A Report on the Excavation of an Ancillary Area (Site 18FR320) of the Historic Ironworking Complex at Catoctin Furnace

Frederick County, Maryland

by

John Milner Associates, Inc.
Architects • Archeologists • Planners

A Report on the Excavation of an Ancillary Area (Site 18FR320) of the Historic Ironworking Complex at Catoctin Furnace, Frederick County, Maryland

submitted to

State Highway Administration,
Maryland Department of Transportation

by

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ABSTRACT

The site at 18FR320, Catoctin, Maryland was initially identified during a survey carried out in 1977 in advance of the dualization of U. S. Route 15. Excavations were conducted in 1979 and 1981 in order to mitigate expected adverse effects by recovering significant data contained within the site.

The results of the excavations revealed that several phases of activity had taken place on the site. A raceway running west to east was the earliest feature. Following the silting up of the raceway, the site became the disposal area for ironworking waste, specifically slag identified metallurgically as deriving from the refining of iron, and gate metal deriving from the casting of iron. Contemporary with this phase was a structure postulated to serve as a charcoal house for the refining forge, located off the site probably to the east.

A later structure is of uncertain function, but may be equated with a historical reference to a warehouse in the vicinity of the site. In a still later phase, a stone revetted earthen storage dam was built to the north of the site. Finally, in the last period of activity, a driveway to the Auburn Mansion ran across the northern part of the site.

Area excavation of these features and layers revealed artifactual evidence of the kinds of molding and casting practices which took place at Catoctin, as well as of the finishing and assembling of the cast iron artifacts, particularly stoves and hollowware.

ACKNOWLEDGMENTS

An involvement that has lasted over as many seasons as that with site 18FR320 has incurred many debts of assistance and kindness. Although some specific names have been forgotten or were never known, our appreciation and thanks remain.

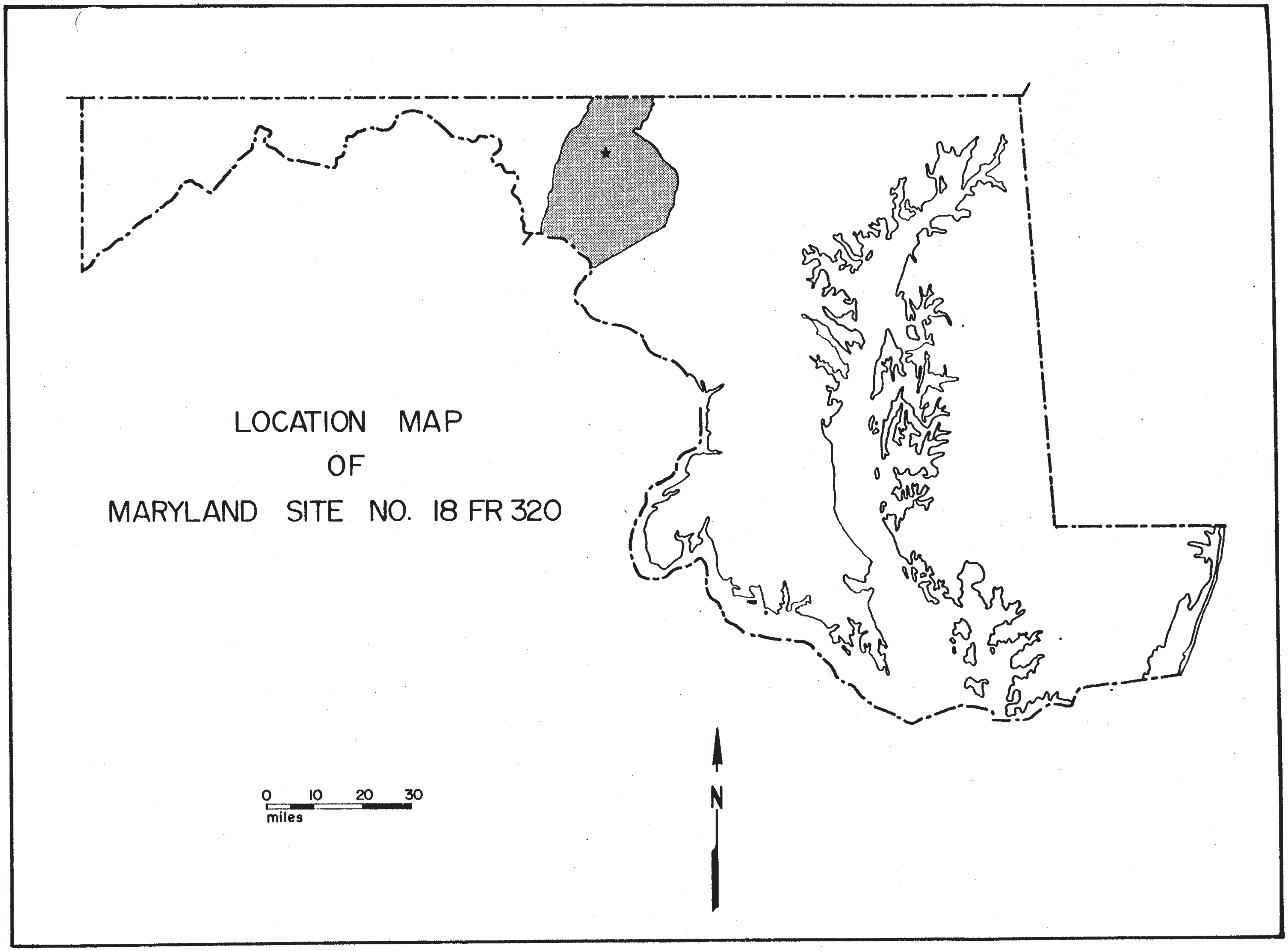
Persons who contributed to the success of the 1981 field season included the field team: Kenneth Joire, Georgia Vichos, Steven Yuresko, and Karyn Zatz who were most productive and good-humored under trying field conditions; Tyler Bastian, State Archeologist, Maryland Geological Survey, Division of Archeology, who made a number of site visits and arranged for the excavation to be advertised through the Archaeological Society of Maryland which led to the involvement of some volunteers from that organization. Those volunteers are to be thanked, as are a number from Montgomery College. Dennis C. Curry, Maryland Geological Survey, Division of Archeology, provided invaluable assistance and coordination throughout the project. Edward Feaser, Resident Maintenance Engineer, State Highway Administration, was most helpful in arranging for removal of trees from the site as well as the Auburn Mansion pillars, and for the use of a backhoe at various points during the field season.

Out of the field, John Milner Associates were fortunate to have the participation of the Museum Applied Science Center for Archaeology at the University Musuem, University of Pennsylvania in carrying out the analytical program. At MASCA, Stuart Fleming, Scientific Director and Vincent Pigott, Research Specialist coordinated and facilitated the carrying out of the program. Nicholas Hartmann took the photographs of all sampled specimens and objects, as well as the microphotographs. Reed Knox, retired metallographer and MASCA volunteer, was of great help in the identification of the microstructures of the metal. Charles Swann at the Bartol Research Foundation, University of Delaware, carried out all the PIXE analyses. Gerry McDonnell of the Archaeometallurgy Group of the University of Aston in Birmingham, England kindly supplied the report on the metallographic examination of the slag. Prior to the examination of the samples, Harvey Yellin of Samuel Yellin Metalworks, provided the important *sine qua non* of cutting them.

In the interpretation of the results of the analytical program, as well as of the archaeological data, Michael Notis, Lehigh University; David Gaskell, University of Pennsylvania; and Robert Gordon, Yale University all made most helpful comments on the slags, and in the case of Michael Notis, on the metal as well. Heidi Moyer, Lehigh University, carried out the supportive SEM work. A trip to the Spring City Foundry, Spring City, Pennsylvania, facilitated by Morton Kanter, vice president and Samuel Marcus, president, and guided by Donald Stroop, foreman, was extremely illuminating and allowed identification of enigmatic artifacts. Sheila Charles of the Museum of Afro-American History, Boston, Massachusetts kindly supplied samples of cupola slag from the Highland Foundry site.

A trip was made to the important ironworking site of Ironbridge (England), where discussion with Stuart Smith, Deputy Director and Curator, Ironbridge Gorge Museum Trust, were extremely informative. He also facilitated a study of the copious collection of slag samples held by the Trust which was of crucial importance in the analytical program, and arranged for the work undertaken by Gerry McDonnell. Much appreciated assistance in artifact identification was given by Robert Vogel and Donald Berkebile, National Museum of American History, Smithsonian Institution.

Finally, other members of John Milner Associates' staff provided support throughout the project. Alex H. Townsend directed the project from 1979 through January of 1982 and produced draft manuscripts which formed the basis of Chapters I and II. Report graphics were prepared by Sara Ruch. Plates 10 through 15 were taken by Thomas Struthers, who also provided support in coordinating and reviewing this report. Pamela McAlonan typed the manuscript and attended to numerous other production details.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I. INTRODUCTION

The Maryland State Highway Administration, in conjunction with its dualization of U. S. Route 15, has undertaken a program of mitigative archeological investigations at Catoctin Site 18FR320 in Frederick County, Maryland. The first season of intensive excavations, conducted in the summer of 1979 by John Milner Associates, Inc., revealed archeological remains far more extensive, numerous, and complex than had been anticipated. It was recognized that full elucidation of the site's research potential would require additional excavations, and accordingly, the initial excavation report (John Milner Assoc., Inc. 1980) delineated remaining research questions and described the excavations and findings to date. The second season of excavations was undertaken by John Milner Associates in 1981 and added significantly to both the types and quantity of data available. The following report details the 1981 excavation and synthesizes its findings with those of the 1979 work in order to present a complete description, analysis, and interpretation of Catoctin Site 18FR320.

