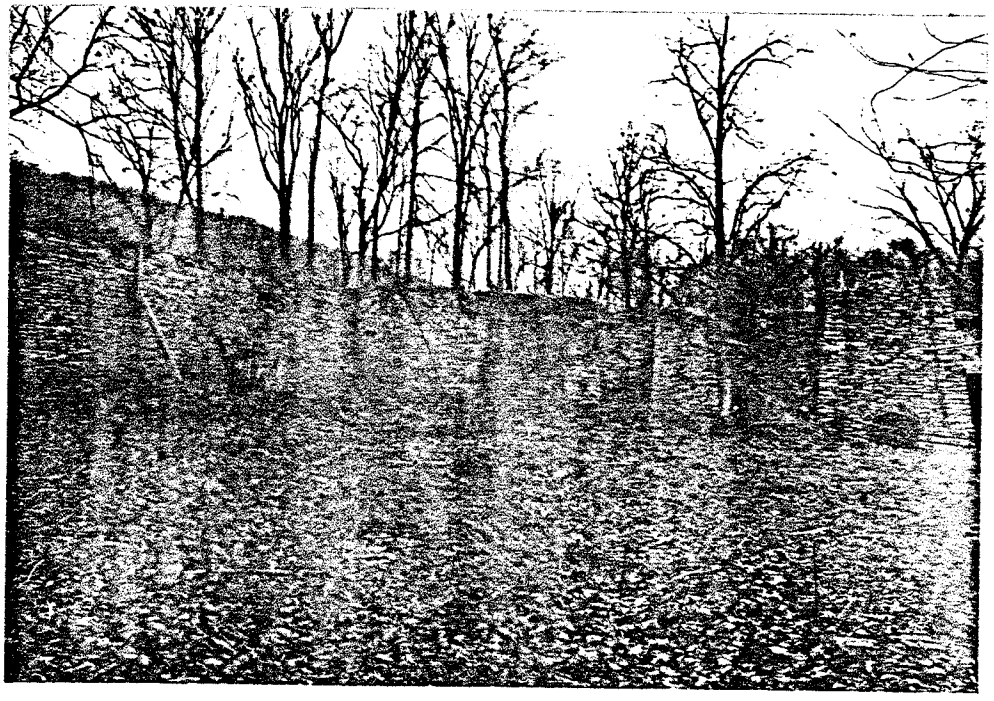
CATOCTIN FURNACE

Construction History of the Retaining Wall



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A Design Program for the
Investigation, Repair and Stabilization of the
Retaining Walls and Furnace Stack at
Catoctin Iron Works
Cunningham Falls State Park

A Report Concerning

The Construction History of the Stone
Retaining Walls and Furnace Stack

Prepared for

The State of Maryland
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by

Douglass and Paula Reed of Preservation Associates, Inc.
Kurt Cushwa of Design/Build
49 North Potomac Street
Hagerstown, Maryland 21740

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ACKNOWLEDGEMENTS

The 1984-85 research and investigation of the stone retaining walls and furnace stack of the Catoctin Iron Works, located within the Cunningham Falls State Park, was the product of the efforts of a number of individuals. Kurt Cushwa of Design/Build Architects, Douglass C. Reed of Preservation Associates, Inc., and Daniel A. Matonak of Fellows, Read and Associates, Inc. were primary investigators of the structure. Mr. Cushwa was the overall project coordinator specifically responsible for the design solutions to stabilize the retaining wall. Mr. Reed, along with Paula Reed and Michael Gioulis, executed the documentary research and Mrs. Reed undertook the synthesis of a large body of previous research and collated it into the present report. Mr. Reed and Mr. Gioulis performed the on-site analysis of the construction techniques and took the necessary photographs. Mr. Matonak was responsible for surveying the present standing conditions of the walls which Mr. Cushwa then transferred to the drawings. In consultation with Mr. Matonak and with some help from Mr. Reed, Mr. Cushwa developed the design solutions and cost estimates presented to the State.

Without the aid of many important people in the research effort, the project would never have gathered as much information as it has. The Department of Natural Resources was of the greatest help during the research effort. The Department's historian, Mr. Ross Kimmel, provided volumes of previous research and associated works concerning the Catoctin

Furnace. In addition, Mr. Kimmel spent some time looking for older photographs of the wall.

The park staff at Cunningham Falls State Park was of utmost importance. Their cooperation and enthusiasm will always be remembered. William Miller, the park superintendent allowed a free hand and access to all parts of the walls and furnace complex. Shortly after the project participants convened their first meeting at Cunningham Falls State Park, the park staff kindly and thoroughly cleared the lower levels of the grounds at the foot of the wall for the purposes of measuring and photographing the walls better.

Mr. William Renner, of Catoctin Furnace, visited the site while the photography was underway. His knowledge of the actual workings of the furnace complex and how the other buildings and work of the furnace was associated with the wall was most helpful.

The working relationship between the three principal firms was always very cordial. The primary participants gave freely of their time and expertise to insure the end product was of the highest quality.

A preliminary version of this manuscript was submitted for critical review of Mr. Ross Kimmel of the Department of Natural Resources. His review made a valuable contribution to the end product.

Chapter 1

Introduction

The Catoctin Furnace iron producing complex has been the subject of numerous historical and archeological investigations over the past 15 years. Many of these examinations would seem to have overlapped, stating and restating data and analysis from the meagre documentation available. Written and physical records pertaining to the actual appearance of the complex in its early days are scarce, although excellent photographs are extant showing the iron operation during the late 19th century. The multiplicity of reports, each giving its own interpretation of the history and early appearance of the complex has become a large and confusing body of information.

The purpose of this report is to describe and analyze the original appearance and configuration of the retaining wall located behind or to the west of the site of the three furnace stacks that operated at Catoctin, and the one remaining furnace stack. Information from the preceding reports will be synthesized and combined with new analysis in preparation for restoration of the walls.

Chapter 2

The Wall Construction

It is easy to overlook the importance of the retaining walls to an iron making complex such as Catoctin. The more important features would appear to be such structures as furnace stacks, casting houses as well as remnants of ore trenches, iron castings and other artifacts illustrating the iron industry. The retaining wall, however, was an integral part of the iron operation.

Iron furnaces, like lime kilns required that raw materials be inserted at the top and the product be drawn off at the bottom. With iron production, iron ore, charcoal or coke (the heat source) and limestone (to collect impurities in the ore) were loaded into the furnace from its top. Then, molten iron and its by-product, melted impurities called slag were collected at the bottom.[1] Obviously, some sort of structure was needed to allow great quantities of material to be taken to the top of the furnace. Therefore, furnaces were generally constructed against steep slopes or embankments so that the bi-level work area could be achieved. (Refer plates 3 & 4). Typically a natural slope would have to be molded or increased with fill so that the proper height would be present. Creating or manipulating such contours in relative height of a slope required that a retaining wall should be built to hold the fill in place.

The retaining wall at Catoctin Furnace is approximately 22 feet high and 200 feet long. It is constructed of native sandstone indigenous to the adjacent mountains. The stones forming the face of the wall are coursed with horizontal joints

aligned at fairly regular intervals. The face stones have also been cut vertically into rectangular blocks. (Refer plate 5). The wall has been measured to be four to five feet thick at the base and more than two feet thick at its top.

Several reports pertaining to the Catoctin Furnace site refer to the retaining wall as "dry-laid." The first mention of the walls as having been laid without mortar appears to be in the 1974 Catoctin Furnace Stabilization Study which contains a detailed analysis of the walls.[2] However, to the contrary, the walls were not laid without mortar, but rather were constructed in a fashion typical of the 18th and 19th centuries in the Mid Atlantic Region. Investigations conducted for this report in late 1984 revealed that the wall was indeed mortared and pointed.

As was typical of stone construction in the 18th and 19th centuries, the rocks were cushioned by a soft bedding of clay or naturally oxidized silacious material combined with lime. (Refer plates 2 & 17). The purpose of the bedding (the interior mortar) was not, as usually construed, to bind the stones together, but rather to hold them apart. The mortar acts as a shock absorber to cushion the stones during movement of the wall caused by thermal changes and freeze-thaw action.[3] Soft mortars such as this were used predominately until the late 19th century when hard cement mortars were introduced. The principle behind the use of hard mortars is opposite that of soft mortars. A hard cement-mortared wall depends upon rigidity for its structural stability while a soft mortared wall depends upon flexibility.[4]

In rehabilitation of historic masonry walls, confusion of these two principles frequently leads to the use of inappropriate mortars and, consequently, significant damage to walls.

The typical method of preparing lime mortars was to dig a pit in the ground, put quicklime in the bottom and pour in water to allow the lime to "slake." The slaked or hydrated lime was then allowed to stand until needed, either at once or covered in the pit for several months or years. When the hydrated lime, also called "lime putty" was needed, the appropriate amount of clay and or sand was added and mixed thoroughly as described below:

> Before the mortar is used, it should be beaten three or four times over, so as to incorporate the lime and sand, and to reduce all knobs and knots of lime that may have passed the sieve. This very much improves the smoothness of the lime, and by driving air into its pores, will make the mortar stronger: as little water is to be used in this process as possible. Whenever mortar is suffered to stand anytime before used, it should be beaten again so as to give it tenacity, and prevent labor to the bricklayer. In dry hot summer weather use your mortar soft; in winter, rather stiff. In laying bricks (or stone) in dry weather.....wet your bricks (or stones) by dipping them in water, or by causing water to be thrown over them before they are used.[5]

A wall constructed with soft mortar would generally be finished with nearly pure lime pointing. The pointing might extend to a depth of one inch in the wall with its outside surface tooled with the trowel to a wedge or inverted "V" for a stone wall.[6] The lime which hardened with exposure protected the inner, softer mortar from moisture penetration which could cause it to leach out and eventually lead to failure of the wall. If

the soft mortar were to leach out of the stone wall, the rocks would collapse upon one another, causing the wall to bulge or bow and ultimately fall down.

The fallacy of the dry-laid theory regarding the retaining wall at Catoctin Furnace probably results from the fact that the original pointing has failed, fallen away and has allowed mortar to wash out, giving the wall the appearance of being dry laid. Fortunately for researchers examining the site in 1984 for this report, small areas of lime pointing remain intact as shown in plates 5, 6, 12, & 13.

During this examination, it was revealed that the entire series of walls at Catoctin Furnace were fully bedded in soft mortar from base to cap. The standing 1856 "Isabella" stack and the presumed remnants of the 1787 stack were similarly bedded. Likewise, all of these features were pointed with a much harder high lime content mortar. The walls were searched carefully for undisturbed areas of bedding mortar. Samples from three areas of the wall were gathered for a standard inorganic analysis by a chemical engineer from the firm of Thompson-Lichtner Company, Cambridge, Massachusetts. Samples of the pointing mortar were also retrieved from the face of the wall. It was difficult to find undisturbed pointing. There are perhaps only four or five areas in the entire wall system where the pointing has not been eliminated by more than a century of exposure and lack of maintenance.

