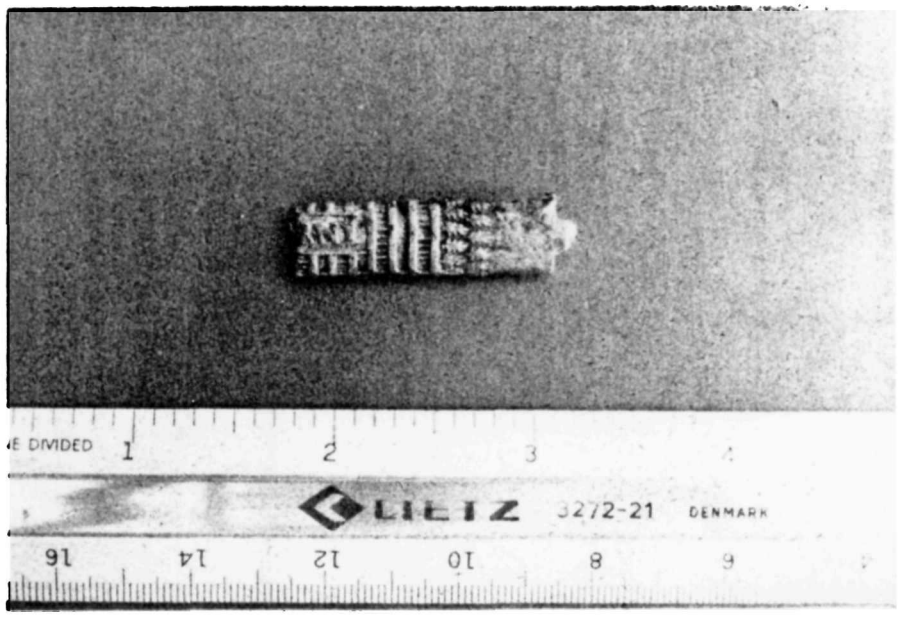


PLATE 16 GAFF HOOK FROM THE FOUNDATION



PLATES 17 (ABOVE) AND 18 (BELOW) PETER DORNI PIPE STEM FRAGMENT



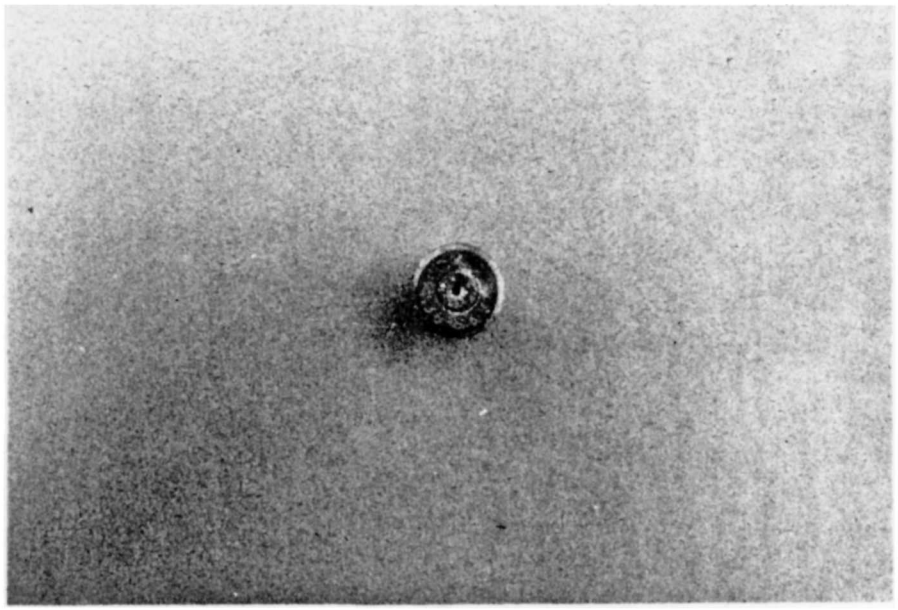


PLATE 19 CLOSE-UP OF .38 CALIBER SHELL: NOTE "U.M.C.", ".38", "S.&W."