The following sections briefly describe the site and its location, and summarize previous investigations and specific objectives of the 1981 excavations. Chapter II provides the historical background of the site and is followed by a synopsis of applicable technological information. Chapters IV and V detail the 1981 excavations and present the analysis of recovered artifacts respectively, and form the basis of site interpretations offered in Chapter VI. The final chapter summarizes the investigations and presents their conclusions. References Cited, Figures, Plates, and Appendices complete the report.

A. Project Location and Description

Site 18FR320 is located in Frederick County, Maryland immediately north of the intersection of U. S. Route 15 and Maryland Route 806, approximately twelve miles north of the city of Frederick and three miles south of the town of Thurmont. Relative to Catoctin Furnace, the site lies about three quarters of a mile south of the furnace stack and the adjacent Ironmaster's House. Occupying a rectangular parcel of land sandwiched between U. S. 15 and Maryland 806, the site is defined on its north side by the stone and earth embankment of the "Auburn Dam," and by a sizeable drainage ditch on the south (Figures 1 and 2). Highway and attendant drainage modifications have obviously infringed upon what was once a wider area of historic features.

Following construction of the present alignment of Route 15 in 1964, the site area became a vacant field covered with scattered trees and seasonally heavy brush vegetation. Prior to highway construction, the site area had been the east boundary of the Auburn estate grounds marked by two stone gate pillars, and was bisected by the earlier alignment of Maryland 806.

Geologically, Catoctin is situated along the boundary between the "Blue Ridge geologic province on the west and the Triassic Lowlands section of the Piedmont geologic province" (Fauth 1980:8) to the east. This location is much more than coincidental, since iron ore deposits in this region are formed primarily where quartzitic deposits of the Blue Ridge province are juxtaposed with the carbonate deposits of the lowlands (Fauth 1980:8).

While iron ore deposits may have been the key factor in determining the general location of Catoctin Furnace, it is also significant that additional natural resources necessary for the successful operation of an ironworks were readily available. These requirements include streams for the provision of water power, limestone for use as flux, and abundant timber for the provision of charcoal. It is interesting to note that iron ore and water power were present in the immediate vicinity of site 18FR320 and were not simply characteristic of the Catoctin area in general.

B. Previous Investigations of the Site

Because the present report is intended as final and complete archeological documentation of site 18FR320, and because previous investigations of the site played a major role in shaping the design of the 1981 excavation, it is important that the results of earlier archeological excavations of the site be presented here in summary fashion. Previous investigations include the site testing conducted by Kenneth Orr in 1977 and the first season of intensive excavations conducted by John Milner Associates in 1979.

It was the archeological testing of the site in 1977 by Kenneth Orr which led to a recommendation for its intensive excavation. Testing of the site, coupled with local informant interviews, seemed to suggest a functional division of the area into two sites--a forge site and an adjacent site conjectured to be the locus of iron casting or founding activities.

The evidence for the existence of the forge was an 1858 map of Frederick County on which an "Old Forge" was located, and oral tradition which located a "forge" in the vicinity at the end of the nineteenth century. The existence of the conjectured foundry was based solely on materials recovered in the course of test excavations, and the interpretations thereof by both Orr and Edward Heite. These materials included gate metal from casting operations, fragments of cast iron artifacts, and slag of a type thought by Heite to be indicative of foundry activities (Orr and Orr 1977:11).

In joint consultation with Kenneth Orr and representatives of the Advisory Council for Historic Preservation, the Maryland Geological Survey, Interagency Archeological Services, the Maryland Historical Trust, and the Maryland State Highway Administration, a research design for intensive investigation of site 18FR320 was formulated. Initially, this research design called not only for the excavation of the conjectural foundry area, but for a limited examination of the forge as well. Emphasis was placed upon a determination of the relationship between forge and foundry.

Overall goals of the project as the 1979 investigations were begun were as follows:

1. Determination of the exact configuration and location of any remains of industrial structures, if present.

2. Determination of the function of any structural features encountered.

3. Determination of the means of construction of the stone dam and the basin which it encloses.

4. Determination of specifics of the use of waterpower and other technological aspects of iron production of the conjectural foundry and forge.

The excavation strategy employed in the attempt to satisfy these goals was one which involved the excavation of a series of long, narrow trenches coupled with the excavation of a number of five foot squares. While the trenches were designed to reveal feature and stratigraphic relationships from one part of the site to another, the small squares were designed to allow careful examination of individual features and strata and to facilitate a more controlled recovery of associated artifacts.

Although excavation of the forge area was soon abandoned and despite eight weeks of intensive hand and machine excavation, it was not possible to adequately satisfy the goals which had been established. This failure was largely a function of the unanticipated complexity and size of the site. Excavation of the forge area, moreover, was frustrated by the instability of the thick slag fill, measuring some eight feet in depth. To be sure, a number of historic structural features were located, and extensive artifactual evidence of iron manufacture was recovered. Nevertheless, a number of significant questions remained unanswered at the conclusion of the field project, and the report of these excavations (John Milner Assoc., Inc. 1980) outlined a series of recommendations for further investigation.

While it is not necessary in this chapter to discuss the findings of the 1979 field season in detail, the major discoveries included a rectangular building foundation with a yellowish sandy floor (Feature 1), a rather substantial stone wall (Feature 4), smaller stone walls (e.g., Feature 6), and numerous deposits of slag and charcoal containing cast iron artifacts and waste materials. Based upon the evidence of a possible raceway recovered by Orr immediately north of the site area near the southwest corner of the dam, it appeared that a watercourse may have entered the northwest portion of the site and that this area was thus critical for further excavation. In fact, the absence of a clear raceway feature in the 1979 excavations presented the project with a major puzzle, since it was assumed that waterpower would have been a requirement for the manufacture of iron. This same absence also served to dampen speculation that site 18FR320 may have been the location of the first iron furnace at Catoctin.

Due to the unanticipated extent and complexity of the site, it appears that the approach taken toward the investigation in 1979 was too fragmentary to allow adequate interpretation. That is, the excavation of small, scattered squares and long, narrow trenches did not provide sufficient opportunity for the determination of stratigraphic relationships across the site. The total number of hours allotted for investigation of the site, moreover, did not prove sufficient to allow for the excavation of an adequate sample of the site area.

The report of the 1979 excavations included the following needs and recommendations for further archeological investigation at site 18FR320:

1. Further examination of known and yet to be discovered structural features needs to be undertaken.
2. More information is required concerning the stratigraphic relationships between features.

3. Exploration needs to be undertaken to the north and south of the excavated area in order to more accurately determine site boundaries.

4. Further efforts are required in order to determine specific aspects of the use of waterpower at the site.

Each of these recommendations was taken into consideration in the formulation of a research design for the 1981 field investigations.

C. Research Objectives of 1981 Investigations

Prior to the initiation of on-site investigations, a revised research design was formulated in consultation with representatives of the Maryland State Highway Administration, the Maryland Geological Survey, and the Maryland Historical Trust. The objective of this reformulation was to ensure a maximization of the recovery of the kinds of data necessary for adequate mitigation of expected adverse effects to the site. The formal research design resulting from this consultation focused upon a number of objectives, some of which were very similar to those which served as project goals during the investigations conducted in 1979.

1. Determine with greater accuracy the horizontal extent of historic ironworking features and deposits.

   Excavations in 1979 revealed that site 18FR320 extends over an area exceeding 10,000 square feet, far in excess of the previous estimate of 6,300 square feet. For this reason, it was deemed necessary to expend some effort in an attempt to more accurately define site boundaries. Accordingly, one of the goals of the 1981 field season was the subsurface exploration of the areas immediately north, east, and south of the 1979 excavation units in order to determine the existence of additional features and deposits associated with historic ironworking activities.

   One aspect of the determination of site boundaries involved excavation both through and beneath the Auburn Dam. Because excavations in 1979 had yielded evidence which suggested the dam post-dated the conjectured foundry operations at site 18-FR320, it was hypothesized that remains of historic features might exist beneath the walls or basin of the stone and earth enclosure. The mass of overburden presented by the walls of the dam effectively ruled out hand excavation for the satisfaction of this goal, requiring that excavation be conducted with the aid of a backhoe. Initial plans thus called for the excavation of two parallel trenches through the south wall of the dam and into the interior of the enclosure, stretching northward from the area excavated in 1979.

Results of the 1979 excavation also indicated that the site extended further to the east than had originally been thought. Feature 6, for example, a narrow stone footing, clearly extended eastward beyond the limits of the excavation. Once again, it was decided that the most effective investigation could be undertaken with the use of a backhoe, and it was decided that a series of parallel trenches be opened along the east side of the site.

Although subsurface testing conducted in 1979 by Kenneth Orr revealed no evidence of ironworking activity in the area south of a highway drainage ditch flowing west to east beneath U.S. 15 and Maryland 806, it was decided that any attempt to further define site boundaries required additional testing in this area. Again, backhoe trenching was deemed the most appropriate excavation strategy.

2. Determine additional details of ironworking technology as practiced at site 18FR320.

Another significant objective of the 1981 excavations was the recovery of additional information regarding the specifics of ironworking technology at site 18FR320. Of principal interest was the recovery of evidence concerning the nature of waterpower at the site, this being seen as a key to the discovery of associated technological features and their interpretation.

The 1981 project was fortunate in having the active participation of the Museum Applied Science Center for Archaeology at the University Museum, University of Pennsylvania, in carrying out a program of metallurgical analysis of selected samples of slag, casting waste, and cast iron objects recovered from the site during the 1981 excavations. The research objectives in undertaking this analytical program included the following goals:

- To determine what metallurgical process was producing the slag found on-site.
- To identify the type of iron being produced, and what its mechanical and foundry properties would have been.
- To understand the metallurgical relationship between the slag and iron.