The few areas found that still retain their original pointing in relatively good condition were photographed to record the pointing techniques. The photographs were then developed to insure that the pointing had been recorded successfully. After photographic work was completed, a small amount of the pointing was removed for chemical analysis along with the previously taken bedding mortar samples. Care was taken to insure that all of the remaining pointing was not removed from any of the sample areas, thereby leaving original pointing in place for display purposes or future examination.

During removal and examination of the bedding and pointing mortar samples, it was noted that the pointing mortar was very hard and stiff while the bedding mortar crumbled and became powdery as it was handled. This characteristic of relative hardness between bedding and pointing mortars was typical of 18th and 19th century wall construction.

The mortar samples were shipped to Thompson-Lichtner & Company for analysis of the contents. The analysis was to reveal the ingredients of the mortars, the percentages of those ingredients by weight and by volume, and provide a comparison of the two samples.

The chemical analysis supports the claim that the wall was fully bedded in mortar and not dry laid. Conceivably, a dry laid wall could have earth leached into most of its crevasses by the action of waterborn particles trapped between the stones. However, the chemical analysis refutes such an argument and

established that the samples, because of their contents were indeed mortar. The bedding mortar had nearly the same amount of natural cement (essentially made up of calcined lime and clay) as the pointing mortar, which was 27.8% SiO_2. The quantity of natural cement is the only similarity between the two samples, however. The softer bedding mortar had far less lime than the pointing mortar. The pointing mortar had nearly twice as much sand and more than two and one half times as much lime as the bedding mortar. (Refer appendix C, Chemical Analysis of Mortars for more detailed information).

There are two reasons for the higher quantity of lime present in the pointing mortar. One is, as mentioned earlier, for the purpose of hardening the pointing mortar to protect the inner softer mortar which, although it was weak, was necessary to allow the wall the elasticity it needed to remain structurally stable. The other reason for the greater amount of lime in the pointing was economic. Lime was available locally through the process of burning pieces of limestone in a kiln with wood to produce quicklime. Making lime for mortar was time consuming and expensive and required large amounts of fuel. Therefore, lime was used sparingly. Since lime makes mortar strong and reduces the intrusion of water, it was reserved for use in the pointing mortar while little was used for the soft inner mortar which did not have to be strong.

The life of the pointing mortar was extended by the technique used in the tooling or actual pointing of the wall. A

variety of methods was used. A "flush joint" was tooled smoothly and helped repel water from the face of the wall. An inverted "V joint," also tooled smoothly would, in addition to helping repel water from the surface of the wall, aid in preventing water from working its way back into the cracks because the surface of the pointing projected outward from the wall surface. Although an inverted "V" joint was more time consuming and expensive to produce than a flush joint, the "V" joint was superior and would last longer. Consequently it is seen more frequently than the flush joint on 18th and early 19th century structures.

Several of the few remaining areas of intact pointing of the Catoctin retaining wall where the mortar was in good condition clearly revealed that the wall was not only fully bedded in mortar, but that the pointing made use of mortar with a high lime content and the inverted "V" technique. (Refer plates 5, 6, 12, & 13).

The poor condition of the Catoctin retaining wall today is the result of many years of neglect. The perilous financial condition of the furnace which plagued its operations for much of its history suggests that little time and money may have been spent on maintenance of the wall, even when the furnace was in a productive state. After the furnace was abandoned in 1903, there was obviously no maintenance at all. Gradually, pieces of pointing deteriorated and fell out exposing the inner soft mortar to the intrusion of moisture. Leaching of the mortar was

accelerated by the moisture source provided by the earth and fill pressing against the entire back of the wall.

As the wall originally functioned, moisture from the earthen embankment could penetrate the wall and gradually evaporate through the hard but not impermeable lime pointing. Since any such water could evaporate gradually, there was minimal washing out or leaching of the soft inner mortar or the pointing.

The wall is essentially wedge shaped in section tapering from a foundation width of approximately five feet to about two feet wide at the top. The inner surface against the earth fill is slightly more vertical than the outer surface. The wall's construction is typical for the 18th and 19th centuries consisting of a rubble interior with a dressed stone face. Long pieces of rock extend through the wall. Called tie rocks, they help to bind the wall together. One end of a tie rock might be exposed to the face and extend inward into the wall. Overlapping it is another tie rock with one end exposed to the opposite surface of the wall. These overlapping tie rocks bonded or knitted together the coursed face stones and the rubble stones of the interior and earth-faced side of the wall. (Refer plates 1,2,3,20 and appendix B, Illustrated Wall Section).

Another means of tying or bonding together a thick stone wall was the use of through rocks. One large, long stone, a "through rock" was laid so that one end was seen on one face and the other on the opposite side of the wall. However, it does not appear that any through rocks were used for the Catoctin retain-

ing wall. Obviously, both faces of the entire wall could not be seen because of the earth embankment which the wall holds in place, but where sections of the wall could be seen, no through rocks were present.

Chapter 3

Configuration Features and Interpretation of the Wall

The total length of the retaining wall at Catoctin is approximately 200 feet. It is constructed on a nearly north-south axis with portions near each end projecting to the east to form a plan resembling an angular inverted "U." The longest uninterrupted span of the wall is approximately 135 feet forming the base of the "U." The shape of the wall is the result of the function which was to allow access to the top of the furnace stacks and to provide a base upon which to construct storage buildings called "stock houses" which held the great quantities of charcoal, coke, and limestone necessary to keep the furnaces in production.

Interpretation of the age and original appearance of the retaining wall is made difficult by the complex history of the Catoctin operations and the opinions expressed in the numerous reports written to date which disagree with one another on details including the location and function of various structures.

Although the history of the Catoctin iron furnace has been included to greater or lesser extent in all of the previous reports, it will be useful here to summarize it once again in order to support this study's interpretation of the original appearance and features of the wall. In the immediate vicinity of the retaining wall was not just one but at least three

separate furnaces which functioned and eventually were dismantled at various times during the history of the Catoctin operation.

The first furnace at Catoctin was producing iron by 1776. Its location is not known for certain. The report entitled An Historical and Archeological Survey prepared by Contract Archeology, Inc., in 1971 conjectures that the original furnace was located adjacent to the present remaining furnace stack. Most other sources however, citing an 1840 description by John Alexander believe that the first furnace was about ¾ mile south of the present location along the Little Hunting Creek. The furnace was relocated in 1787 to its present location. According to Mr. Alexander, the reason for the move was to have the furnace located in closer proximity to its principal ore bank which was within 100 feet of the new location of the furnace.[7] To date, no archeological evidence has been found of the original furnace which operated until 1787.

The exact location of the 1787 furnace is conjectural, but most sources agree that it was adjacent to the existing stack at Catoctin Furnace. This 18th century furnace was rebuilt or replaced in 1831.[8] It is not clear from the scant documentation available whether or not the 1831 rebuilding meant a construction of a completely separate structure or renovations to the existing 1787 stack. Contract Archeology's 1971 report states that the furnace was enlarged in 1831, surmising that the existing structure was kept.[9]

In 1856 the second furnace stack was constructed. It is this stack which remains on the property today. Called "Isabella" in honor of owner Peregrine Fitzhugh's wife, it was a steam operated cold blast charcoal furnace. According to most sources, it was built next to the first furnace and ran from the same ore. Interestingly, the 1856 furnace was constructed essentially in the same manner as 18th century furnaces. It is a truncated square stone structure with brick linings. The "Isabella" furnace is located near the northeast terminus of the wall. Today it stands alone except for the wall and a modern reconstruction of its attached casting house. When it was originally built, however, it had an 80 horsepower steam engine which operated large bellows,[10] an engine house to protect the machinery, and a stock house on the upper level in which the charcoal was kept. Until it was dismantled in 1890, furnace stack #1 stood "adjacent" to the "Isabella" stack. The exact location of the first stack has not been ascertained, but most of the earlier reports conjecture that its location was along the south face of the north end of the wall, southwest of the "Isabella" stack. That area of the wall is marked by two buttresses or projections in the stonework. (Refer plates 14, 15, & 16). Another theory is that stack #1 was located northwest of stack #2, due north of the aforementioned buttressed section of the wall. If this location is accurate, the base of the furnace has been covered with fill and what is exposed is actually the remains of the upper portion of the stack. The

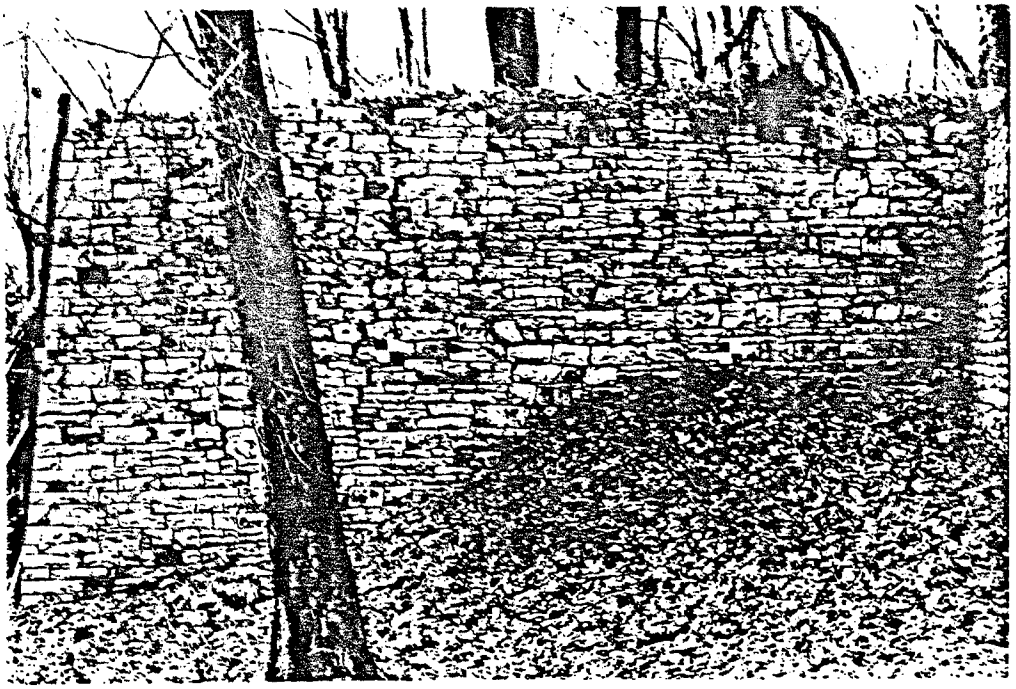


Plate 7

North face of engine house retaining wall.