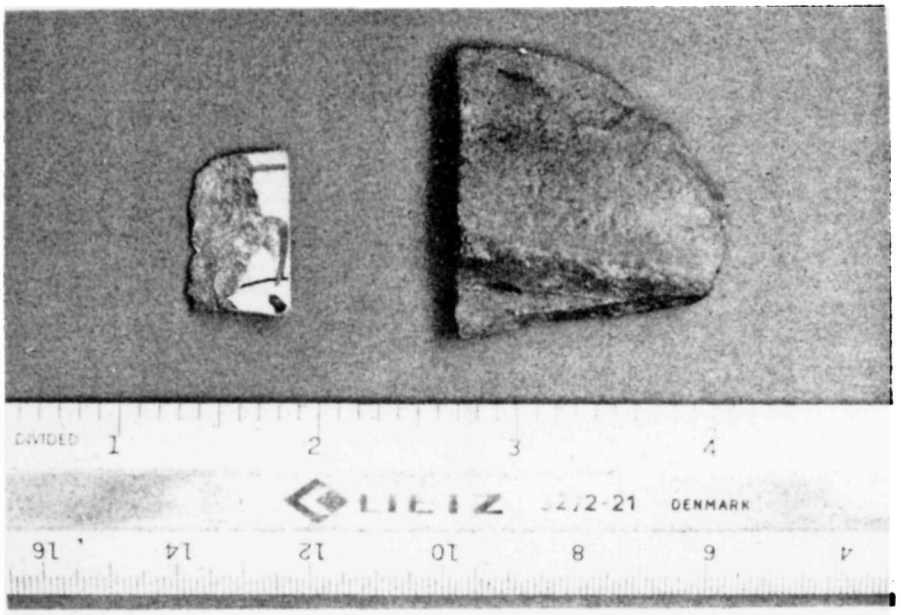
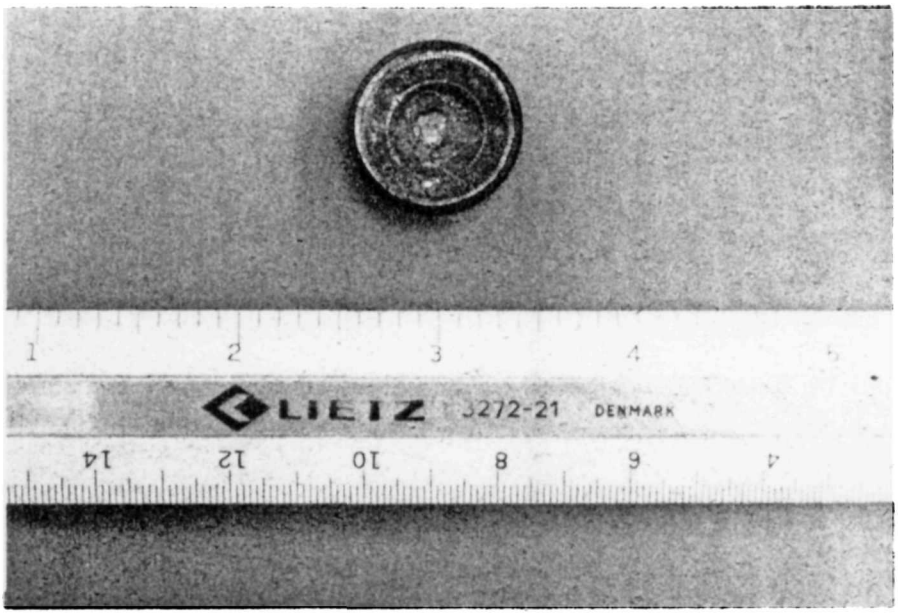


PLATE 20 BOTH CERAMICS FROM THE EXCAVATION

Six buttons were found: three shell, two glass, and one brass. The brass button exhibits the motto "EXCELSIOR" and a military looking insignia on the front; it has the lettering "EXTRA" on the back. The "EXTRA" refers to a technique of eyelet manufacture which postdates 1830. This technique, the use of soldering to affix the eyelet, was such an innovation that all buttons made with it proclaim it (i.e., extra quality), (Olsen 1963), (see Plates 21 & 22).

PLATES 21 & 22 OBVERSE (ABOVE) AND REVERSE (BELOW) VIEWS OF BUTTON: NOTE "EXCELSIOR" AND INSIGNIA ON OBVERSE, "EXTRA" ON REVERSE



SOILS ANALYSIS - SECTION NINE

Through the utilization of both physical and chemical soil data the archeologist can, among other things: 1) discern cultural from natural depositional activities (especially important in historical archeology, e.g. in distinguishing historic grade), 2) recognize certain key elements such as phosphorus, magnesium, potassium as indicators of soil modification by human occupation (cf. Cook and Heizer 1965, Dietz 1957, VanDerMerwe and Stein 1972), 3) generate a better picture of the age relationships between the archeological and pedological materials (cf. Foss 1974).

The major objective of this phase of the analysis and report was to interpret some of the chemical and physical characteristics of the soils in the excavation areas. Specifically, this was done to understand the depositional processes within the dry dock itself and to attempt to correlate and explain the artifact patterning with those processes.

The actual soil analysis was carried out in two phases. The first was the determination of the physical characteristics of the soils. This is the delineation of the percentages of sand, silt, and clay in the samples, the soil texture. This phase of the analysis was done by the author at the University of Maryland Soils Teaching Laboratory utilizing the hydrometer method, as outlined by Agronomy Mimeo no. 37, University of Maryland (Bandel and Rivard 1975:16-19).

The second phase of the analysis was the determination of the chemical constituents, the measure of the amounts of phosphorus, magnesium and potassium, and the determination of the soil pH. This analysis was done

by the University of Maryland Soils Testing Laboratory, on their "4-Channel Technicon AutoAnalyzer II" which conducts all the test simultaneously (Bandel and Rivard 1975:1).

Soil samples were taken of each strata in all the excavation units (except for the two additional units, N33 E25, and N21 E40.5); samples were also taken of all soil anomolies and feature associations where appropriate. In all, twenty-five samples were recovered and tested.

The discussion to follow will first deal with the physical analysis results and their implications, then the chemical analysis results. Each of these sections will be more interpretive than descriptive; however, a general description of the soil strata is given in Appendix 3, and all the physical and chemical data are given in Appendices 4 and 5.

PARTICLE SIZE ANALYSIS

The premise and method of this analysis is uncomplicated. Fifty grams of the soil material to be tested is placed in a Buoyoucos Cylinder and put in solution with a mixture of Calgon (100 ml) and distilled water (approximately 1031 ml). The solution is mixed thoroughly, then allowed to rest. After a period of forty seconds the sand fraction of the soil has settled out of solution. A hydrometer is then placed in the cylinder and records the material still in suspension, the silt and clay fraction. After two hours the silt fraction has settled out of suspension and a hydrometer reading is again taken, this time measuring the clay fraction still in suspension.