3. <u>Determine the relative chronology of features and deposits</u>.

Specific questions were raised in 1979 regarding the possibility of successive periods of industrial activities at site 18FR320. That is, was the site relatively static over time or is there an archeologically recognizable sequence of industrial activities?

Because of the fragmentary nature of the 1979 excavations, it proved especially difficult to make stratigraphic comparisons and interpretations regarding the relative chronology of excavated features. This was made even more difficult by the lack of necessary time and manpower to excavate certain areas of the site to depths sufficient for stratigraphic correlation.

Accordingly, it was determined that intensive excavation would be undertaken over a comparatively wide area of the site in an explicit effort to determine stratigraphic correlations and relative chronologies. A better understanding of the technological evolution of the site was seen as important in determining whether variations observed amongst the cast iron waste and implements recovered from the site are reflective solely of the different types of contemporary items once manufactured and/or used at the site or whether these variations also have spatial and temporal correlations.

4. Determine the function of structural features exposed during excavation.

It is of crucial importance to an overall interpretation and assessment of the site that the function of each structural feature be determined as closely as possible. It is important to determine, for example, whether the features unearthed at site 18FR320 are remains of structures once associated with the primary manufacture of cast iron, or whether they are remains of ancillary structures used for final processing or storage. In the absence of such determinations, the relationship of the site to the Catoctin Furnace complex remains in doubt.

Interpretations of function also have an important bearing upon the determination of technological change at the site. Interpretation of this nature may suggest, for example, that the site underwent a change from primary manufacture to a more secondary function.

In comparison with the determination of site boundaries, the satisfaction of each of the other project goals was viewed as requiring an emphasis upon careful hand excavation. The use of heavy machinery in this respect was in fact restricted to the occasional removal of overburden.

D. Excavation Methods

As in 1979, the 1981 excavations were conducted within the framework of a horizontal grid which functioned as a spatial reference for the location of excavation units and excavated materials. This grid, the same employed in 1979, is anchored to a datum marker set in concrete on the south edge of Maryland Route 806, situated so as to avoid impact from the dualization of U. S. 15. The grid is oriented on an approximate north-south axis and is infinitely expandable in all directions. Each grid unit is labeled by the position of its southwest corner in relation to an arbitrary point located 39 feet north and 136 feet west of datum and designated North Zero/East Zero, or simply N0E0. The reason for locating the N0E0 point away from the site datum was to provide a point close enough to the excavations for practical grid measurements and at the same time to fit most of the excavation area within a single grid quadrant (north and east of N0E0). An excavation unit having as its southwest corner a point lying 50 feet north and 35 feet east of N0E0 would thus be designated as unit N50E35.

In contrast with the 1979 excavations, all mechanically excavated trenches dug in 1981 were aligned with the site grid, with the single exception of a large trench through the south face of the Auburn Dam. In the latter instance, a decision was made to orient the unit perpendicular to the face of the dam in order to reveal a more representative cross section of this feature.

Based on the 1979 excavations, it was believed that most of the site's data were to be obtained through examination of its features, supplemented by artifactual data. Accordingly, recovery techniques were chosen with an emphasis towards the exposure of features with less emphasis on the recovery of every artifact. The bulk of the excavation was carried out with pick and shovel, trowels being utilized only when necessary. Similarly, excavated soils were passed through wire mesh screen only when necessary for the recovery of a sample of small artifactual materials.

II. SITE HISTORY

A. Historical Background: Catoctin Furnaces

The history of ironworking at Catoctin Furnace has been described in a number of reports, some of which discuss the development of the site in a fair amount of detail. This previous research has been heavily relied upon in this section, which attempts to integrate these studies into a summary which is relevant to site 18FR320 and to the iron technology of Catoctin Furnace.

The construction date of the first Catoctin Furnace is uncertain. A furnace was probably in existence by 1776 when James Johnson and Company acquired additional land to add to the tract already in their possession for which they were to pay one hundred tons of pig iron (National Heritage 1975:4). The initial land patent by Thomas Johnson and Benedict Calvert in 1770 was "for the purpose of Erecting and Building an Iron Works" (National Heritage 1975: 4), but how soon the furnace was in blast and producing after this date is uncertain. The furnace was certainly in production by July 22, 1776 when Thomas Johnson, in reply to an earlier letter from the Maryland Council of Safety, stated that "We have now by us a few potts of about the size you describe [two gallons and four gallons], a few kettles & a few Dutch ovens of much the same contents (Contract Archaeology, Inc. 1971:17-18).

Further corroboration of the furnace's existence and activities is given in a 1777 newspaper advertisement which refers to "Salt pans ten feet square and 15 inches deep with screws ready to join and fit them up at Catoctin Furnace about 10 miles from Frederick Town" (John Milner Associates 1980:5). In 1780, the furnace was producing ten-inch shells for the Board of War (National Heritage 1975:5; Documents 1 through 5), and a dated stove of 1786 (National Heritage 1975:Plate 1) demonstrates that stoves were being produced after the Revolutionary War.

According to John Alexander, writing in 1840, who obtained his information from a descendant of the Johnsons, the furnace was built in 1774 and operated successfully until 1787," in which year the same company erected the present furnace, about three fourths of a mile further up Little Hunting Creek and nearer the ore banks" (Alexander 1840:78-79).

In 1811 Baker Johnson, who was then the owner of the furnace, died and the property was sold by his heirs to Willoughby and Thomas Mayberry of Philadelphia in 1812 (National Heritage 1975:7). An inventory taken at the time of Baker Johnson's death listed a blast furnace, wheel and bellows, a large dwelling house, two storehouses, a chopping mill, stonesmith shop, barns, stables, and cornhouses (Thompson 1976:65). In his will Johnson left his house, Auburn, which was built around 1804 (National Heritage 1975:7) to his son (also called Baker), and his daughters received the furnace and furnace lands (Contract Archaeology, Inc. 1971:21). A newspaper of this period states that there were two furnaces in Frederick County producing 380 tons of pig iron and 400 tons of pots and stoves valued at $42,970.00 (Contract Archaeology, Inc. 1971:21). One of the two furnaces was Catoctin; the other, a furnace also owned by the Johnsons, was erected on the Monocacy River in 1787 (Thompson 1976:64).

In 1820 Catoctin was bought by John Brien and John McPherson and added to their already substantial ironmaking investments (Thompson 1976:79-80). The sale inventory for the property included "A commodious casting-house and pot house, sufficiently large for sixteen moulders, built of stone, office and storehouse, coal house, two blacksmith's shops, a large ware-house and stables for four teams; chopping, stamping and saw mills all in complete order . . . Also 22 houses for Workmen" (Thompson 1976:81). During this period, in 1836, the furnace shipped castings to the railhead at Frederick where they were transported on the rail line to Baltimore (National Heritage 1975:10; Document 6). Other products were hollow-ware (Contract Archaeology, Inc. 1971:22) and stoves (National Heritage 1975:Plate 2).

Brien and McPherson rebuilt the stack in 1831 and added 3,000 acres more to the 5,547 they already owned (Thompson 1976:84-85). An 1841 sale notice lists property at the furnace including ironworkers' houses and a grist and saw mill, but makes no mention of the actual furnace. After the death of John Brien, the furnace was operated by his heirs until it was sold in 1843 to Peregrine Fitzhugh (National Heritage 1975:10-12).

Under Fitzhugh the furnace which had been out of blast since 1839 was modernized: by 1850 ninety workmen were producing 5,000 tons of pig iron and castings and a steam engine was providing power for the operation (Thompson 1976:103). In 1848 and in 1855 records indicate that pig iron from Catoctin was being sold to foundries in Baltimore (National Heritage 1975:12). In 1856 Fitzhugh sold a half share in the furnace to J. Kunkel; at this time, the inventory of property belonging to the furnace included six teams of horses and mules, wagons, the ore mines and furnace stack, furnace tools, blacksmith tools, carpenter tools, farming tools, and ore bank mules (Contract Archaeology, Inc. 1971:41-42). Fitzhugh's financial problems which had caused him to sell a half share to Kunkel worsened, and by 1859 he had forfeited his remaining interest in the furnace and the whole of the property came into the possession of J. Kunkel (Thompson 1976:105).

In 1856 Fitzhugh had erected a steam operated cold blast charcoal furnace (Isabella) alongside the existing hot blast furnace (Contract Archaeology, Inc. 1971:24). In 1860, under Kunkel, the production of the furnace was 4,500 tons of pig iron and castings per year; an 80 horsepower steam engine was providing power for the furnace, 90 men worked at the furnace, two men at the foundry, three men at a blacksmith's shop, and two men at a wheelwright's shop; the main products of the ironworks were heavy castings; implements, tools, and wagon iron were also being made (Thompson 1976:105-106). In 1873, a new steam operated hot blast coke furnace (Deborah) was built with a capacity of 35 tons a day which produced pig iron and foundry iron (Contract Archaeology, Inc. 1971:25).

Under Kunkel and his sons the furnace attained its greatest period of productivity. In 1870 the furnace complex was capitalized at $150,000.00 and its iron production was valued at $142,000.00 (Thompson 1976:106-107). In 1880 the property included three stacks, 10,000 acres of land, warehouses, shops, storehouses, 50 ironworkers' houses, two steam engines, and 30 ore carts; the iron producing capacity of the complex was 10,000 to 12,000 tons and an estimated 500 men formed the work force (Contract Archaeology, Inc. 1971:26). After a short period of operation as the Catoctin Iron Company after Kunkel's death, the furnace went out of blast in 1892 (Thompson 1976:108). In 1899 the furnace was sold to the Blue Mountain Iron and Steel Company which enlarged Deborah in 1900 and ran the furnace until 1903 (Contract Archaeology, Inc. 1971:28). This was the last time that the furnace was in blast; in 1905, the property was sold to Joseph E. Thropp who mined the ore banks and dismantled some of the furnace structures for scrap (Thompson 1976:109). The 1787 stack had been pulled down in 1890 (Directory 1894:71), leaving only two operational furnaces.