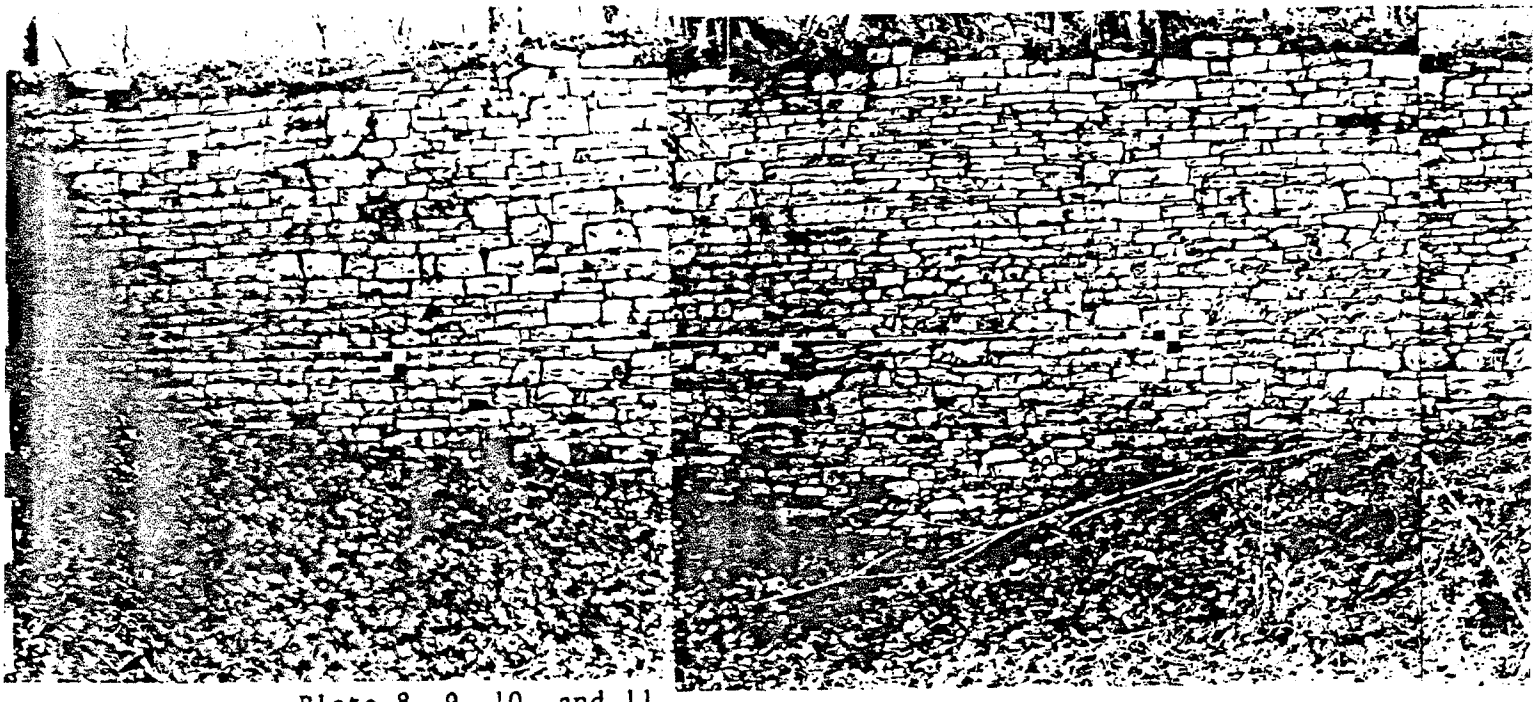
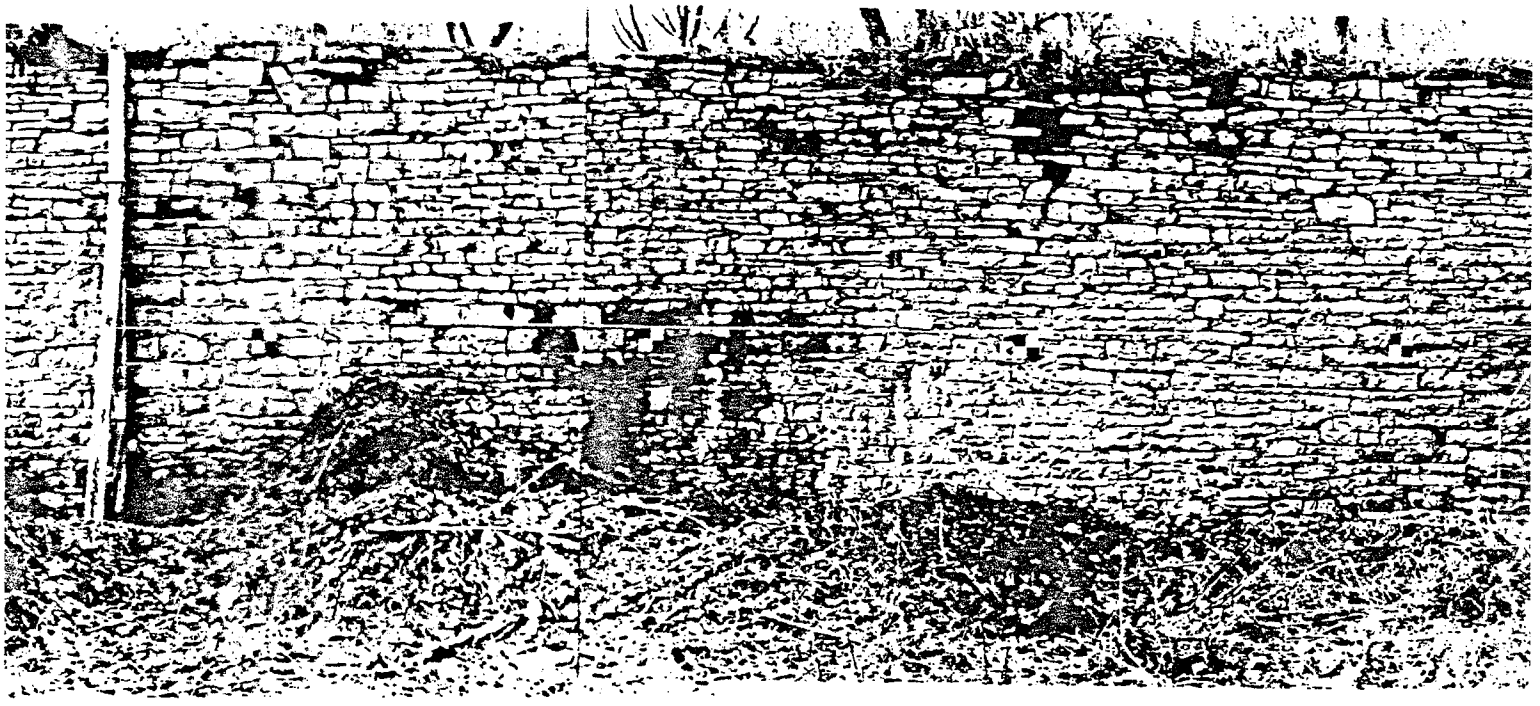


Plate 8, 9, 10, and 11

South end quadrant of long retaining wall, mid south quadrant of long retaining wall, mid north quadrant of long retaining wall, north end quadrant of long retaining wall.



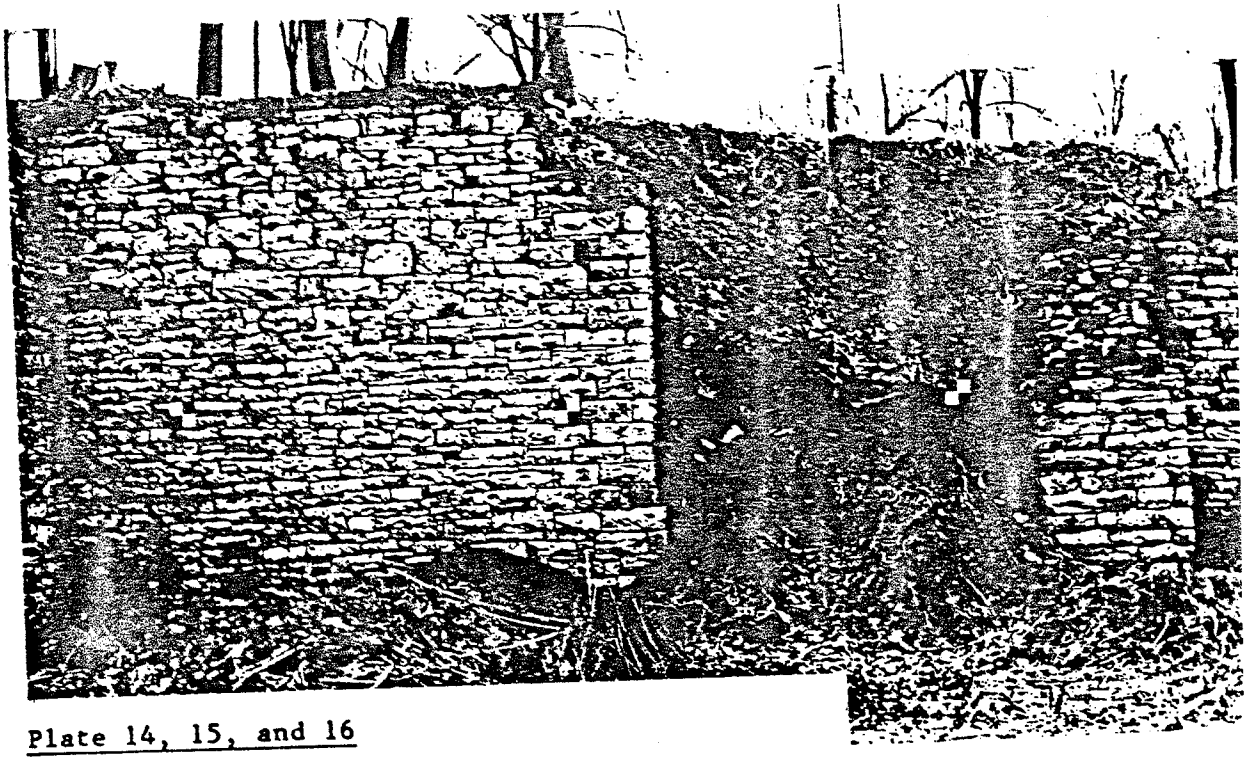


Plate 14, 15, and 16

West end of north retaining wall, collapsed section of north retaining wall, 18th Century bellows house wall.