The hydrometer readings which measure the grams of material in suspension are translated into percentages of sand, silt, and clay using

a standard formula correcting for temperature and Calgon solution strength. Thus:

1) /(T + R1) - C/ x 2 = % silt and clay

   100 - % silt and clay = % sand

2) /(T + R2) - C/ x 2 = % clay

   % silt and clay - % clay - % silt

   T = 0.2 (Temperature of solution - 67°)

   C = hydrometer reading of Calgon in distilled water solution

   R1 = hydrometer reading, 40 seconds

   R2 = hydrometer reading, 2 hours

The results of this analysis are listed in Appendix 4. These results serve to confirm suppositions regarding the depositional activities at the site, as well as quantify and therefore delineate anomalies noted in the field.

In terms of the former, it was hypothesized that the deposition of the three strata in the dry dock basin was successive over time. Stratum C would represent the original floor of the basin, Stratum A the most recent. The implications of this would be that a concentration or lack or artifacts in the strata would indicate use or disuse of the dry dock at certain relative time periods. It also implies that the soil strata should be relatively homogeneous since the factor varying would be time and not the depositional processes. There would be a certain amount of heterogeneity introduced and expected since soil particles settle out of solution differentially (Ruhe 1975:61); this is, of course, the main assumption

behind the hydrometer method. Regardless, the soil strata should be fairly homogeneous, and the artifact patterning heterogeneous if this hypothesis is correct.

There are two ways to test this hypothesis. One, by examining whether the soil strata are homogeneous or heterogeneous, that is whether the changes in particle size between the strata are statistically signfficant. This has to be done empirically since it is difficult to judge relative homogeneity or heterogeneity simply by observation. Unfortunately, though we have adequate data for soil profile descriptions, we are lacking the requisite number of samples to test the changes statistically.

The second method of testing would be to examine whether the artifacts varied or exhibited heterogeneity through the profile. There are adequate numbers of artifact counts to make this test feasible and statistically significant.

Therefore, a chi square test was performed on the nail counts from each strata of each square in the dry dock (after Comer 1977). Nail counts were used because they were the most numerous artifacts and would provide an adequate sample number; they were also used because they were the best indicators of the dry dock use and activities.

Both nail and nail fragment counts were used since it was felt that each varied in accordance with the other. In other words, increased nail fragments counts would be just as indicative of increased dry dock use as increased nail counts.

The null hypothesis tested (Ho) was that the artifact patterning was not related to the soil strata, and that there was no variance in the frequencies between strata. Thus: $\underline{O}$ = observed nail count
E = expected nail count

	N20 E25	N27.5 E70	N30 E20	N32.5 W17	Total
Stratum A	$\frac{16}{53.35}$	$\frac{46}{64.6}$	$\frac{130}{76.76}$	$\frac{16}{13.2}$	$\underline{208}$
Stratum B	$\frac{194}{158.76}$	$\frac{236}{192.26}$	$\frac{146}{228.4}$	$\frac{43}{39.52}$	$\underline{619}$
Stratum C	$\frac{27}{24.87}$	$\frac{5}{30.12}$	$\frac{65}{35.79}$	$\frac{0}{6.19}$	$\underline{97}$
Total	$\underline{237}$	$\underline{287}$	$\underline{341}$	$\underline{59}$	$\underline{924}$

If the observed frequencies (underlined in the above chart), are in close agreement with the expected frequencies (immediately below the observed values in the above chart), the differences (O - E) will be small and consequently the chi square value will be small. With a small value of chi square, we may not reject the null hypothesis. The larger the value of chi square the more likely it is that the groups (nail counts) differ with respect to the classifications (strata), and we can reject the null hypothesis.

Yet the significance of the chi square value is also quite obviously dependent on the number of observations in the data. To account for this factor we can calculate the 'degrees of freedom,' an analytic value which

reflects the number of observations which are free to vary after certain restrictions have been placed on the data (Siegel 1956:44, 106). This provides a statistical 'equalizer' between relative observations and consequently allows the calculation of the critical chi square values (absolute values).

In this example, the calculated chi square value is 168.19, and the degrees of freedom are equal to six. Using a table of "Critical Values of Chi Square" (Siegel 1956:249), we then note the extent that that chi square value is significant given those degrees of freedom. The table shows that this value of chi square is significant beyond the .001 level (the level of greatest significance). Therefore we can reject the null hypothesis of no differences between strata as indicated by nail counts.

The implications of these results for the hypothesis outlined are this: Though the artifact horizons are heterogeneous, this does not presuppose that the associated soil horizons are heterogeneous. However, we can make the assumption that soil strata deposited over time will exhibit heterogeneous artifact distribution. One should have expected the distribution that was observed, therefore the hypothesis is accepted.

This of course leads to other conclusions. One, that the relative lack of artifacts in Stratum A probably signals the gradual decline and ultimately abandonment of the dry dock, prior to the abandonment of the canal in 1924. That is, there was sufficient time after the period of intensive dry dock activity (exampled by Stratum B) that the source of

the artifacts was declining while the source of the sediments was not, and Stratum A was deposited.

The second conclusion is that Stratum B exhibits the period when the dry dock was in its relatively fullest operation. That is, the predominance of the nails and nail fragments in Stratum B is a substantial indicator of intensive use.