The history of ironmaking at Catoctin appears to have run a similar course to many other eighteenth and nineteenth century furnaces. In the eighteenth and early nineteenth centuries, Catoctin produced the traditional range of "country castings," hollowware, stoves, some munitions during the Revolutionary War, and a variety of other small castings. By the mid-nineteenth century, the furnace appears to have largely abandoned the production of this type of product in the face of increasing competition from urban foundries and was specializing in heavy castings. During this period, the furnace reached its highest level of prosperity and diversification, and appears to have been manufacturing wagons, tools and agricultural implements, as well as heavy castings. The furnace was becoming mechanized and had steam engines, a narrow gauge railroad running to the ore banks, and a steam powered foundry (Thompson 1976:105-106).

The documentation relevant to the furnace during its 130 year history is fragmentary and sparse. Most of the furnace journals are said to have been destroyed in 1927 when the furnace office was dismantled (National Heritage 1975:17). While the surviving documentation indicates something of the size and scale of the major components of the ironworking complex, especially in the second half of the nineteenth century, the paucity of the documentary evidence creates gaps which make interpretation of some aspects of the furnace operations difficult.

Specifically, the chronology, operation, and location of various ancillary structures throughout the period of the furnace complex are not well understood (cf. Struthers 1981:82). Site 18FR320 is probably an area of those ancillary structures, and as such does not appear directly in the records and notices cited above. However, a good deal of indirect and circumstantial evidence relating to the site can be garnered from the documentation, as discussed below.

B. Historical Background: Site 18FR320

The Auburn Mansion, built by Baker Johnson early in the nineteenth century, is located quite near the 18FR320 site. The old driveway to the house runs across the excavation area flanked by two stone gate posts erected in the 1920's (Orr and Orr 1977:10). The relationship between the Auburn Mansion tract and the furnace lands is indicated by a deed of 1802 which states that 934 acres were re-surveyed and incorporated into the Auburn tract (Contract Archaeology, Inc. 1971:20). The wording of the deed indicates that this was land already owned by Baker Johnson which presumably was now being separated from the furnace lands. The 18FR320 site probably is located on what was then the Auburn tract and, presumably, was also separated from the furnace lands at this time.

How long the site might have remained out of furnace ownership is uncertain, but the furnace owners in 1831, Brien and McPherson, acquired 3,000 additional acres of land, part of which included the Auburn tract (Thompson 1976:84-85). In 1843 when Peregrine Fitzhugh bought Catoctin Furnace, the property included Auburn Farm which suggests that the furnace lands included part of the Auburn tract at that date (National Heritage 1975:12). In 1848 what is described as the "warehouse" plot was bought by the Auburn owners. This purchase excluded the stream, pond, and forge site. The warehouse was apparently on the left of the driveway near the gate, and reference is also made to a gate near the "forge where castings were made" (Heite 1980:3). Assuming the pond referred to is the earthen dam which still stands at 18FR320 and given the mention of the "driveway," it seems probable that the property described by this source can be equated with the excavation site.

The reference to the "forge" is also interesting in the light of the evidence of the 1858 Bond Map which shows a forge located to the south of 18FR320 (Struthers 1981:Figure 4). Despite the extensive documentary research carried out on the history of Catoctin, no other references to this forge have been located. The 1808 Varlé Map, while it identifies the furnace to the north of 18FR320, does not show any evidence of a forge (National Heritage 1975:7). The inference of this map evidence is that the forge was built after 1808, but if as suggested above this portion of the Auburn tract was not owned by the furnace until after 1831, it would be unlikely that the forge was in existence before 1831. The identification of the structure as an "Old Forge" in 1858 suggests that by this date the building was defunct. The implications of this interpretation are that the forge building was very short-lived as a functioning industrial structure, an interpretation which perhaps accounts for the paucity of historical documentation concerning it.

On the 1858 map the forge is shown schematically on the east side of the highway with another structure on the opposite side of the road and slightly further to the north which would place it within the area designated as 18FR320. Neither of these structures is shown on the 1873 Lake Map (Struthers 1981:Figure 5), suggesting that both were overgrown or in ruins by then. The oral history evidence, too, indicates that the "forge" was a ruin probably by the 1870's; these sources also describe "boating on Auburn Lake" (Orr and Orr 1977:8), which presumably relates to the present earthen dam on the site.

According to the oral history interviews carried out in the 1930's, the water from the dam ran beneath a brick arch which carried the highway over it. This was said to be "within the memory of middle-aged residents" indicating, perhaps, a date in the 1890's (Orr and Orr 1977:78). Interviews carried out in the 1970's suggest that the dam powered the forge which was located below the ravine (Orr and (Orr 1977:8). The dam is thought to have been constructed c.1845 (Contract Archaeology, Inc. 1971:51-52), and the 1848 reference discussed above referring to a pond in this area, supports that dating. The highway which passed over the ravine (Route 806) was moved 20 feet to the west in the early twentieth century, and the ravine was filled in with furnace slag (Orr and Orr 1977:78). Little use appears to have been made of the site area in the twentieth century, which was overgrown and had a number of fairly substantial trees growing on it when excavations commenced in the 1970's.

III. TECHNOLOGICAL BACKGROUND

There is no question but that at site 18FR320 one is contemplating a site at or near which ironworking processes were in operation. The finds of casting waste and slag from 1979 and 1981, and the proximity of the site to the Catoctin Furnace complex make this a foregone conclusion. Accordingly, it is important to have a good understanding of the different metallurgical processes which were involved in working iron in the nineteenth century: what form and construction the physical plant would have to take and what the products would be, both waste and finished. This section is tied to site 18FR320 in that discussion focuses on those activities of which evidence has been seen in the archeological record, or which the historical record suggests may have been in operation.

A. Furnaces and Hearths

In the late eighteenth and nineteenth centuries, iron was generally produced in the indirect method by primary smelting of iron ores together with flux and fuel in blast furnaces to produce cast or pig iron, defined as iron containing between two to five percent carbon, together with other impurities, most notably silicon, sulfur, phosphorus, and manganese. Cast iron, because of its high percentage of carbon, has a low melting point and is therefore easy to melt and cast into complex shapes. However, it is a brittle material that can be applied only in circumstances where it will not be subjected to shock loads, and it cannot be worked (Gagnebin 1957:7). Since these were not the mechanical properties desired for most uses, most of the iron produced in the first half of the nineteenth century was converted or refined to wrought iron (85 percent in 1831) (Temin 1964:25). Wrought iron is commercially pure iron with less than 0.5 percent carbon. It has excellent resistance to shock and vibration, and is readily welded and machined. It is soft, ductile, and malleable.

In England by this time, most furnaces were coke-fired, following Abraham Darby's success with using coke at Colebrookdale in 1709

(Schubert 1958:99). In America in the early nineteenth century most furnaces were still fueled by charcoal with the first commercially successful furnace to smelt with coke being Lonaconing in western Maryland, and the first commercially successful furnace to use anthracite being Catasauqua in Pennsylvania, both around 1839 (Sanders and Gould 1976:63; Swank 1884:272). However, charcoal was the only fuel in use at Catoctin until 1873 (and the only fuel found in quantity at 18FR320), so only charcoal furnaces are relevant to this discussion.

Early charcoal furnaces were substantial, stone-built structures in the shape of truncated pyramids. The stone shell enclosed the hearth proper, which would have been lined with some refractory material, preferably firebrick for the inwalls and sandstone for the hearth (Overman 1854:156-159). The products would have been cast iron, either in the shape of pigs or, if casting was being done directly from the furnace, objects; and slag.

Blast furnaces produced large quantities of slag, although charcoal furnaces did not, apparently, produce as much as coke furnaces. Alexander notes that an "ordinary-sized [English] coke furnace furnishe[d] about thirty tons of cinder per day" (1840:131). Slag might have just been run out of the slag notch to collect on the sand floor, as suggested in Diderot's engraving of 1763 (1959:Plate 90), or might have been run into iron carts, as suggested by Alexander (1840:131) as being the English practice.

The pigs might take various forms (Barriault 1978:Plates 5 through 12), depending on the form of the mold in the pig bed into which they were run, and were frequently, but not always, marked with the name of the furnace at which they were cast. Probably, this would depend on whether they were being sold in that form or being immediately utilized at the same complex for remelting or refining. A Catoctin pig which was apparently unmarked was found in the excavation within the casting house area of the standing stack in 1975 (Orr and Orr 1975:14 and Plate II).

Casting was also done at this time from remelting furnaces. Overman (1872: 189) discusses the advantages and disadvantages between the two methods:

> There is really no advantage in casting directly from the blast-furnace, for the iron is never of such uniform quality as to secure good castings . . . . There are, however, instances where casting from the blast-furnace is not only excusable but necessary . . . . Iron, cold-short of phosphorus, is generally not used in forges, and it has too little carbon left to admit of remelting. There is hardly any other way left but to make castings of such iron . . . . The only and best purpose it is adapted to is for casting hollow ware and stoves; it will form fine and sharp castings, and cooking pots made of such cold-short iron cannot be surpassed in quality.

Generally speaking, from the introduction of the drop bottom cupola in the New England region around 1850, the cupola was the foundry furnace *par excellence*, although the first cupola used in America seems to have dated around 1815 (Simpson 1948:191). Early cupolas were built on stone or brick foundations and might be constructed of cast iron staves held together by wrought-iron bands. The cupolas were only from six to eight feet high (Kirk 1899:149). An example of this type is preserved in the Musuem of Iron at Ironbridge, England. Ultimately, the most common form was a furnace, the shell of which was boiler-plate, lined with firebrick and set above the floor level on either iron or brick supports (Simpson 1948:Figures 170 and 171). The firebrick lining, within the narrow cupola, was generally made of wedge-shaped or curved brick (Kirk 1899:22).