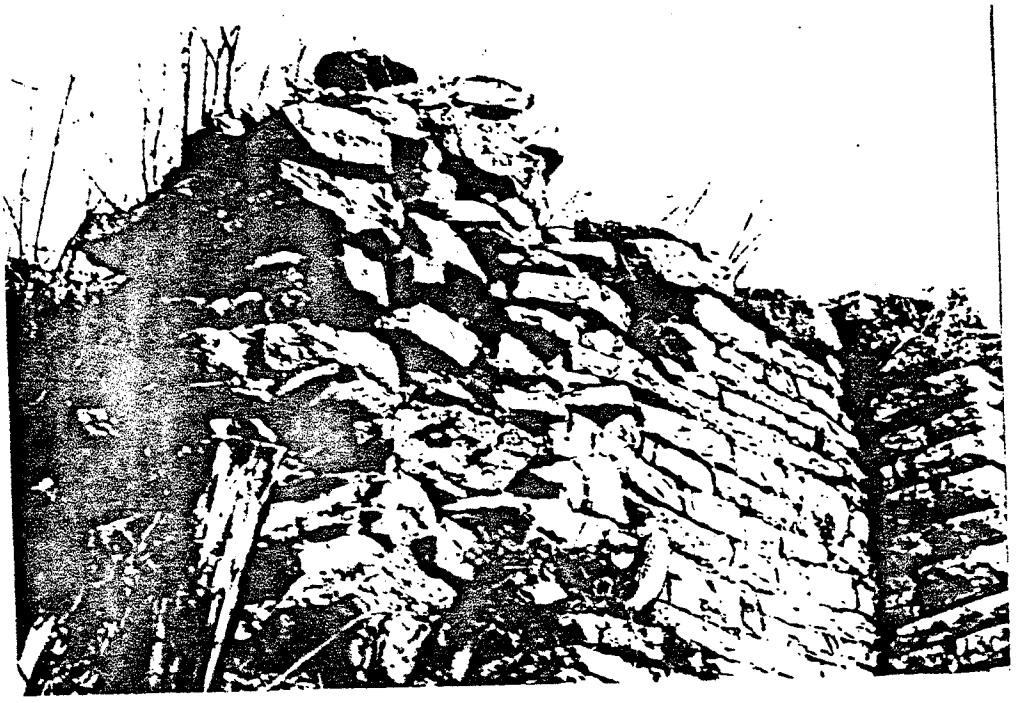
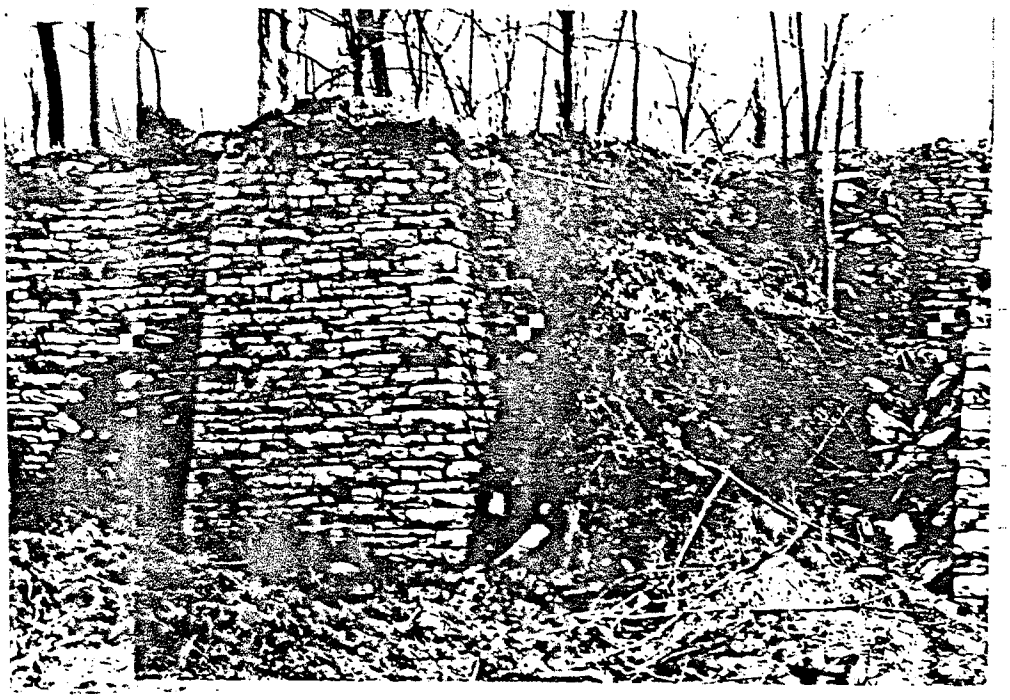


Plate 17

Inner wall construction, 18th Century bellows house wall.



first furnace stack was abandoned in 1880 and it was dismantled ten years later in 1890. All known historic photographs of the furnace area were taken after stack #1 was dismantled, therefore offering no help in locating it and determining its relationship to the retaining wall. However, since it is known that "Isabella's" casting house was attached to its east face and the ground to the south is shown in photographs to be fairly open work area, stack #1 could really only have been located to the west or north of "Isabella," assuming that they were in close proximity to one another.

Like "Isabella," stack #1 would also have had various associated structures attached to it. Among these would have been a casting house, bellows, a large waterwheel to drive the bellows, a race way to direct water to the wheel and a stock house (possibly shared with "Isabella"). Between 1856 and 1880 both stacks would have operated simultaneously meaning that there was substantial activity, machinery, production and transportation concentrated at what is now the north terminus of the wall.

In 1873, stack #3 known as "Deborah" was built at the south end of the wall. "Deborah" was a steam-powered, hot blast coke-burning furnace. Its stack was a cylindrical cast-iron column which stood 50 feet high and was 11½ feet in diameter. Associated with the "Deborah" furnace was an engine house and hot-air structure to its south, a wooden or masonry elevator tower to its north and a large casting house to its east. Atop the retaining wall and running almost the entire length of the

westernmost span of the wall (approximately 135 feet) was a stock house. The 1971 report prepared by Contract Archeology, Inc. conjectures that this stock house held charcoal for stacks #1 and #2.[11] However, it is also possible that this structure was used to store coke for use in the "Deborah" furnace, particularly because of its proximity to the elevator tower and stack.

In 1880, the first furnace stack ceased operation and was dismantled in 1890.[12] It is not clear from the term "dismantled" just how much of the stack was left in place in 1890. Furnace stack #2, "Isabella" was closed in 1893 and was dismantled in 1904. After dismantling, however, the stone and brick furnace structure was left standing. The "Deborah" #3 stack was taken down in 1904, along with its support structures. Thus, the only remaining substantial above-ground features associated with the furnace are the retaining wall and stack #2.

The preceding history of the furnace serves to put into context some of the features of the wall. The age of the wall remains uncertain. There is clear evidence to show that the walls were not constructed until after stack #1 was present and in operation. Soil borings performed in 1974 by Robert B. Balter, Soil and Foundation Consultants, Inc., indicated that the entire wall was backed by fill dirt that contained ash and slag, a clear indiction that iron production was in progress at the site prior to construction of the walls.[13]

In addition, observation of the style of masonry employed in constructing the face surfaces of the wall and the "Isabella"

stack (stack #2) suggests that the entire expanse of the wall was not constructed at one time. While the same type of native sandstone was used for all of the construction, the method of working the stones was not. The method of stonework used in construction of the "Isabella" stack and the section of wall immediately to its north and east appears to have been done at a different time by different stoneworkers and masons from the rest of the wall. Both sections of the wall have stones laid in relatively even narrow courses, but this similarity is the result of the natural cleavage or breaking surface of the local sandstone. The vertical surfaces of the wall's face stones are quite different in the two areas of the wall mentioned as can be seen in careful examination of the wall or photographs of it. The furnace stack and the wall to its north are made up of stones with more randomly finished vertical joints than those of the rest of the wall. Also, there is a greater variation in the size of the stones used for the furnace stack and north wall. On the contrary, the portion of the wall from the furnace stack extending to the west and south is made up of more evenly sized modules nearly all of which have been carefully tooled with 90° corners. The exposed surfaces of these stones have been hammered intentionally to a rock-faced finish. The exposed surfaces of the stones forming stack #2 and the wall to its north and east, while also hammer finished appear more randomly tooled.

This evidence suggests that the "Isabella" stack and the wall to its north and east date from 1856 (the documented date

for "Isabella") while the entire remainder of the wall extending west and south from the buttressed area dates from a later time and is probably contemporary with the construction of "Deborah," stack #3, in 1873. The style of masonry finishing used for the west and south portions of the wall is consistent with late 19th century practices. Similar examples can be seen with walls retaining embankments for railroad overpasses in the area. The wall does however employ the older method of structuring using soft bedding mortar.

The 1873 date suggested for the majority of the retaining wall is indicated further by the evidence in the southernmost area of its length, known as the "engine house wall" that the "Deborah" furnace which was located there was, along with its associated machinery integrated into the wall.

The Engine House Wall:

The east face of the engine house wall is approximately 53 feet long. (Since the face of the wall batters inward toward the embankment as it rises in height, its length at the base is greater than at the top). The original top finish of the wall is unknown since vegetation and weathering have removed much of the top surface. (Refer plates 1 & 3). As has been stated already, most of the pointing and mortar have washed away leaving the joints between the stones open and giving the wall the appearance of having been dry-laid. The south terminus of the engine house

wall is a finished or returned edge indicating that the wall ended here as constructed. (Refer Plates 2 & 3). At the upper corner of the south end of the wall, stones have loosened and fallen away. A wooden bracing system as been constructed against the wall in an effort to help support it. The bracing was done in 1974. (Refer plates 3 & 4). Two diagonal cracks near the north end of the engine house wall occur along vertical joints of the stove to form a V-shaped weak area in the wall.

Several significant features of construction are apparent at this area of the wall. They are part of the original construction of the wall and remain as evidence of where the "Deborah" stack and its related machinery were integrated with or tied to the wall. At the upper half of the south edge of the engine house wall along grid line "A" in the attached drawings, (Refer appendix D) is a series of four brick quoins or returns in the wall. (Refer plates 1, 2, & 3) Each brick module, made up of a group of interlocking bricks, approximates in size its stone counterparts forming other corners of the wall. The workmanship associated with this brick work indicates that it is original to the construction of the wall and not some sort of later infill. The surfaces of the brick quoins retain traces of whitewash, although no other portion of the wall shows evidence of similar treatment. No explanation for the presence of the brick quoins in this location has been discovered. The engine house and the hot-air houses for the "Deborah" stack stood just southeast of this section of the wall. Whether the brick quoins were somehow

associated with these structures cannot be ascertained from information available at present. It is known that there was a great concentration of machinery and structures in the immediate area as indicated in several photographs from the 1880's, 90's, and early 1900's.