The final conclusion is that Stratum C was probably the original floor of the dry dock, since the artifact deposition just begins within that stratum. This is further corroborated by the depth of the existing dry dock walls. In other words, the base of the walls are approximately 1.9 feet below the surface, and Stratum C extends to the same level; Stratum C is probably the material in which the dry dock walls were orginally set and buried. Evidence from the soil chemical analysis also supports this conclusion.

Particle size analysis of the soils associated with Feature No. 3 partly delimit what seems to have been a builder's trench from the Feature. In Square N32.5 W17, where the Feature was located, there was a distinct difference in soil compaction and moisture retention between the east and west (adjacent to the Feature) halves of the square. Accordingly, soil samples were taken in each half of the square in both Stratum B and C to examine whether those differences noted in the field were significant or differed in other respects in the laboratory.

Again the laboratory results could not be tested statistically. However, they did seem to indicate some definite differences between the halves. As

was expected, the sample from the east half (which in the field was less compact and generally moister than the other half) had higher percentages of sand than the west half (which at times seemed to exhibit hardpan characteristics - high compaction and irreversible drying upon exposure to the air).

That there was also a clear, almost straight line dividing the two halves suggests that these soil patterns were the result of artificial rather than natural processes. In other words, the soils of the west half of the square were probably created when they dug a trench to lay in the wood sill (Feature No. 3); the soils in the east half were the natural strata, not unlike the remainder in the dry dock basin.

This means that Feature No. 3 was probably the base of the sill rather than the remains of a stop gate which had simply fallen down. The latter could not create the soils found in association with the Feature.

Within the foundation the particle size analysis clearly delineates the Stratum A/Stratum B interface. There is a marked increase in the sand content and a decrease in the silt and clay contents between the strata. The source of the soil materials is most probably historical fill since there is no evidence of <u>in situ</u> soil development (i.e., an illuvial or eluvial horizon), and since the chance for colluvial (down slope) and alluvial (river) deposition was slight, except for the occasional floods, though they left little evidence in these soils.

In this case, a chi square test (again using nail counts) will help identify strata of occupation. The null hypothesis in this test is that

there is no significant difference between the artifact counts of Stratum A and Stratum B. Thus: $\frac{O}{E}$ = observed nail count / expected nail count

	Stratum A	Stratum B	Row Total
NW quadrant	$\frac{123}{123.5}$	$\frac{28}{27.43}$	151
NE quadrant	$\frac{65}{57.2}$	$\frac{5}{12.71}$	70
SW quadrant	$\frac{320}{301.1}$	$\frac{48}{66.86}$	368
SE quadrant	$\frac{118}{144.02}$	$\frac{58}{31.97}$	176
Column Total	626	139	765

The degrees of freedom in this example were equal to three, and the chi square value was equal to 38.73. Again, as in the previous example, the value was significant beyond the .001 level. We can reject the null hypothesis that the patterning of the artifacts by strata is not significantly different. Coupling this with the obvious predominance of all types of artifact materials in Stratum A, it can be suggested that the structure was built on the Stratum B materials; and during its occupation/use, it accumulated the Stratum A horizon. This is quite reasonable since Stratum A is only .3 feet thick.

CHEMICAL ANALYSIS

The chemical analysis of the soil samples was performed by the University of Maryland Soils Testing Laboratory; the results are listed in Appendix 5.

As mentioned above, soil chemical analyses are most often used as indicators of human occupation and as a result are especially useful in delineating prehistoric settlement patterning. The analyses were done on the samples from the dry dock more for the potential information to be gained rather than to answer any specific questions. As it turns out, some of the potential was realized, and we were able to deal with some specific problems.

The total amounts of phosphorus in the average mineral soils are generally much lower than those of magnesium and potassium (Brady 1974:457). This was reflected throughout the phosphorus results save for one or two exceptions. It is these exceptions which serve as the indicators of human disturbance.

Phosphorus is only found in small amounts owing to the unavailability of native phosphorus and the marked fixation of added soluable phosphates in the soil. By comparison, high amounts of phosphorus are resultant from the decomposition of human and animal excreta, foodstuffs, and burials (Cook and Heizer 1965) and are therefore, if found in the soil, index markers for human activity. A good example of this is the phosphorus frequency in Stratum C of N27.5 E70. There the phosphorus counts of 750+ lbs./acre indicates intense human activity which corroborates the earlier

suggestion that that stratum was once the original ground surface. The other example in these results are the relatively high phosphorus counts in the foundation soil samples. Again these results are acceptable, owing to the immediate source for the phosphorus materials.

The potassium frequencies were expectably higher, though also expectably varied. That is, potassium moves readily through the soil profile as a result of leaching, and one would therefore expect high levels in the upper strata and lower levels with increasing depth. This was the observation and is best exampled by the series of samples from N30 E20 (Laboratory numbers 001-006) which were taken at .3 foot intervals from the surface to 1.8 feet below surface. The potassium frequencies ranged from 219 lbs. acre at the surface to 54 lbs./acre at 1.8 feet below surface. This was also mirrored in the foundation with counts of 330 lbs./acre in Stratum A (Laboratory number 011) decreasing to 96 lbs./acre in Stratum B (Laboratory number 013). This also serves to indicate the better drainage of soils in the foundation.