Produced by the cupola were slag and cast iron products. The quantity of slag produced varied quite a bit depending on whether or not the cupola was fluxed; Kirk cites a figure of between 25 to 100 pounds of slag produced per ton of iron (1899:142), substantially less than the figure quoted of half a ton of slag for each ton of iron produced in the blast furnace (White 1980:57).

The material fed into the cupola would be pig iron and scrap, which would often include the gate metal from the castings. The fuel used most commonly was coke. The slag was released by dropping the bottom of the furnace after all the iron had been run out, or sometimes by running it from the tap hole with the iron (Kirk 1899:66).

Another remelting furnace in use in the first half of the nineteenth century was a reverberatory or air furnace. Reverberatory furnaces were rectangular structures which would commonly have a firebrick interior and common brick or iron plate enclosure; the hearth interior might be five to eight feet long and equally as wide with a 40 feet or higher chimney (Overman 1872:197). In the English iron industry, the use of remelting furnaces began about 1702 (and cupola furnaces about 1701) (Schubert 1958:101 and Figure 57); in the United States, they were in use at least from 1787 and probably earlier (Sanders and Gould 1976:173). The reason for the term given to them was that the hearth in which the charged pig iron was melted did not come in contact with the fuel; rather, the fuel (usually coal) was burned in a separate firebox and the hot air drawn over the pool of metal by the action of the chimney melted the iron (Morton 1973:Figure 4). Overman notes that at the time he was writing (1872), reverberatory furnaces "are in a great measure replaced by cupola furnaces" (1872: 196). Castings and slag were produced, but it is not known in what form the slag occurred.

In the first part of the nineteenth century, wrought iron in the United States generally was produced in charcoal forges (finery and chafery). Henry Cort's technique of puddling, patented by 1784 (Morton and Mutton 1967:722) was adopted in America between 1820 and 1850; by 1856, only ten percent of the wrought iron produced in the States was made in forges (Temin 1964:101). However, Overman (1854:280) points out that charcoal forges produced superior wrought iron and that they were less expensive than puddling establishments: "Iron works, situated at remote places in the country, frequently find a favorable market for a limited quantity of iron."

The form that these would take has been well described for English examples (Morton and Wingrove 1971), and excavated American examples indicate they would have had substantially the same appearance (Lenik 1974; Ditchburn 1966). Generally speaking, within the forge would be four to six hearths which would appear similar to blacksmith's hearths. The base and chimney would be stone or brick built; the crucible or hearth proper would probably be lined with cast iron plates (Den Ouden 1981:63). It is not clear if firebrick would have been required. Cast iron plates would have provided a skidway to drag the pasty bloom or loop to the hammer and anvil, which would have been set into a massive tree trunk similar to those found at Saugus (Robbins 1959:60) and Chingley Forge (Crossley 1975:Plate X).

Bar (wrought) iron would have been the product, the dimensions of which may be as pictured in Diderot's Encyclopedia of 1763 (1959: Plates 96 and 98). Slag would have been produced in both the finery and chafery hearths, and the amount would have been directly proportional to the silicon content of the wrought iron, perhaps five pounds of slag per one hundred pounds of pig iron. However, Morton and Wingrove note that as a larger volume of slag would have been needed to work the charge effectively, additions of hammerscale, ore, and so on might be added (1971:27). The slag would overflow onto the sand floor in saucer-shaped depressions (Morton and Wingrove 1971:25).

Direct production of wrought iron in bloomeries has not been discussed because no evidence whatsoever suggests this would ever have occurred at Catoctin. Puddling has also not been discussed because the only mention of it at Catoctin occurs in John B. Kunkel's patent application of 1876, which is also the only mention of a cupola at Catoctin. In this he writes that "when operating upon metallic iron to eliminate its phosphorus I apply the dolomite either in the cupola or puddling-furnace . . ." (National Heritage 1975: Document 8).

In conclusion, the various finds that might be expected at a site where any of these furnace or hearth types were in operation will be summarized. For a charcoal blast furnace, a substantial stone foundation would be anticipated, along with finds of ore, limestone or some other fluxing material, and charcoal. Firebricks from the lining should be encountered, and volumes of slag. The cast iron and waste found would depend on whether the furnace was producing only pig iron or also finished artifacts. If the latter, then flask parts and molding tools (discussed in the following section) might be discovered, along with casting waste.

For a cupola, the physical remains of the furnace itself would be less substantial than for a blast furnace. However, some sort of a foundation or base would be required which would have to be quite solid, preferably constructed of solid stonework and possibly incorporating an iron ring on which to place the cupola supports (Kirk 1899:18). Firebricks from the lining would be expected; fragments of cast staves or boiler plate from the casing might turn up. Finds of pigs, gate metal, flask parts, and molding tools would all be likely, as would small volumes of slag. Most importantly, one would expect large quantities of molding sand.

Very little seems to have been written specifically about reverberatory furnaces, but the general description suggests a large structure which should have left substantial remains. Again, finds of firebrick would be encountered.

Refinery forges could be small or large, depending on the quantity of iron being produced and the number of hearths in operation. The hearths would need solid foundations, probably of brick. Finds of cast iron plate would be expected, both for the skid or dragway, and for lining the crucible. Anvil bases and evidence of hammers would be anticipated. "Hammerscale," which is the name given to the flecks of oxidized iron which are created on the surface of heated iron and then knocked off in hammering, would build up on the floor around the anvil bases and, with the slag squeezed from within the loop of iron itself, would probably form hard, concreted surfaces, as seen at Saugus (Robbins 1959:61).

Finally, no mention has been made hitherto of the power source needed to operate the blast which all of these installations would have required. Fundamentally, until steam-driven blowing-cylinders came into common use in the United States, which was probably not before around 1815 (Schubert 1958:105), the blast would have been supplied by water-driven bellows. At Catoctin, the first mention of steam power is in the 1850 Census (Thompson 1976:103).

B. Casting and Finishing

The most identifiable and diagnostic artifacts found at 18FR320 were the various items of gate metal and other casting waste, stove parts, and fragments of hollowware. Accordingly, this section focuses on the specific processes of casting stoves, hollowware, and machine parts, and the subsequent removal of casting waste or "fettling" of these items, and in the case of stoves, the assembling of them.

The way in which iron artifacts were cast in the nineteenth century was dependent on the shape and level of complexity of the finished artifact. Simple flat artifacts such as stove plates could be cast in open molds. This, at least, was the practice in the eighteenth century, and as late as 1820 some furnaces were still casting in this way (Tyler 1973:158). Stove plates cast in open molds tended to be of irregular thickness and weight, and were generally heavier than those cast in closed molds. A survey of stove plates in the collection of the Bucks County Historical Society showed that European plates averaged between a quarter and three eighths of an inch in thickness, whereas American made stoves averaged half an inch thick (Mercer 1961:37).

The conclusions of this limited survey agree with the known differences which existed between European and American founding practices. By the close of the eighteenth century, coke fired furnaces were the norm in Europe, and the higher fluidity of iron achieved in these furnaces enabled the casting of finer, more delicate stove plates in closed molds. By the early nineteenth century, improvements in blast machinery enabled higher temperatures to be achieved by charcoal furnaces. The increased temperatures made the iron more fluid and enabled American manufacturers to produce finer stove plates cast in closed molds (Tyler 1973:161).

Economic factors played a major role in determining why and when American iron manufacturers introduced new techniques for producing cast iron.

The availability of vast tracts of forest for coaling allowed the production of charcoal iron to continue long after the majority of European furnaces had changed to coke. Likewise, the casting of stove plates directly from the blast furnace, as at Hopewell Furnace (Walker 1967:151) was economically viable, as it produced items of greater value than pig iron. At Hopewell, stove production was a major source of furnace revenue until the mid-nineteenth century; for the most part, however, the stove parts were not assembled but were shipped out as parts to dealers who bolted them together and finished them (Walker 1967:156-158).

Finishing and assembling stoves required a supply of wrought iron and a blacksmith to manufacture the nuts, bolts, brackets, and other hardware needed to produce the finished stove. The archeological evidence at Catoctin indicates that stoves were assembled there as numbers of stove bolts were found. Blacksmiths were, of course, an integral feature of ironworking sites, and were kept busy repairing and manufacturing hardware for the use of the miners, colliers, and other ancillary workers. As the Catoctin furnace was in production from the 1770's, there were undoubtedly blacksmiths working there from this date. The furnace was producing stoves in the eighteenth century as witnessed by an example dated 1786 (National Heritage 1975:Plate 1), and if as suggested the stoves were being assembled at Catoctin, the services of a blacksmith would be required to produce the wrought iron hardware needed to bolt the stoves together.

The 1786 stove referenced above was probably cast in an open mold directly from the furnace. The patterns were of wood with the pattern or design carved in relief or sometimes formed out of sheets of lead which were nailed or glued to the wood; mahogany was the preferred wood "because it warps least" (Mercer 1961:33-34). By the early nineteenth century, more complex designs were being manufactured including curved plates which led to the use of flask molding (Tyler 1973:158). Some of the more elaborate stoves produced at Catoctin would have been made in flask molds as would the hollowware (National Heritage 1975:Plates 3, 5, and 6).