At the opposite end of the engine house wall is another significant but as yet unexplained feature, consisting of an angular opening also part of the original construction of the wall. In the accompanying drawings of appendix D, this area is located along grid line "D." The upper few feet of the north edge of the engine house wall, approximately two feet south of the north edge incorporates into the stonework a return or finished edge which also forms the end and rear surface of the wall which extends back or west from the engine house wall (noted on the drawings with grid lines 3, 2, 1). (Refer plate 4). Against this finished or returned edge is the north side of a large "T"-shaped opening or pocket. In photographs taken of the wall in 1974, (see plates F and 17 in the Catoctin Furnace Stabilization Study by National Heritage Corporation) this area or recess in the stone work was partially filled with bricks which appeared to have traces of whitewash similar to those bricks forming the quoins at the south end of the wall. Since 1974 these bricks have been removed or have fallen out. A short distance above the "T"-shaped recess is a soldier course of eight header bricks with their north end against the aforementioned finished stone return. From the base of the recessed area

eminates one of the two large cracks already described.

The purpose of this recess, like that of the brick quoins remains a mystery. This work does, however, appear to be original to the construction of the wall and does relate to the operation of the "Deborah" furnace. Old photographs show that the elevator tower for the "Deborah" furnace stood near this end of the wall. It is possible that this feature of the wall may have been related to the operation of this tower which lifted coke and limestone to the top of the 50 foot high furnace stack. Perhaps it held a conveyor or auger to carry coke and stone from the stock house to the base of the elevator.

Also in the engine house wall are a series of joist pockets, four of them, extending across the wall in a level line approximately one half the distance from top to bottom of the wall. Other pockets are located closer to ground level near the north end of the wall. (Refer plates 4 & 5). Exactly what sort of structure was built into the side of the wall is unknown, but there was likely a cat-walk or some sort of work area at the back of the furnace stack, especially with the concentrated activity which occurred here.

Grid Section 3 - 1:

This section of the retaining wall, noted on the accompanying drawings in grid sections D-E, 3,2,1 extends west from the north end of the engine house wall. (Refer plate 7).

Like the rest of the wall, its surface is of cut rectangular blocks with a hammered rock-faced surface finish. The exposed or north face of this wall is fairly uninterrupted except for the general deterioration already noted. A mound of earth heaped against the west end of this section of the wall has been identified in the 1974 Catoctin Furnace Stabilization Study as a pile of limestone. Three joist pockets are located near the east end of this wall. These apparently were associated with the operation of the "Deborah" furnace. They appear to be original to the construction of the wall. A tree stump protrudes from the top of the wall near its west and there is a vertical crack near its east end.

Grid Section F - L:

This is the longest uninterrupted section of the wall. It runs in a north-south axis for approximately 135 feet. (Refer plates 8, 9, 10, & 11). Its construction of rock-faced sandstone cut into rectangular blocks is that already discussed for the entire wall except for the "Isabella" stack and the wall to its north. The wall has deteriorated due to weathering, lack of maintenance, and overgrowth of vegetation. In 1974, a wooden brace was planted against the east face of the wall, 72 feet north of the beginning of this span, between grid lines H and I. Approximately two feet north of the brace is a vertical crack in the wall. This area of the wall has moved and bows outward or

to the east substantially at this point. (See drawing #3 of appendix D). Several tree stumps protrude from the top of the wall indicating that after the furnace was abandoned, trees rooted and grew to maturity directly on top of the wall. These trees have been a major contributor to the deterioration of this part of the wall. In the vicinity of grid line "K" efflorescence and water seepage is clearly visible on the surface of the lower half of the wall. A number of stones have fallen away from the top of the wall in this area adjacent to two of the tree stumps. From this point northward, the wall has also moved and now leans backward or west into the slope. There are a few open areas in the wall suggesting the presence of joist pockets, but their locations are erratic, forming no pattern. These holes apparently are where small stones have fallen out of the wall. A few small mounds on the ground along this section of the wall were identified in the 1974 report by National Heritage Corporation to be slag heaps. Old photographs of the furnace complex indicate that a stock house, stood on the embankment directly above this section of the wall. It probably served the "Deborah" furnace, and possibly also held raw materials for furnace stacks #1 and #2. These old photographs also show that a structure was built against the face of this wall long most of its length. It appears to have been a catwalk.

Grid Section 1 - 6:

This part of the wall runs in an east-west direction and is

defined in the attached drawings as grid sections L, 1 - 6. This section extends approximately 80 feet from the west section of the retaining wall eastward to the "Isabella" furnace stack. This span is interrupted by an opening which appears to be original near grid line 3, by two protrusions or buttresses on the south face of the wall near grid line 4, and by a return and northward recess in the wall near grid line 5. (Refer plates 14, 15, & 16). Then, between grid line 5 and 6, the wall has fallen in against the base of the "Isabella" stack. However, sections remaining suggest that it apparently zig-zagged east then north to meet another section of wall which extends eastward, north of the "Isabella" stack, near grid section 6. The east-west wall located north of the "Isabella" stack is that which was described earlier as having stone masonry different from that of the rest of the wall.

The first and westernmost section of the wall, between grid lines 1 and 3 has been damaged particularly along its top by vegetation and weathering. As shown in drawing #3, the wall has shifted and tilts backward into the embankment. Stones along the top have been dislodged by the plant growth and the upper corner where the wall terminates is now missing, in the vicinity of grid line 2.

The gap in the wall near grid line 3 is approximately 16 feet wide and appears to be an original opening since the ends of the wall on either side are finished or returned. Through this opening, the earthen embankment slopes upward steeply.

The next section of the wall to the east, marked by the two protruding buttresses is approximately 25 feet in length. Much of this part of the wall has tumbled down, particularly toward its west end where the wall still follows its original configuration only for about six feet of its height. (Refer plate 17). The wall returns or is finished at each end indicating that this small section was between two openings, which may have resulted in the need for the buttressing. Joist pockets are in evidence in the recess between the buttressing and on the surface of the buttresses. These holes may indicate that some sort of structure was built into the wall, or they were simply unfilled holes left from the construction scaffolding. Photographs do not give a clear indication of what, if any structure was located in this area. In the recess between the buttresses is an area where stones have fallen away. The damaged section is about four feet wide near the base of the wall at grid line 4. Borings though the wall indicate that the wall in this area is not as thick as elsewhere.

Between grid lines 4 and 5 is the north terminus of this part of the wall. The wall, as with its termination points elsewhere batters inward as it rises in height. Here, the wall turns to the north along the west face of the "Isabella" stack. The beginning of a right angle turn to the east is seen before it collapses into a pile of rubble. (Refer plates 18 & 19). However, 1920's and 30's photographs show part of this section intact.

Extending southward from the wall which is located north of the "Isabella" stack is a very cracked and deteriorated section of wall showing stone masonry different from the more southerly sections of the wall. The top few feet of this wall as viewed form the east have a finished vertical edge facing south. The wall then juts southward before collapsing into rubble. (Refer plate 21). It is conjectured that this wall is actually the remains of the 1787 stack #1. The wall is laid in narrow courses of sandstone that are more random or rubble-like than the southern parts of the wall. The masonry appears similar to that of the north wall which extends to the east, north of the "Isabella" stack. If part of this stonework is in fact a remnant of the 18th century stack, and those remnants are constructed into or integrated with the northernmost wall, then it, to may date from the 18th century, and not the mid 19th century when the "Isabella" stack was built. A historic photograph taken of the "Isabella" stack from the southeast shows this stack and a bridge house straddling the open area between the top of "Isabella" and the buttressed section of the retaining wall. Other structures partially obscured extend to the north and would have been bellows, wheel, and stock houses. Unfortunately, this photograph cannot help us verify the location of the 18th century stack.

The northernmost wall remains covered with vegetation which obscures details of its use and configuration.

The Isabella Furnace Stack

The Isabella Furnace Stack, also known as Stack #2, dates from 1856. Other than a hard cement cap and various archeological excavations around the base of the stack, no work has been done to stabilize or restore the stone structure.

The stack is in fair to poor condition. The footers are stable, but the thick stone walls partially held together by a series of metal tie rods are shifting and cracking due mainly to the washing away of mortar from between the stones. Most of the lime pointing that protects the softer interior bed mortar is gone thus leaving the bed mortar vulnerable to rapid deterioration.

In addition to two rather large vertical cracks and loss of pointing mortar, the brick arches in the base of the stack are falling apart. The cement cap on top that was an attempt to keep rain from entering the stack is in failure. A great deal of precipitation can now work its way down inside the stack.

Although it is deteriorated, the stack is restorable. The work would be both extensive and costly, but should be considered necessary so that this single remaining component of such a significant industrial complex as Catoctin Furnace can be preserved, along with the expanse of retaining walls.

NOTES

1. Michael D. Thompson, The Iron Industry in Western Maryland, research paper, West Virginia University, Morgantown, West Virginia (1976), p. 3.

2. National Heritage Corporation, Cactoctin Furnace Stabilization Study, (West Chester, Pennsylvania, 1974) Note: references to the wall being dry-laid are made throughout this report.

3. Harley J. McKee, Introduction to Early American Masonry, Washington, D.C., (National Trust for Historic Preservation, 1973), p. 61.