The magnesium counts were all quite high, and again this was to be expected since the area of the site is geologically limestone/dolomite rich. The only exception to these high frequency counts was where it was expected least, though this has proven to be valuable information.

The sample from Feature No. 6, a pit in the southwest quadrant of the foundation, contained what looked like large amounts of coal fragments. Magnesium is a prime constituent of coal (Clifford Stein, personal communication), and its expected presence in the Feature soil sample (Laboratory number 025), in large amounts, would give further clues to

the Feature's function. However this turned out not to be the case. In fact, the magnesium value for the sample from Feature No. 6 was the lowest of all twenty-five samples. This rules out the function of the Feature as being somehow related to coal storage or burning. The dark soil color of the pit was therefore probably organic in origin, though it is not charred wood. The function of the Feature might have been a trash pit of some sort.

The soil pH values all tended toward neutral or basic, again this being in part a reflection of the geologic parent materials. The pH values also serve as controls to assure the validity of the phosphorus, potassium, and magnesium counts. That is, all these elements have their maximum availability and therefore visibility in our soil tests in this pH range. Therefore there is little chance that an anomaly, such as the Feature No. 6 magnesium count, is the result of the pH influence.

SUMMARY AND CONCLUSIONS

The prestated goals and objectives of the excavation and analysis were basically two-fold. One was to provide an archeological resource assessment of the dry dock and the adjacent structure remains in the Lock 35 area. This was pursuant to the National Historic Preservation Act of 1966, especially Section 106. The second was to contribute information towards the historical record and towards the C & O Canal Park's Interpretive Programs. Both of these objectives are closely related.

The resource assessment attempts to compile, within a limited framework, a more complete picture of the historical activities. As a result of this, we can then begin to contribute information of a specific sort as shown by the questions asked at the beginning of this report and consequently of a general sort with regard to land management decisions.

Ways to assess whether this project accomplished its goals might include an examination of the sampling coverage, the numbers of artifacts recovered, or the number of cubic feet excavated. Yet each of these are only parts of a much larger whole. That larger whole is the understanding of the historical activities associated with the dry dock and the structure. The evidence in these pages does not provide the reconstruction of the total picture. However, we can now return to answer all the questions formulated in the introduction and perhpas even ask and answer some that were not formulated.

1. The dry dock was built around the mid-1890s. The evidence for this is the lack of its mention in the Canal Company records prior to 1889, its absence from the 1890s structures list of the canal prepared when the canal went into receivership, and its probable presence on the 1894-1896 Mackall map.

There is the possibility that since dry docks were not particularly important to the Canal Company; this one simply could have been ignored in both the Canal Company records and the 1890 structures list and thereby predate 1890. If this is the case, then it is interesting to note that the dry dock survived the devastating flood of 1889 without any trace archeologically. This flood carried away the entire towpath between Lock 33 and Lock 36, filled the nearby Guard Lock No. 3 with stone and gravel, and damaged Locks 34, 35, and 36. In fact, compared to areas downriver, this damage was slight. The archeological evidence of the flood might be in the form of a debris-laden or else sterile soil horizon. Stratum A does not qualify simply because it is above Stratum B which had an associated date of 1907; Stratum B does not qualify since it exhibits intensive dry dock activity. Stratum C is the only possible candidate. Yet Stratum C is neither debris-laden nor sterile. In fact, the dry dock wall was set into this horizon, and the evidence from the artifact and soils analyses is of cultural and not natural activities. We can reasonably reject the possibility that the dry dock predates the 1890s.

2. This means that the dry dock was not built by the C & O Canal Company but rather by the B & O Railroad Company or even more likely by the shadow

company of the B & O, the Chesapeake and Ohio Transportation Company. The evidence for this, though circumstantial, is tenable. When the B & O Railroad gained control of the canal in 1890, they were not generally concerned with maintaining its operation. The canal still was a form of competition with them for the Cumberland coal. Yet owing to a court order from the State of Maryland, they were required to repair the extensive damage of the 1889 flood, put the canal back in operation, and gain a profit. The first requirement was completed by September of 1891, and by January of 1894 they had taken steps to insure the fulfillment of the other two. This was done through the establishment of a shadow company which would take over the operation of the canal. I think it can be suggested that this company, the Chesapeake and Ohio Transportation Company, with its concern for the profit and thereby the efficient operation of the canal probably built the dry dock. I suspect it is hardly a coincidence that the dry dock which appears on the map made shortly after this company took over seems to be in its construction stages.

3. The dry dock structure as it now stands is the original structure. The speculation was that the structure was not the original and that wooden forms predated the concrete stanchions. This, of course, carried the implication that the dry dock was built prior to at least 1870 - the date of the first use of concrete on the Canal. Observation and archeological testing have not recommended the possibility of wooden precursors through a careful examination of the two proposed hypotheses and their supposed forms.

One hypothesis had suggested that the two existing indentations in the dry dock wall were exhibitive of beam holes which once housed large timbers of wood which stretched the width of the dry dock and supported the boats. This was rejected since no other similar indentations were found either existing, collapsed, or filled-in. It was also rejected because a beam stretching the width of the dry dock would have to be firmly planted in the dry dock wall, at least one foot deep, in order to support a barge. This would make it inexpedient to replace in the event it broke since that would require tearing out the wall.

The second hypothesis was that there were wooden stanchions similar to the existing concrete ones. One feature was found (Feature No. 2) which could have represented the base for such a wooden structure, but subsequent testing for another one either directly in line or adjacent to the first was unsuccessful. Therefore this too was rejected.