Flask molding of iron as a technique for the production of hollowware and later for stove plates dates from 1707 when Abraham Darby patented "a new way of casting iron bellied pots . . ." (Tyler 1973:145). The introduction of this method allowed finer hollowware to be cast, and because the technique was more rapid than previous methods, the finished products were produced more quickly and could be sold at a cheaper rate. Small castings such as stove plates, hollowware, "cartwheel bushes," and small machine parts were usually produced in wood or iron flask molds (Overman 1872:31). A pattern which replicated the shape of the desired casting was encased in green sand which had been tempered with charcoal before being rammed around the pattern in the flask.

For flat castings such as stove plates, the molding process was comparatively simple. More complex objects such as hollowware and stove plates with curved surfaces required the use of composite or "parted patterns" (Clemens 1924:Section 69:14). For casting hollowware, the pattern was often made from an existing iron pot which was cut in half after its feet and handles had been removed (Tyler 1973:147). The technique involved the use of a composite flask mold in which the two halves of the pattern were inserted upside down, and green sand was rammed around the pattern and around the feet and handle patterns. A wooden plug called a gate or sprue was pushed into the sand to form an opening for the molten metal, then the flask was turned over and the inside of the pattern was rammed with sand.

The green sand used to form the mold was high in magnesium and alumina which helped to make it plastic and cohesive; coal or charcoal dust was added also to help bind the sand (Spretson 1878:163-166). After the pattern was removed from the mold, the surfaces were smoothed and dusted with charcoal or blacking (Tyler 1973:147-148). This was to prevent the molten iron from sticking to and being roughened by the sand. Despite these precautions, however, the castings were frequently in need of cleaning. At Hopewell, the job of cleaning castings was frequently done by women, and the molders were responsible for paying them at the rate of 75¢ per ton (Walker 1967:323). This no doubt encouraged the molders to produce better quality castings, as poor mold preparation would increase the number of castings needing cleaning with a direct effect on the molders' income.

The artifactual evidence for the casting process which might be expected on a site would usually consist of waste products and broken or faulty castings. Evidence of the kinds of products being made would be indicated by the castings themselves. The kind of casting technology in use would be shown by the waste iron, or gate metal, and by fragments of hardware from molds. Post-casting activities such as removal of casting scars and the assembling of items like stoves would be demonstrated by the presence of tools such as cold chisels, files, hammers, and wrenches.

Open mold casting is usually suggested by the presence of runners, half-round sections of cast iron which formed in the channels in the sand which led to the casting. Runners may be found with a main stem and a number of branches indicating flat bed casting of multiple items. These were usually small articles such "as parts of locks, latches, hinges, knife-blades, knife covers, and other small articles [which] are generally put ten or twenty or more together . . ." (Overman 1872:67). The open molds would be enclosed by a wooden frame or sometimes beds were formed by mounding sand up over pigs of iron to form a pouring basin (Clemens 1924:Section 72:6-7). Pigs of iron were, of course, cast from the blast furnace onto the casting house floor. This form of casting, known as open sand molding, was primarily confined to the production of pig iron, although items for foundry use were sometimes cast this way as well (Overman 1872:50).

Finds of gate metal, wedge gates, and sprues are indications of flask casting. Sprues are cylindrical tapering cast iron objects of varying length; wedge gates, as the name suggests, are wedge-shaped and they, too, are of varying sizes. Their function was to convey the molten iron into the closed mold; after the casting had cooled, the sprues or wedge gates were removed. This was done with a hammer and chisel and then the casting scars were "scoured" with "dull, coarse files, which have been used and rejected by machinists" (Overman 1872:220). The trimming of the wedges or sprues was usually done by the molder on the foundry floor; scouring and the removal of ragged edges was carried out in the "fettling shop" (Spretson 1878:368-369).

The shape and size of gates is governed by the surface area of the casting; the aim is to ensure that the molten metal reaches all parts of the mold more or less simultaneously (Spretson 1878:184). Personal preference for the shape of gates was also a factor. Tyler cites the example of a stove in the William Penn Memorial Musuem, Harrrisburg, Pennsylvania, which has two doors cast with a wedge gate and one with a sprue (Tyler 1973:153). In general, the precise shape and volume of gates seems to have been decided by the individual molder on the basis of his experience.

Other evidence of flask casting might be represented by fragments of the iron flasks or the associated hardware. Hollowware was generally cast in iron flasks (Overman 1872:71). These flasks were made in several pieces to aid the molding process and were held together with clamps or hooks and eyes. Stove plates and other larger castings might be cast in wooden flasks. These, too, would have iron hardware and nails which could survive in the archeological record. Wooden flasks were often held together with flask clamps during the casting process when the weight of the molten metal might force the two halves of the flask apart. Flask clamps were made of wrought iron and cast iron, and were clamped onto the flasks with wedges (Clemens 1924:Section 72:30-32). Other items associated with this form of casting are gaggers which were iron braces inserted in the mold to strengthen the sand, and chaplets which were iron braces designed to support the sand core of a mold (Overman 1872:75). All these items have distinctive and peculiar forms indicative of flask casting.

As mentioned above, the presence of a blacksmith was a prerequisite for ironworking sites. The equipment used in mining and transporting ore to the furnace and the various tools used in the production of iron from the ore were usually made and repaired by the blacksmith. The presence of two smiths at Catoctin is documented in 1820 (Thompson 1976:81). A later reference which may be relevant to Catoctin indicates that blacksmiths were there in 1834. This source, taken from an inventory of John Brien's property, suggests that "8 Torr [tons] Bar Iron" was among the property at Catoctin, and also flasks and powder valued at $1,000 (Mid-Atlantic 1981:Appendix 1; Historic Documentation Report, n.p.). If this inventory actually relates to Catoctin, the presence of bar iron would indicate the presence of either a smithy or a forge. The reference to flasks and powder, which presumably means casting flasks and sand, supports the contention that flask casting was carried out at Catoctin.

An 1856 document lists horses, mules, wagons, and blacksmith's and carpenter's tools at the furnace (Contract Archaeology, Inc. 1971: 24). In the 1860 census, a smithy employed three men who used ten tons of iron and 11 tons of steel to make wagon iron, plows, and tools (Thompson 1976:105-106). The function of the Catoctin blacksmiths varied with the changes in the types of products produced at the furnace. They would always have been involved in basic maintenance of tools and equipment, but would also be required to produce the wrought iron hardware needed to assemble stoves and salt pans. They may also have made hinges and catches for flasks and nails for wooden flasks. Various kinds of small specialized tools would be needed for moldmaking and other processes at the furnace, and these, too, would probably be made by the blacksmith.

By the second half of the nineteenth century, a change of emphasis is apparent in the type of castings being produced at Catoctin. In 1860, "twenty ton" castings were the main product (Thompson 1976:106). Large castings such as these would be cast in large flasks or possibly in open sand molds, but the net result would be to reduce the work load of the blacksmith, as fewer pots and stoves would be cast. This situation may be responsible for the apparent specialization in wagon production in 1860, when the blacksmiths made wagon parts, two wheelwrights made parts of 28 wagons, and the sawmill produced 10,000 feet of boards (Thompson 1976:106). The apparently changing role of the blacksmith was a symptom of the changes in ironmaking technology which were occurring in the second half of the nineteenth century. The introduction of coke furnaces and the urban foundry forced the country furnaces to change from their traditional products, as these could be marketed more competitively by the town foundries (Tyler 1976:223).

IV. DESCRIPTION OF THE EXCAVATIONS

As discussed in the Introduction, excavations at site 18FR320 have been carried out over a number of seasons since 1977 by different personnel with varying goals and research designs. Coordinating the results is bound to be fraught with difficulty. In particular, correlating the stratigraphic soil layers encountered in the three seasons of excavation has proved most difficult. This problem is accentuated by the notable lack of closely datable artifacts within these layers.

In general, this chapter concentrates on the excavations of 1981. However, wherever possible the stratigraphic relationships observed in the 1979 excavations (John Milner Associates, Inc. 1980) and in some cases those noted in the 1977 survey (Orr and Orr 1977), have been correlated with the 1981 results. The 1979 work was relied on particularly for the sequence of layers in the approximately top two feet of fill over the entire site, which had been almost entirely removed by the 1981 season. Reference will be made to some of the profile drawings in the 1980 report on the 1979 excavations, and a shorthand system of notation, namely, "1980" preceding the figure number, has been employed to indicate that. For convenient reference, those figures are included in Appendix I following the figures generated for this report. Grid square notations will always refer to the ten-foot grid of 1981, unless otherwise indicated.

Because the stratigraphy and nature of the layers encountered varied markedly between the south and north halves of the site, they will be described separately, as will the upper levels of the site. The break line is considered to be at the N60 line. In the north, the stratigraphy is so complex that rather than trying to make uniform the field descriptions of the layers on the drawings, single letter designations have been given to the major layers discussed on all the figures, both 1980 and 1982, and in the text, to facilitate their correlation. The following paragraphs should be read with reference to Figure 3, an overall feature plan of the site.

A. <u>18FR320 South</u>

The stratigraphically lowest feature encountered within the area of excavation in the south half of 18FR320 was F44, which consisted of a water channel dropping from west to east (Plate 1). It was traced through the entire excavation, from grid lines W5 to E55, and was excavated to the bottom, except in the easternmost ten-foot square. In the fifty feet of its excavated length, the bottom dropped one foot, nine inches. It had a broad, shallow, flat-bottomed profile with gently sloping sides (Figure 4). It had a width at the top of about eight feet, at the bottom of about four feet, and was about one foot, six inches deep, although these measurements varied substantially along its course. Its sides were defined by a layer of quartz pebbles in a finely divided yellow clay matrix.

F44 was defined along its entire southern edge, with the possible exception of the easternmost 15 feet, by a stone embankment which consisted of a substantial construction of rounded boulders in a sandy, yellowish-brown clay matrix (Plate 1). The boulders were in no discernible order, but rather heaped along the edge of the channel. They rose about a foot above the south edge of the channel and their overall height dropped by just under a foot from west to east.