4. McKee, Masonry, p. 61.

5. Peter Nicholson, The New Practical Builder, (London: Thomas Keller, 1823), p. 354.

6. Bulletin of the Association for Preservation Technology, Vol. V, No. 1, (1973), p. 71. Transcribed by Hugh C. Miller.

7. Thompson, Iron Industry, p. 81.

8. Thompson, Iron Industry, p. 84.

9. Contract Archeology, Inc., An Historical and Archeological Survey, (Alexandria, Virginia, 1971), p. 35.

10. Census of 1860, Marshal's Report on Manufactures, Federick County, Maryland, Mechanicstown District.

11. Contract Archeology, Inc., Survey, p. 64.

12. The American Iron and Steel Association, Directory of the Iron and Steel Works of the United States. (1890), p. 30.

13. National Heritage, Stabilization, p. 12.

Appendices

Appendix A

PLATES

Place:	Catoctin Furnace Retaining Wall
Address:	Catoctin Iron Works Catoctin Furnace, MD
Date:	12/27/84
Photographer:	Douglass C. Reed
Negative Location:	Preservation Associates, Inc. 207 South Potomac Street Hagerstown, MD 21740 1-301-791-7880

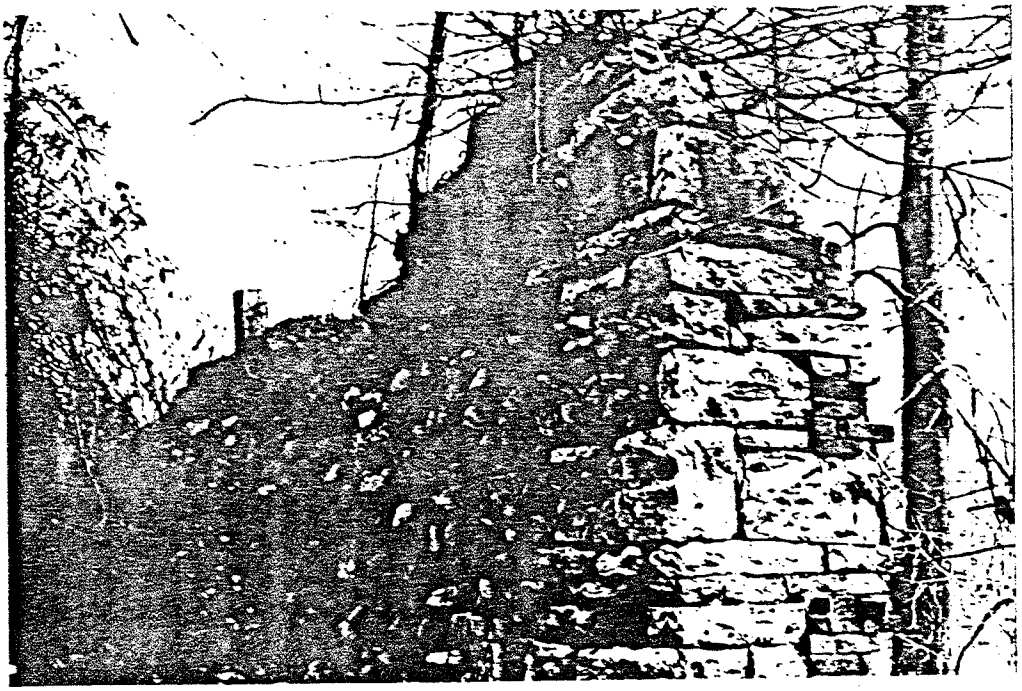


Plate 1

Southwest corner of engine house retaining wall.

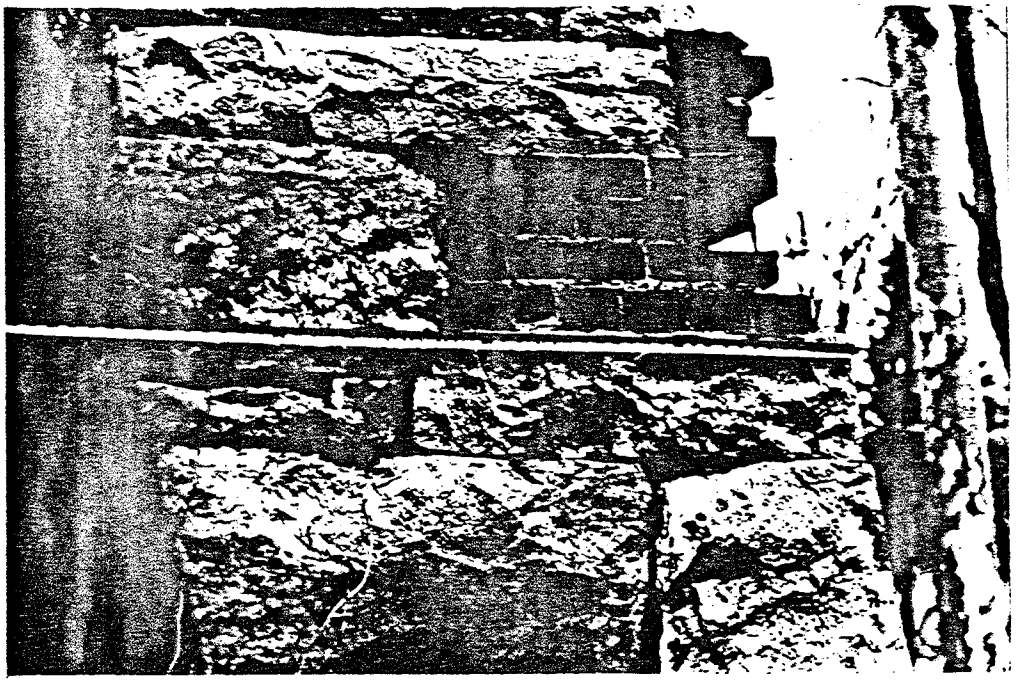


Plate 2

South end of engine house retaining wall.

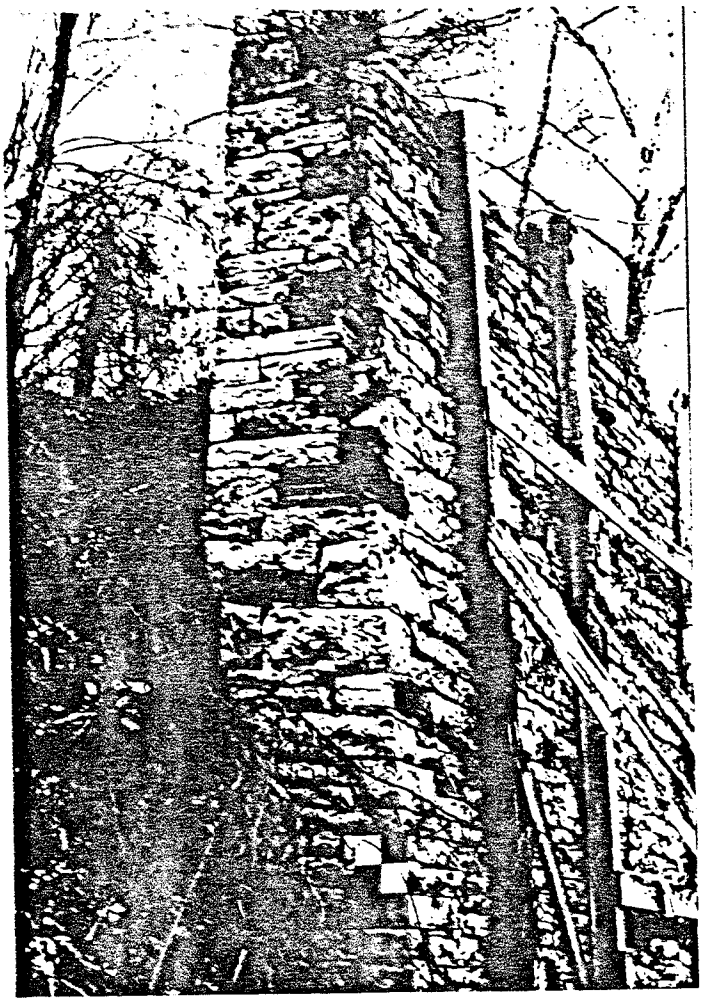


Plate 3

Southeast corner of engine house retaining wall.

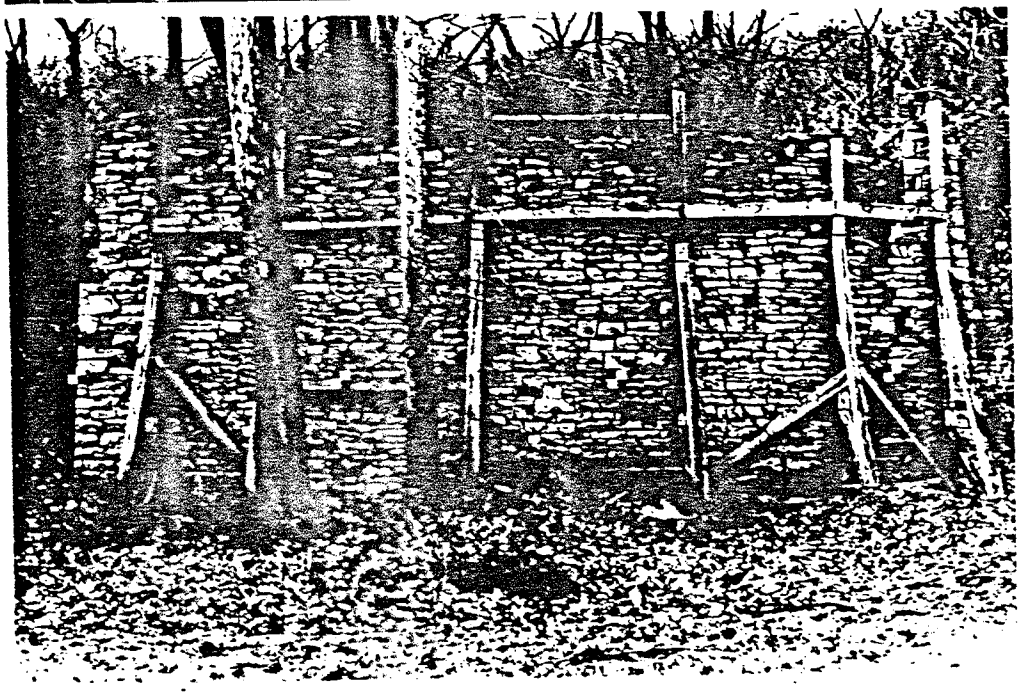


Plate 4

East face of engine house retaining wall.

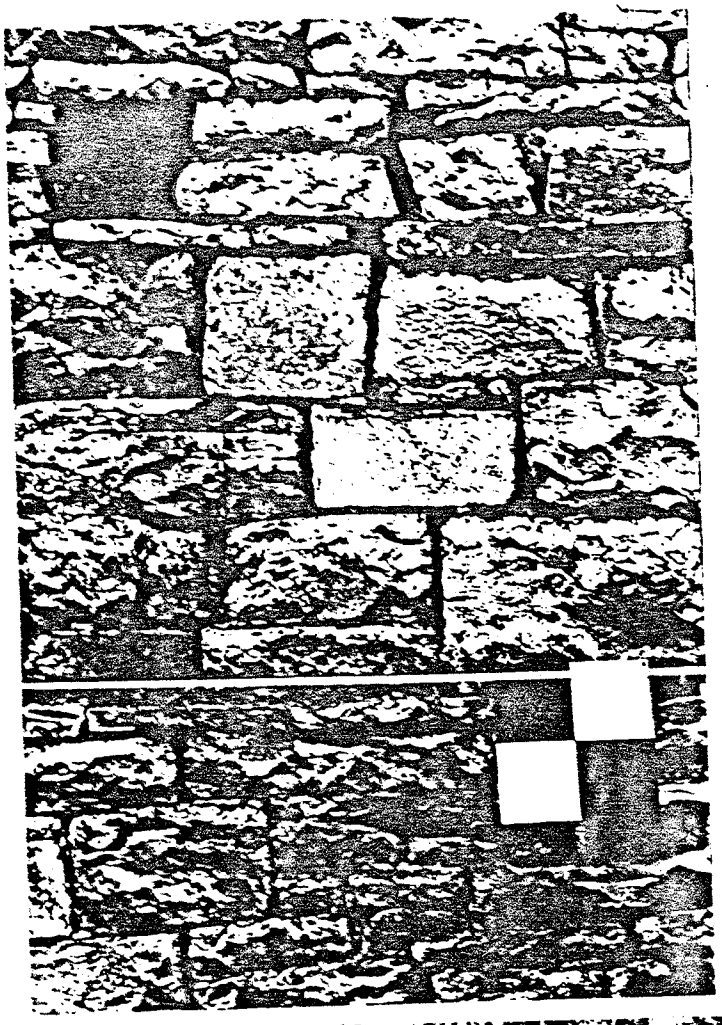


Plate 5

Pointing sample, engine house retaining wall.