4. The function and use of the dry dock was for more heavy-duty repairs, though there was speculation that only light repairs (i.e., tarring and tinning) were being done. The archeological evidence for this was in the form of the 924 nails and nail fragments recovered in nine percent of the dry dock basin area excavated. That is, the large number of nails, but also the size of the nails, are indicative of major repair work. Of the nails typed in a pennyweight basis, ninety-three percent were greater than 10d in length.

The historical evidence is not so conclusive, but it is tenable and serves to verify the suggestion. Built as late as it was, the dry dock might have been the only operating structure of its kind on the canal

between Georgetown and Cumberland. This is especially likely since the previous dry docks built were in the early 1870s, twenty years and at least one devastating flood and one major economic depression prior to the construction of this one. This lack of other accessible repair areas would precipitate the need for more extensive refitting of boats at this facility.

5. The dry dock was used until at least 1907, but was probably abandoned prior to the abandonment of the canal in 1924. The central item of evidence for the former is from a 1907 Indian head penny found in Stratum B in N27.5 E70; the evidence for the latter comes from artifact frequency and soils analyses. The patterns that emerged from these analyses exhibited a stratum of early dry dock use and activity and perhaps the original floor (Stratum C), a stratum of intensive dry dock operations (Stratum B), and a stratum of the decline in use of the dry dock (Stratum A - this was evidenced by the decrease in the amounts of nails and an increase in the amounts of more nonfunctional artifacts such as glass fragments all accompanied by an increase in the sedimentation/artifact ration.

6. The structure whose foundation remains were excavated was by the historical record probably built after 1890. The historical evidence is the presence of the structure on the 1894-1896 property map and in a 1920 photograph.

The problem with attempting to date the construction of the structure solely on the basis of the historical evidence is this: As was obvious from the summary above, the structure itself was a fairly common, expectable, and perhaps even temporary structure on the Canal. These factors would

probably have mitigated against it being included on the 1890s properties list which dealt primarily with the larger, more permanent structures. Further, the archeological evidence suggests that the potential exists for it to predate the 1890s. That is, the predominant type of nail found was machine-cut (seventy-eight percent) as opposed to wire (twenty-two percent). We are suggesting that aside from the cluster mentioned above, the nails were the material remains of the building and could therefore be used to date the building. This indicates either an unavailability of wire nails or a preference for cut nails. In both cases, this suggests a construction date prior to the turn of the century and possibly before the 1890s. I am suggesting by way of conclusion that I favor a date of construction for the structure as being post-1890 rather than prior to it. This is mostly on the evidence at hand which seems to verify this rather than the conjectured evidence which must be tested in some other fashion.

7. The structure had multiple, interrelated functions. It was probably a lock keeper's wait house which served as a temporary shelter when it was inexpedient for him to return to his lockhouse 300 yards uphill. The circumstances making it inexpedient might be inclement weather or heavy lock traffic. The second suggested function was that it served as a tool shed for the implements and supplies related to the lock use as well as for the materials related to the dry dock use. The evidence, archeologically, for the former include a four-foot valve key, pitchfork, and gaff hook; the evidence for the latter was the predominance of a particular frequency of nail size at the foundation which mirrored the predominance frequency used in the dry dock.

The dry dock and structure, by the evidence presented here, were built during a fascinating period in the history of the C & O Canal. They were relative latecomers constructed on a canal which for all intents and purposes were already obsolete. They were built under the company which made the canal obsolete.

As such, they (though especially the dry dock) serve as reminders and representatives of one of the last major efforts to make the canal an important and viable link to the west. It failed. The gradual decline and disuse of the dry dock in the years prior to 1924 is only a small reflection of the decline and failure of the Chesapeake and Ohio Canal.

RECOMMENDATIONS - SECTION NINE

These recommendations are being made specifically in consideration of the General Land Use Plan for the C & O Canal Park (Parsons 1976). It is suggested that the use of this area as outlined by the Plan should not negatively affect the existent cultural resources if the guidelines presented below are followed.

The Park Plan designates the dry dock and adjacent areas Zone B status, that is Cultural Interpretive zones which have generally less intensive park activities than Zone A but do have some historical interpretation activities. Zoned as such, there would seem to be little need for any major disturbances to the area; however, in the event there is, I offer these guidelines to prevent the destruction of the significant cultural resources:

1. There should be no disturbance of the ground surface below .5 feet below surface in the dry dock basin. That is, if disturbance is unavoidable, it should not intrude into the level of intensive cultural activity which begins throughout the dry dock basin at a minimum depth of .7 feet.

2. The dry dock structure itself should not be disturbed, save for the necessary structural repairs to maintain it.

3. The foundation stones which remain in the ground and <u>in situ</u> should not be moved.

4. Ground disturbance should be avoided in the areas of land between the dry dock and the lock. This portion of land, excepting the foundation and the area surface collected , may possibly contain other structural foundations or activity areas.