Along the southern edge of the channel at a point approximately halfway up the slope were widely spaced stone features. These occurred in N30W5, N40F15, and N40E25 (Figure 5). The two latter features were about ten feet apart, but the first was 25 feet from the second. Their form varied: the west and east features consisted of three stones in a pile; the middle feature had a single stone beside a slot (four by ten inches) cut in the wall of the channel. They occurred at a uniform depth, approximately halfway up the south slope of F44. Four feet to the south of the middle feature, directly at the edge of the stone embankment, was a piece of cut wood standing vertically, the top of which was one foot, four inches above the level of the stone features.

The fill of this channel varied, and probably represented a gradual silting process. Above both sides and in the interstices of the rock pile was a hard, mottled, tan and reddish-brown silty clay with lenses of red gravel, which seems to have had the effect of constricting the channel's width. In the center three feet were superimposed layers (from the bottom up) of fine mixed gravel which was extremely hard, yellow and red finely divided plastic clays, and fine red gravel (Figure 4). Within both the mottled clay and the layers in the middle of the channel, large quantities of wood were embedded. The pieces of wood were at differing levels and orientations, and varied quite widely in dimensions and type, from planks up to six feet long to five inch square posts to flat thin sheets to bevel-edged laths (Figure 5). Many of the pieces were pierced by nails, spikes, or wooden pegs. In the northeast corner of N40E15 and in the southwest corner of N50E25 were half sections of a massive tree trunk, three feet long.

Associated with F44 and the stone embankment was F40 in N20W5. This was another wide, shallow, flat-bottomed water channel with its course perpendicular to F44. It measured approximately five feet wide at the top. The bottom width of two feet at the N29 line narrowed to just under one foot at the N20 line. In that nine feet, the bottom dropped one and one-half inches. The sides of this course were formed of a hard, pinkish, mottled clay. Into this clay had been cut, along the east side of the channel, a flat-bottomed, straight-sided slot (F39) at least five feet, six inches long, eight inches wide, and 11 inches deep, with its bottom at a uniform depth. Its north edge was at N25.5, it extended south to N20, and must have continued outside the square. F40 was filled with a brown sand, then a gray clay, and was capped by a charcoal spread which covered the pink mottled clay to the east. At the base of this charcoal spread was a substantial amount of ferrous slag. Over the charcoal and filling of F39 was a dark yellowish-brown silty clay.

To the north of F40 was a one foot, six inch wide "break" in the stone embankment of F44. This was a diminuation in the height of the rock buttressing of no more than six inches. The base of the "break" was formed of the same rocks in sandy, yellowish-brown clay matrix as the rest of the embankment, but atop it were water-deposited fill layers equivalent to the fill of F44 to the north. The bottom of the "break" was six inches above the bottom of F40 at the N29 line, and one foot, three inches above the bottom of F44. The stone feature mentioned above in N30W5 was directly to the north of the "break."

The layer which seemed to be stratigraphically contiguous with F44 was a dark reddish-brown silty clay with flecks of charcoal, which was the lowest artifact-bearing layer over the entire site, and was found uniformly to the north of F44. Because the depositon of this layer respected the water course, it is suggested that it was contemporaneous with the period when it was silting up. The artifacts and slag contained within it closely tie it to the layer which overlay F44.

The major feature which stratigraphically overlay both the water channel (F44) and the dark reddish-brown silty clay on its north bank was a roughly rectangular construction of stone about 50 feet long and about ten feet wide running at an approximately northwest-southeast orientation from the N40E5/N50E5 grid squares to the N40E45 square (Plate 1). The form its construction took was a closely spaced platform of large unworked boulders with the interstices filled with small stones and, in some places, brickbats. At the west end of the site in N40E5 and N50W5, it directly overlay both the uppermost layers of the fill of F44 and the dark reddish-brown silty clay with flecks of charcoal. Here it had a total height above these levels of no more than about six inches, and was the height of one boulder. At its eastern end, it overlay the same layers and more or less butted up to and intermingled with the stone embankment of F44, which is why it was difficult to define the latter in this area. The height of the rock platform here is as much as two feet below its height at the west.

Directly overlying the rock platform from the E5 line to the east was an extremely hard-packed ferrous slag which showed a metallic blue break. This was heavily compacted on top of and down into the interstices of the rocks. It uniformly overlay the rock platform, the stone embankment (in N40E35), and (to the north and west) the dark reddish-brown silty clay with flecks of charcoal. At the base of this level in N40E25 within an elongated gap in the rock platform was a hard, gray clay with many pieces of wood (Plate 2).

To the north of the rock platform and its hard-packed slag surface in N50E45, was another stone construction (see within F45 in Figure 3). It took the form of an uneven rectangle, measuring four feet north/south by three feet east/west. It had an extremely informal construction, consisting of a loosely spaced platform of rounded stones and some fire-brick and brick fragments. Stones haphazardly placed extended from all but the southwestern corner. All the stones were sitting directly on and, in some cases, were sunk into the fill of F44. It was clearly not overlaid by the hard-packed ferrous slag layer, but it was not clear if it may have overlaid the edges of that layer. It was not as closely packed as either the rock platform or the stone embankment, and could not be described as a foundation (Plate 1).

Two layers are associated with these two features (namely, the rock platform and the stone construction described above). A layer of loamy, gray clay with wood chips and patches of charcoal, red gravel, and slag overlay the rock platform and its hard-packed slag surface. and extended over the fill of F44 to the north (in N50E35, in particular). It resembled the uppermost of those fill layers but had more inclusions, and contained increasing charcoal to the north.

Superimposed on the gray clay and wood chip level was a layer of a compact but not hard-packed reddish-brown mixed ferrous slag and charcoal layer. This also covered the stone construction in N50E45. To the north of the rock platform and stone construction, it covered the dark reddish-brown silty clay with flecks of charcoal. Directly over the rock platform this layer was quite thin, especially in the west. It got markedly thicker to the north, and also contained an increasing admixture of charcoal: at the north edge of N50E45 it consisted of a seven inch thick lens of charcoal. This mixed slag and charcoal layer extended south to the N40 line in the two easternmost grid squares. In the northeast corner of N40E35, a long plank of wood was lying on the mixed slag and charcoal layer, oriented northwest/southeast. It measured 12 feet long by one foot wide.

The next (stratigraphically defined) significant feature was F45, which was encountered in all four easternmost squares. It consisted of a layer varying between one and six inches thick (about four inches thick generally) of a soft yellow sand with clay and flecks of mortar with an uneven surface, rising about three to four inches to the northeast corner of N50E45. It was roughly rectangular, oriented northeast/southwest, and extended beyond the north and east banks of the area of excavation, so it was at least 20 feet long. Its width at its southwest end was about 10 feet. The southwest end seemed to be somewhat defined by the wooden plank mentioned above, although a spread of yellow sand with clay overlay it extending some two feet to the southwest beyond it. Directly to the northeast of the plank and parallel with it was a "hummock" of the same layer. Scattered on its surface in no discernible order were several large boulders and smaller stones (Plate 3). Contiguous to this feature to the northwest (in N50E35) was a layer of gray plastic clay. This gray clay overlay about two feet, six inches of the wooden plank extending beyond the mortar surface.

Both the gray clay and F45 overlay the mixed slag and charcoal layer, and both were uniformly overlaid by a red shale with slag inclusions, about four inches thick. Over the area of the stone embankment in the southwest corner of N40E35, the red shale layer directly overlay the mixed slag and charcoal layer. In the southeast corner of N40E35 and in most of N40E45 the red shale layer did not exist as described here. Above the red shale layer was a layer of brownish gravel with some discontinuous lenses of loamy charcoal between the two in the northwest corner of N50E35.

The stratigraphy above the hard-packed slag surface over the rock platform has been quite meticulously described for the easternmost four grid squares because it is here that it is most complex, and best related to the features. Almost all of the most crucial soil layers which elucidate the relationship and phasing of the structural remains of the southern part of 18FR320 appeared here, and their relationships can be extended out from these 400 square feet.

Moving west from the four eastern squares the stratigraphy was markedly simpler. As already discussed, the stone embankment, the watercourse fill, and the dark reddish-brown silty clay with flecks of charcoal were all encountered in the squares bounded by the grid lines N40-N60, W5-E35, at a stratigraphically equivalent level, though the dark reddish-brown silty clay was about five inches below the top of the rock buttressing, and the fill of F44 dipped slightly between them. As already mentioned, the rock platform and its hard-packed slag surfacing overlay both F44 and the dark reddish brown silty clay.

A layer of water-washed red gravel seen in the west wall of N40E15 (Figure 6) overlay the fill of F44 throughout N40E15 where it butted up to the edge of the hard-packed slag surface over the rock platform. This edge also seemed to be defined by an "edging" of pieces of timber lying in the surface of the F44 fill below the red gravel (Figure 7 and Plate 4). The red gravel layer continued into N40E25, still to the southwest of the edge of the slag and rock platform and stratigraphically at the same position, though much thinner (it does not appear in the E25 profile in Figure 4). It did not extend very far into N40W5.

The equivalent of the gray clay and wood chip layer which separated the mixed slag and charcoal layer from the hard-packed slag surface in N40E35 and N50E35 was also encountered in this area in N50E15.

The mixed slag and charcoal layer covered all of these levels, and extended right to the W5 line in these trenches. Again, at a distance from the rock platform, the mixed slag and charcoal layer showed increasing admixture of charcoal.