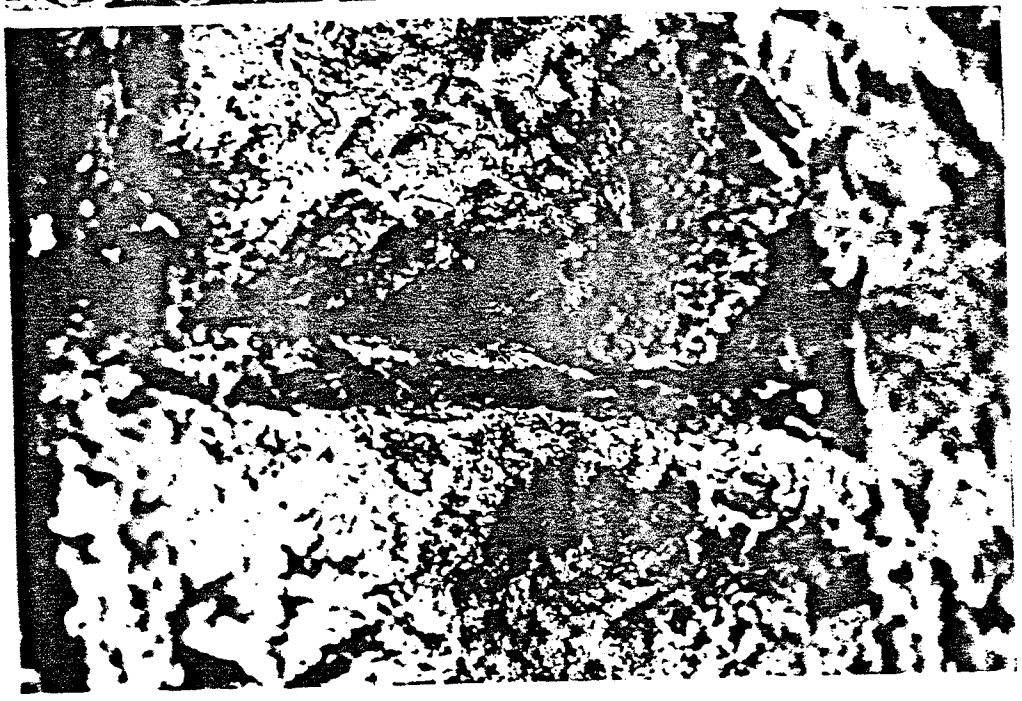


Plate 6

Pointing sample, engine house retaining wall.

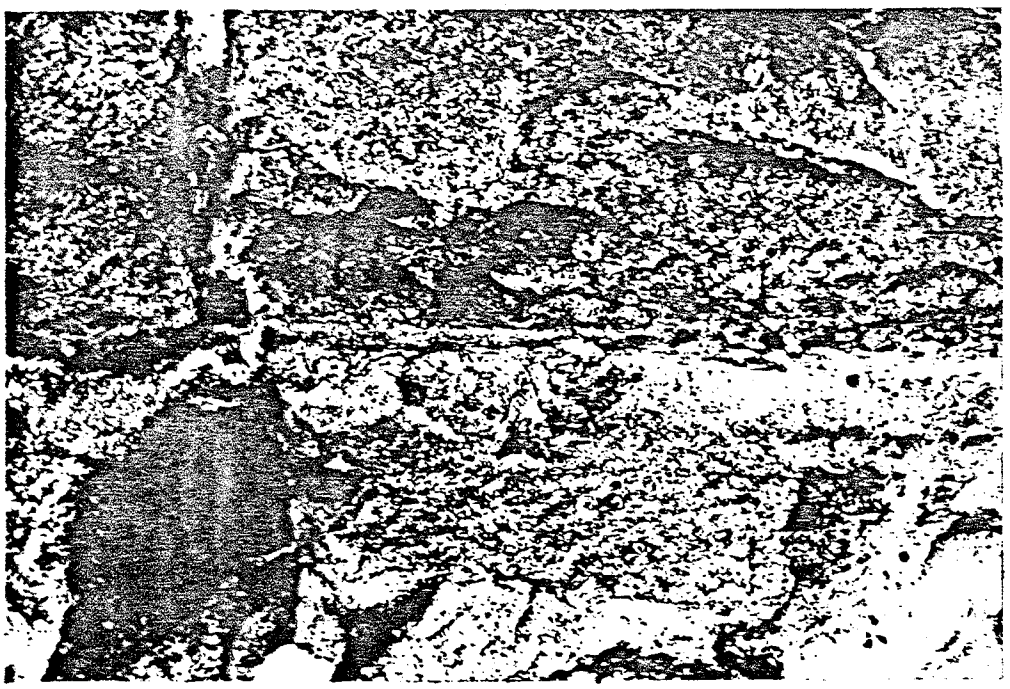


Plate 12

Pointing sample of long retaining wall.

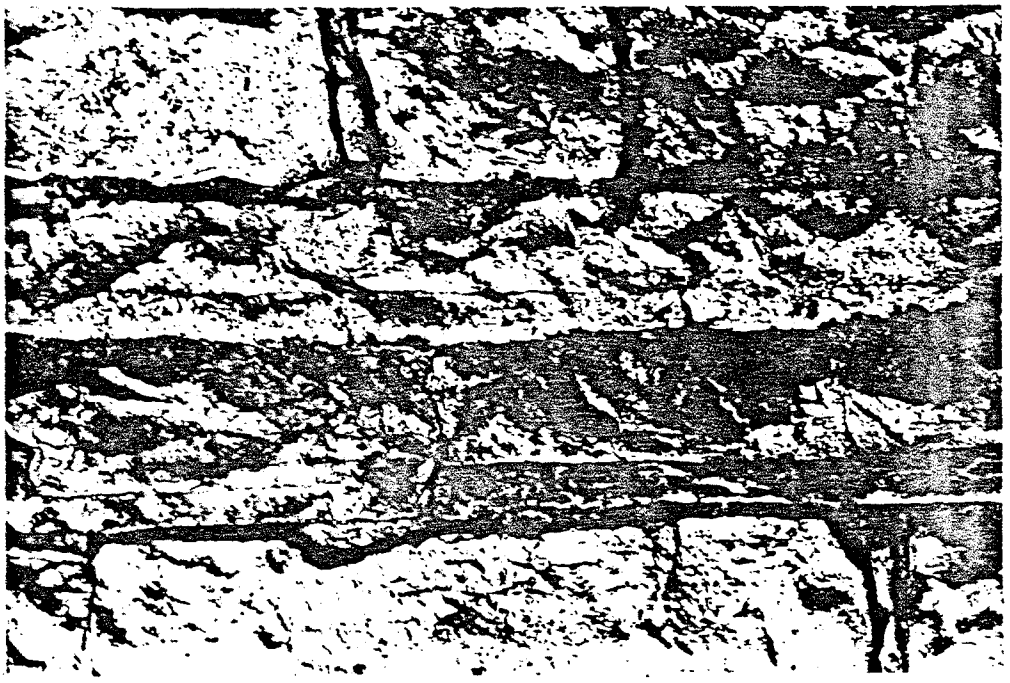


Plate 13

Pointing sample of south face of north retaining wall.

Plate 18

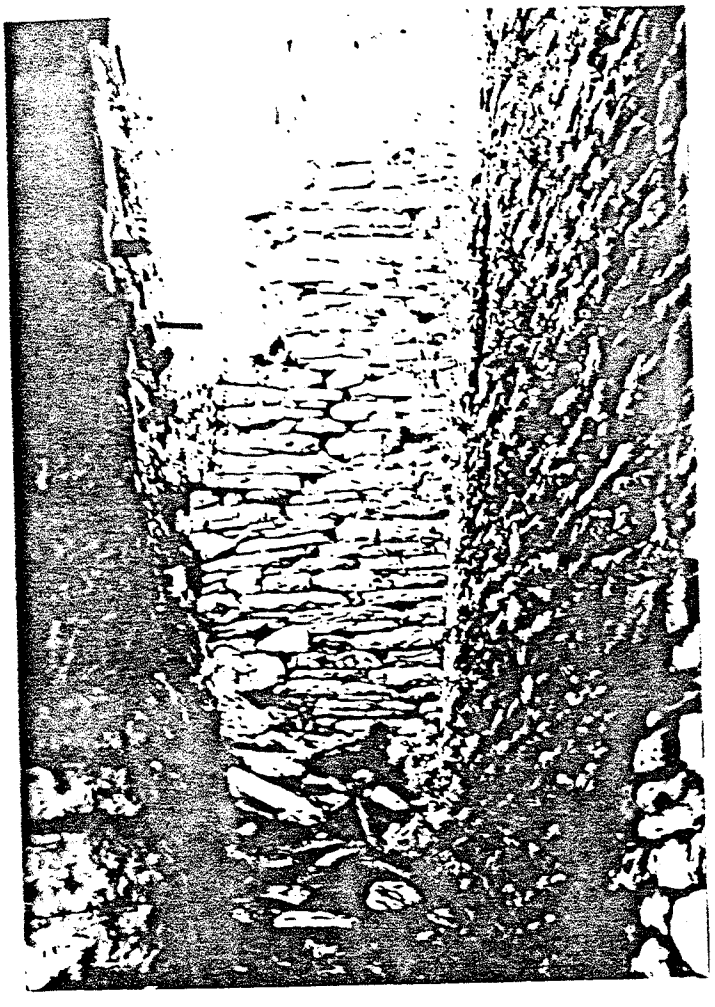
Inner wall construction, 18 Century bellows house wall.