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APPENDIX I

DRY DOCK

Nails	N20 E25 Strata A	B	C	N27.5 E70 Strata A	B	C	N30 E20 Strata A	B	C	N32.5 W17 Strata A	B	C	Totals Strata A	B	C	Total All Strata
60d	1	-	-	1	6	-	9	2	-	2	1	-	13	9	-	23
50d	1	2	-	-	5	-	-	2	-	-	2	-	1	11	-	12
40d	2	13	-	2	24	-	-	9	-	3	2	-	7	48	-	55
30d	1	8	-	8	12	-	52	10	1	-	3	-	61	33	1	95
20d	-	17	-	3	13	-	16	8	-	-	-	-	19	38	-	57
16d	-	-	-	-	1	-	16	2	-	-	-	-	16	3	-	19
12d	-	1	-	-	-	-	8	-	1	-	-	-	8	1	1	10
10d	-	-	-	1	-	-	-	9	-	1	-	-	2	9	-	11
9d	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8d	-	-	-	4	5	-	-	3	-	-	-	-	4	8	-	12
7d	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1
6d	-	-	-	-	1	-	2	-	-	-	-	-	2	1	-	3
5d	5	-	-	-	-	-	-	-	-	-	-	-	5	-	-	5
4d	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3d	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2d	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
frags	6	149	27	23	159	5	23	94	61	8	30	-	60	432	93	585
6"	-	-	-	3	12	-	5	7	1	3	5	-	11	24	1	36
Glass																
Bottle	12	1	1	21	6	-	8	8	1	-	2	-	41	17	2	60
Window	3	2	-	13	5	-	23	2	-	2	1	-	41	10	-	51

APPENDIX 2

FOUNDATION

Nails	Surface Stratum A	NW Quad A	NW Quad B	NW Quad A Per	NW Quad B Per	NE Quad A	NE Quad B	SW Quad A	SW Quad B	SW Quad A Per	SW Quad B Per	SE Quad Totals A	SE Quad Totals B	Totals A	Totals B	Total Both Strata
60d	-	-	-	1	-	-	1	-	-	1	-	2	1	4	2	6
50d	-	-	-	1	-	-	-	-	-	-	-	1	-	2	-	2
40d	3	1	1	5	4	1	-	5	1	4	-	18	3	37	8	45
30d	6	1	1	7	-	-	1	2	-	-	-	2	1	18	3	21
20d	3	-	-	4	-	1	1	-	-	-	2	13	1	21	4	25
16d	1	-	-	1	-	-	-	-	-	-	-	-	-	2	-	2
12d	-	-	-	-	2	-	-	-	-	-	-	1	-	1	2	3
10d	22	8	1	7	1	12	-	32	2	7	-	10	6	98	10	108
9d	4	1	-	2	-	-	-	-	-	-	-	2	1	9	1	10
8d	23	7	4	4	2	4	1	42	6	6	-	2	6	88	19	107
7d	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1
6d	29	12	-	3	1	3	-	112	6	12	6	21	14	192	27	219
5d	-	-	1	-	-	-	-	-	-	-	-	-	1	-	2	2
4d	-	-	-	-	-	-	1	3	-	-	3	-	-	3	4	7
3d	-	-	-	1	-	-	-	-	-	-	-	-	2	1	2	3
2d	-	3	-	1	-	1	-	3	-	-	-	-	-	8	-	8
frags	38	5	9	14	2	10	-	47	17	10	4	13	18	137	50	187
6"	-	-	-	1	-	1	-	1	-	-	-	1	4	4	4	8
Glass																
Bottle	-	1	2	4	-	-	2	2	-	3	-	-	1	10	5	15
Window	-	14	2	3	6	10	13	19	1	8	1	19	37	73	60	133

APPENDIX 3

There were basically three soil horizons within the dry dock basin, though their depths and characteristics varied somewhat. Presented below are their profile descriptions, as well as a composite profile description of the soil in the foundation. Also, see Figure 7, a drawing of the dry dock soil profile in cross-section taken from PROFILE 1 below.

PROFILE 1 - Composite profile of N20 E25 and N30 E20

Stratum A (0 - .75')	Very dark brown (10YR 3/2) sandy loam/sandy clay loam; abrupt smooth boundary at base of stratum.
Stratum B (.75' - 1.25')	Dark brown (10YR 3/3) to dark yellowish brown (10YR 4/4) sandy loam; high frequency of large gravels; gradual smooth boundary at base.
Stratum C (1.25' - 1.8')	Dark reddish brown (5YR 3/4) with occasional red (10YR 4/8) sandy clay loam and sandy loam; splotches of yellowish brown (10YR 5/4) loamy sands and gravels.

PROFILE 2 - N27.5 E70

Stratum A (0 - .7')	Dark brown (10YR 3/3) clay loam; abrupt smooth boundary at base.
Stratum B (.7' - 1.2')	Dark brown/brown (7.5YR 4/4) sandy clay loam; high frequency of large gravels; gradual smooth boundary at base.
Stratum C (1.2' - 1.7')	Strong brown (7.5YR 4/6) and yellowish brown (10YR 5/8) sandy loam.