Plate 19

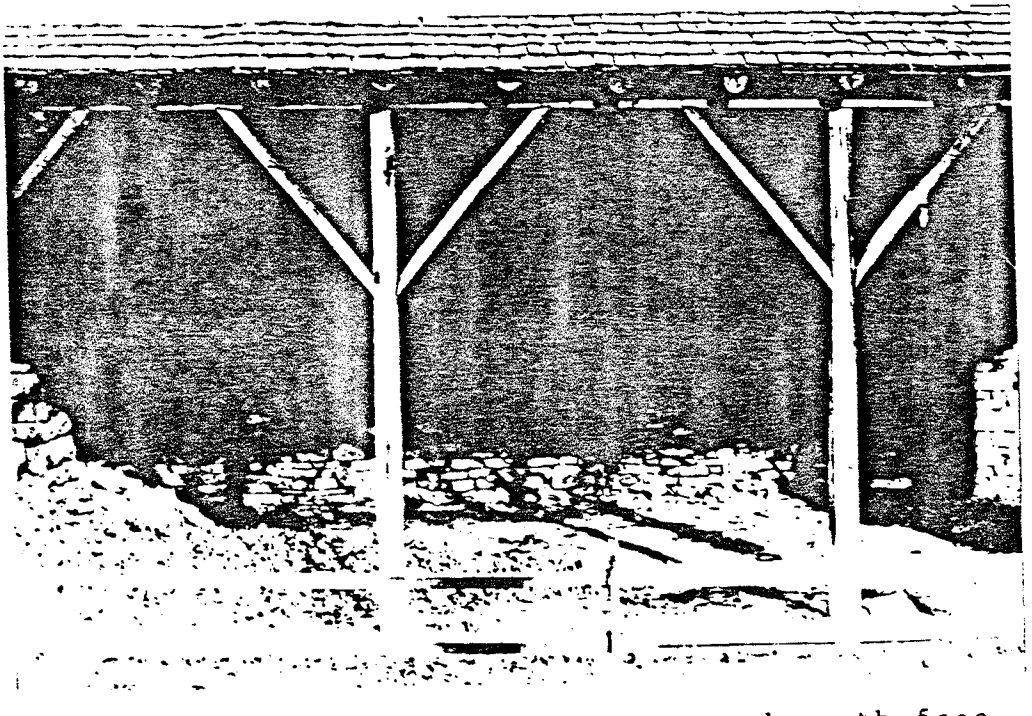
Earth side face of 18th Century bellows house wall.

Plate 20

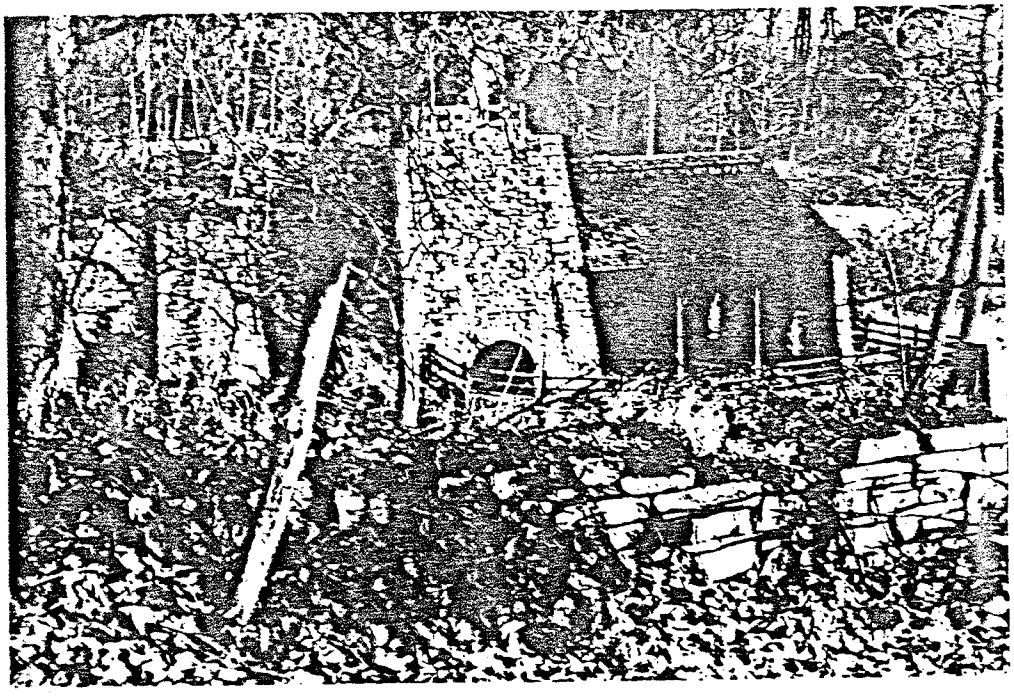
Inner wall construction, 18th Century furnace retaining wall.



21. Northern most retaining wall (to right) and collapsed west wall, furnace stack to left.



22. Reconstructed casting house and south face of the north retaining wall.

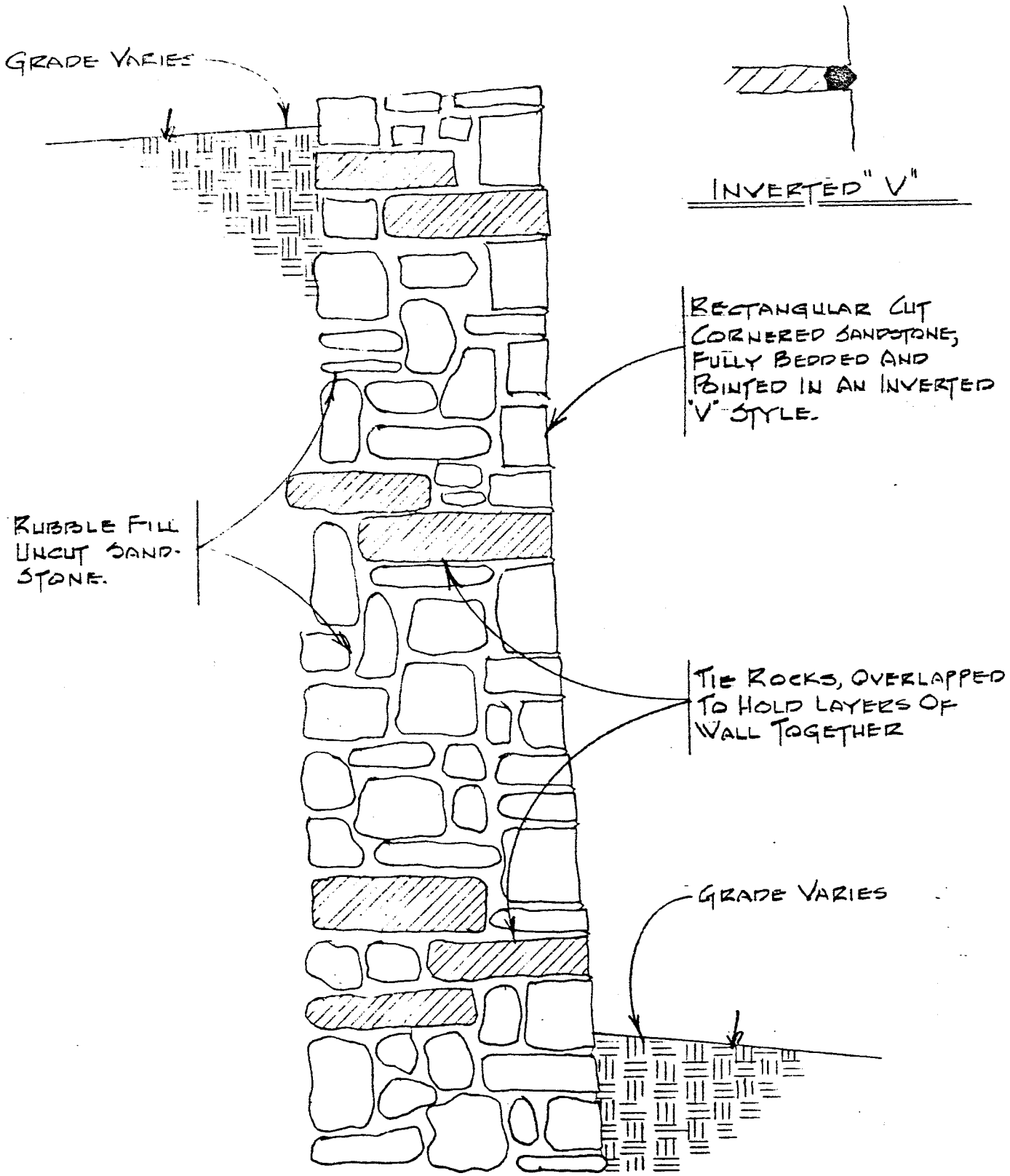


23. Northeast view of furnace, casting house and portions of the retaining wall.

24. Northeast view of furnace, casting house and a portion of the wall.

Appendix B

ILLUSTRATED WALL SECTION



ILLUSTRATIVE WALL SECTION

SCALE: NONE CATOCTIN WALL MARCH, 1985

PRESERVATION ASSOCIATES, INC.

Appendix C

Chemical Analysis of Mortars

of

Catoctin Furnace Retaining Walls

February 20, 1985

THE THOMPSON & LICHTNER COMPANY, INC.

Consulting Engineers
Engineering and Testing Laboratories

111 First Street
Cambridge, Massachusetts 02141
(617) 492-2111

February 20, 1985

PRESERVATION ASSOCIATES, INC.
HAGERSTOWN, MARYLAND

CHEMICAL ANALYSES OF MORTARS

Catoctin Furnace
Maryland

Test Number - HH-644

Date Received - 2-7-85 Date Tests Completed 2-14-85

Source - Submitted by you reference your letter of transmittal of February 1, 1985

Samples - Two samples of hardened mortar pieces stated to have been taken from joints in a stone masonry retaining wall at Catoctin Furnace, MD, built in 1858. The samples were identified as follows:

- #1, 1858 Pointing 1228841
- #2, 1858 Bed 1228842

Test Procedure - Standard methods of inorganic analysis

Results - The following data have been obtained:

	% by weight		Proportions by weight		Proportions by volume	
Sample Mark	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2
Cement - *	9.2	16.2	1	1	1	1
Hydrated Lime Equivalent -**	31.8	20.7	3.46	1.28	8.13	3.00
Sand-(silicious)	59.0	63.1	6.41	3.90	7.53	4.58
Ratio by Volume Sand/Lime plus Cement					0.82	1.15

*As natural cement having 27.8% SiO_2.
**Heavily carbonated.

Note - Particles of coal, charcoal, and limestone observed to be present

Test Number HH-644

Gradation - Reclaimed Aggregates

Sieve	% Passing Sample #1	% Passing Sample #2
# 4	100	100
8	92	88
16	83	76
30	70	63
50	41	38
100	15	16
200	2	4
F.M.	1.99	2.19

The samples of reclaimed aggregate and the remaining untested portions of the original samples are being returned to you as requested.

THE THOMPSON & LICHTNER COMPANY, INC.

G E Jacobs

G. E. Jacobs

GEJ:j

2c

Appendix D

DRAWINGS

Note: The accompanying drawings because of their bulk have not been bound into this report.