PROFILE 3 - N32.5 W17

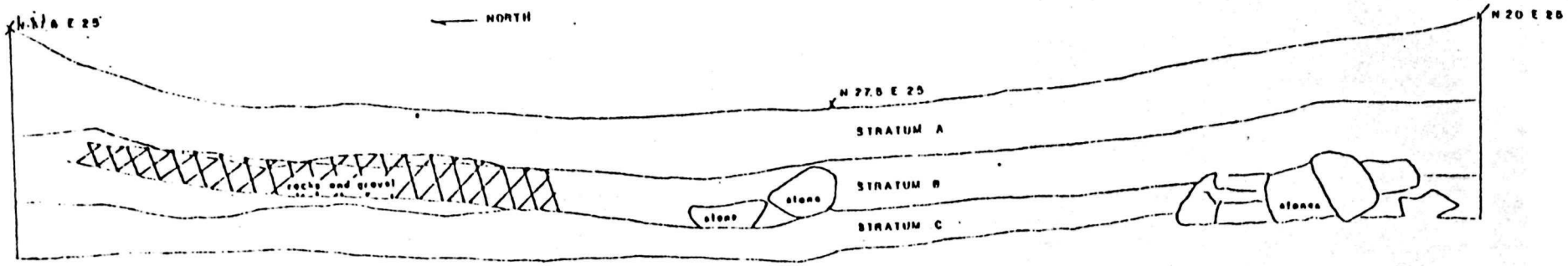
Stratum A (0 - .7')	Very dark brown (10YR 2/2) sandy loam; abrupt smooth boundary at base.

Stratum B (.7' - 1.1')	Dark brown (10YR 3/3) to dark yellowish brown (10YR 3/4) sandy loam; discontinuity (Feature 3) noted in west half; gradual smooth boundary at base.
Stratum C (1.1' - 1.5')	Dark brown/brown (7.5YR 4/4) sandy loam; discontinuity (Feature 3) noted in west half.

PROFILE 4 - Composite profile of the interior of the foundation

Stratum A (0 - .3')	Very dark brown (10YR 2/2) to dark brown (7.5YR 3/2) sandy loam; high frequency of gravels; abrupt smooth boundary at base.
Stratum B (.3' - .6')	Dark yellowish brown (10YR 3/4) to brown (2.5YR 4/4) sandy loam/loamy sand; high frequency of gravels.

FIGURE 7



CROSS SECTION of DRY DOCK SOIL PROFILE

APPENDIX 4

SOIL PARTICLE SIZE ANALYSIS

Sample Location Dry Dock	Depth	Lab #	% sand	% silt	% clay	Textural Class
N30 E20	0-.3'	001	53	31	16	Sandy loam
	.3-.6'	002	53	28	19	Sandy loam
	.6-.9'	003	69	16	15	Sandy loam
	.9-1.2'	004	67	16	17	Sandy loam
	1.2-1.5'	005	53	19	28	Sandy clay loam
	1.5-1.8'	006	59	20	21	Sandy clay loam
	Str. A	007	49	26	27	Sandy clay loam
	Str. B	008	47	20	33	Sandy clay loam
	Str. C	009	61	18	21	Sandy loam
	Str. C L2	010	71	28	19	Loamy sand
N27.5 E70	Str. A	022	35	36	29	Clay loam
	Str. B	023	57	22	21	Sandy clay loam
	Str. C	024	63	18	19	Sandy loam
N32.5 W17	Str. A	016	61	24	15	Sandy loam
	Str. B (E)	017	63	18	19	Sandy loam
	Str. B (W)	020	55	24	21	Sandy clay loam
	Str. B (W)	021	55	26	19	Sandy loam
	Str. C (W)	018	55	24	21	Sandy clay loam
	Str. C (E)	019	71	14	15	Sandy loam
Foundation						
NW Quad	Str. A Perimeter	011	63	24	13	Sandy loam
	Str. A L2	012	67	20	13	Sandy loam
SW Quad	Perimeter Str. A L3 (west)	014	63	20	17	Sandy loam
	Perimeter Str. A L3 (south)	015	77	14	9	Sandy loam
NW Quad	Str. B	013	79/81	12/8	9/11	Sandy loam/loamy sand
SE Quad	Fea. #6	025	71	14	15	Sandy loam

APPENDIX 5

SOIL CHEMICAL ANALYSIS

Location Dry Dock	Depth	Lab #	Phosphorus lbs/acre	Potassium lbs/acre	Magnesium lbs/acre	ph
N30 E20	0-.3'	001	15	219	300+	6.4
	.3-.6'	002	15	96	300+	6.6
	.6-.9'	003	15	66	300+	7.0
	.9-1.2'	004	10	57	300+	7.0
	1.2-1.5'	005	10	60	300+	7.0
	1.5-1.8'	006	10	54	300+	6.7
	Str. A	007	15	135	300+	6.9
	Str. B	008	15	108	300+	7.1
	Str. C	009	10	69	300+	6.9
	Str. C L2	010	15	54	300+	7.0
N27.5 E70	Str. A	022	15	87	300+	7.2
	Str. B	023	45	75	300+	7.4
	Str. C	024	750+	36	300+	7.6
N32.5 W17	Str. A	016	15	84	300+	6.4
	Str. B (E)	017	10	63	300+	6.4
	Str. B (W)	020	15	78	300+	6.4
	Str. B (W)	021	15	78	300+	6.2
	Str. C (W)	018	10	48	188	5.1
	Str. C (E)	019	10	60	214	5.6
Foundation						
NW Quad	Str. A Perimeter	011	180	330	300+	6.6
	Str. A L2 Perimeter	012	65	102	300+	7.2
SW Quad	Str. A L3 (west) Perimeter	014	55	84	300+	7.8
	Str. A L3 (south)	015	105	72	300+	7.5
NW Quad	Str. B	013	50	96	300+	7.6
SE Quad	Fea. #6	025	260	69	122	7.9

PLATES

NOTE: All photographs, with the exception of Plate 3, were taken by the author. Plate 3 is from a series of photographs made by The Consolidation Coal Company, circa 1920; the Copy negative is held by the Superintendent, GWMP-PWFP.[1]