How do these layers relate to the two features found in this area in 1979? F1 was a rectangular stone foundation, with mortared walls of large boulders, about 21 to 24 inches thick. Its southern half measured about 21 by 11 feet (discussion of the northern half is postponed for the moment). The designation F6 was given to both branches of a smaller rubble foundation wall, about one foot, six inches thick. It had a characteristic construction of small, thin "edging" stones placed vertically either side of larger stones placed flat and was unmortared. The corners of the south half of F1 were at grid points N47E13, N60E3, N68E30, and N55E34. F6 east/west branch was traced from the south edge of N30E15 (and must have extended further south) to the west edge of N40W5 (and must have extended further west); F6 north/south branch joined the east/west branch in grid square N30W5 and ran almost due north. It intersected with the F1 west wall and was traced into the interior of F1 where it seemed to end at grid point N57E13 (Plate 5). Despite careful examination, it was not possible to conclude if F6 cut through F1, or vice versa. However, the stratigraphic sequence uncovered in 1981 elucidated their relationship.

The southeast corner of F1 was encountered in the northeast corner of N50E25. Excavation in that grid square and the one to the east indicated that the foundation stones of the east wall of F1 were sitting on (or perhaps in) the red shale layer. Moving further west, it was clear that the south and west walls of F1 were on or in the mixed slag and charcoal layer. Although no wall trench for F1 was ever identified, in some cases (particularly for the west wall) the F1 stones were actually sitting on the hard-packed slag surface over the rock platform, and might therefore have cut through the layer above, or the surface rose sufficiently to be directly under the stones.

In contrast, the wall trench of F6 was cut into the hard-packed slag surface of the rock platform (in grid squares N40W5 and N50W5), and may have cut into the water-washed red gravel in N40E5. Most significantly, however, the mixed slag and charcoal layer cut into by F1 dipped into the destruction trench of F6 (east/west branch) (Figure 6). See also 1980 Figure 10, where the "dark reddish brown clay with gravel and iron waste" is equated with the mixed slag and charcoal layer. In other words, F6 predated the deposition of the mixed slag and charcoal layer, while F1 post-dated it.

Within F1 (south half) and more or less bounded by the foundation stones was a spread of yellow sand with clay and flecks of mortar about two to three inches thick, identified as the floor of the structure in 1979. Outside F1 to the south and east, a layer of loamy charcoal showed some compaction and an artifact deposition pattern suggestive of its being an occupation surface equivalent to the yellow sand with clay surface inside. It overlay the mixed slag and charcoal layer to the south, but because that layer dropped to the east, at the east corner of the structure, this occupation surface was on top of the red shale layer. There did not seem to be an equivalent surface on the west.

The yellow sand with clay did intrude into the interstices of the foundation (see 1980 Figure 14). It also overlay the stones themselves in N50E25. A second line of small stones parallel with the south wall of F1 and extending along its course as far as the E25 line delineated the edge of this spread of mortar.

In N50E35 and N50E25 a trench (F41) had been cut down from the red shale layer, through it and the mixed slag and charcoal layer to bottom on the hard-packed slag surface over the rock platform. It extended from the middle of the north bank through both squares, parallel with the south wall of F1 and about nine inches south of it, was about one foot, nine inches wide at the N60 line and narrowed to one foot wide at the E25 line. It was about five inches deep and filled with a dark loamy matrix with large slag nodules and a little charcoal. Right along its base was a skim of a clean plastic beige clay. It had been overlaid by the small stones to the south of the F1 wall and by the yellow sand with clay and, accordingly, must have predated that occupation surface. Its course so closely corresponds to that of the wall of F1, however, that it is hard to believe that the two do not have some connection.

No evidence of such a trough had been recorded in the excavation of N40E15. However, in N40E5 a feature designated F34 had previously been defined under the mixed slag and charcoal layer. It was a very shallow (less than an inch thick) skim of clean plastic beige clay about five inches wide in a trough cut into the hard-packed slag surface which extended in a northeast/southwest direction parallel to the south wall of F1 and about six inches to the south of it. It extended from the E15 line six feet, six inches to the southwest and then petered out. It is postulated that F34 represents the westernmost terminus of F41. It was not so recognized in the field, probably because without the red shale layer in this area, the walls of the trench cut into the mixed slag layer, and filled with a very similar matrix were imperceptible. Only the slick of plastic clay at the base was identifiable and, in fact, had also been noted in the field notes for N40E15. This hypothesis is supported by the profile across this area (Figure 6) where the dip in the mixed slag and charcoal layer between the water-washed red gravel and the rock platform may represent F34/F41.

Interestingly, the north/south branch of F6 seemed to interrupt F34. It is somewaht difficult to understand this given the clear-cut stratigraphic relationship between F41 and the mixed slag layer, and that layer and F6. Possibly F6 was an intrusion into the floor of F41/F34, although it was not noted as such in the field.

Overlying the charcoal and loam occupation surface and the mixed charcoal and slag layer, from about the N40E25 square to the east, was a layer of brownish gravel (Figure 4), which was the same as that over the occupation surface and the red shale layer in the eastern squares. There was no opportunity to observe the layers over the foundation walls of F1 (south) in 1981. However, this sequence was closely observed in 1979, and it seemed that a layer of "dark reddish brown crumbly clay with gravel" overlay much of the area contained within the south half of F1, and the stones themselves in some cases (1980 Figure 6). It is possible that this is equivalent to the (1981) brownish gravel.

Then overlying this area and, indeed, the entire site were two sequential layers. The lower one was a mottled dark grayish brown clay with flecks of rust and charcoal. It directly overlay the mixed slag and charcoal layer in most of the area over and north of F44 (Figure 6). East of the E25 line it overlay the brownish gravel atop the red shale, and the red shale itself where the former did not exist. Above this layer of clay with flecks of rust was a layer of very dark grayish-brown loamy clay. In 1981 this was the starting surface of the southern part of the site, and was universally encountered.

It is postulated that the 1980 "dark yellowish brown clay mottled with charcoal" equates to the clay with flecks of rust, and the 1980 "dark yellowish brown sandy clay" to the brown loamy clay. If so, the former directly overlay the walls of F1 in some areas (1980 Figure 8). It will be noted, however, that in 1980 Figure 6, the two layers were not differentiated to the south of the milky quartz gravel (to be discussed below). The two layers were very similar, and at the southern, western, and northern periphery of the site where the flecks of rust and charcoal in the lower clay were lacking, it was difficult to distinguish them.

The area to the south of the stone embankment has not been discussed hitherto because its stratigraphy is markedly different from that to the north, and is not well understood. The sequence associated with F39 and F40 in square N20W5 has already been described, and it only remains to add that over the silty clay atop the charcoal spread, and the channel walls of pink mottled clay was the very dark grayish-brown loamy clay. The layer of clay with flecks of rust and charcoal was either not present or not distinguishable. The mixed slag and charcoal layer was also seemingly not present.

Further to the east, the sequence south of the stone embankment was best observed in N30E25. Here, below the very dark grayish-brown loamy clay, the clay with flecks of rust and the mixed slag and charcoal layer was a layer of compact ferrous slag and charcoal, as in the south half of Figure 6, where it also can be seen that F6 had cut through this slag layer (as well as through the hard-packed slag over the rock platform). This was not as hard-packed as that, but consisted of flat circular plates and cylindrical chunks of ferrous slag, up to 18 inches wide or long. It sat on a pink mottled clay, which was also found in the two squares to the west at the base of the layers and is probably equivalent to that forming the bottom and sides of F40 in the farthest west square.

B. <u>18FR320 North</u>

The stratigraphically lowest artifact-bearing layer in the north half of 18FR320 was the dark reddish-brown silty clay with flecks of charcoal already discussed above (Layer A). This covered the entire northern area excavation, and generally was the limit of excavation in 1981. It rose dramatically from south to north: on the northern bank of F44 in N50E5 the surface was two feet, six inches below datum; at the N60 line it was one foot, nine inches below datum, then rose sharply in that one square (N60W5) to ten inches below datum. It then rose more gradually to three inches above datum at the N100 line. It is likely that this layer is equivalent to the layer of reddish-brown subsoil with charcoal, brick flecks and slag which was under a layer of charcoal in a similar matrix which directly underlay the Auburn Dam (Figure 9). The top of this layer was two feet, nine inches above datum, so if it is the same layer across the site, it rose over five feet in about 85 feet.

Above this layer is one which, while varying markedly in degree and nature of inclusions, seemed to be encountered in some form or other throughout most of this area as well. This was a layer of charcoal which sometimes had quite an admixture of ferrous slag, and sometimes did not. Towards the southern limit of this area (i.e., the N60 line) it generally directly overlay or was stratigraphically equivalent to the mixed slag and charcoal layer (Figure 8). Around the perimeter of F1 (north half) it seemed to have taken on some of the attributes of an occupation surface, just as the mixed slag and charcoal layer did to the south of F1. Both those layers overlay the reddish-brown silty clay (A) and both contained large quantities of charcoal and varying amounts of slag, thus there is a tendency to think of them as the same layer. But in the north part of the site, charcoal seemed to dominate, while in the south part of the site ferrous slag nodules seemed to dominate; accordingly, this stratum will be termed a charcoal and slag layer (Layer B) in this part of the site.

A stratigraphically anomalous area was encountered in 1981 in grid squares N90W10 and N100W10 in the area bounded by T-3 on the east.

Beneath the charcoal and slag layer (B), instead of the reddish-brown silty clay expected, was a dark yellowish-brown gravel with pebbles side by side with a dark brown gravelly clay with charcoal veining. Below this was the reddish-brown silty clay (A), but here it included a seven inch thick layer of ferrous slag chunks in a spread extending northeast/southwest and covering most of grid square N90W10. Below that was the red shale which was the natural subsoil of the site, as established in a deep test trench here and in N70E10, and in the trench under the Auburn Dam (Figure 9).

Above the charcoal and slag layer in the northern part of the site, the stratigraphy across the center of the site was extremely complex and difficult to interpret. However, as far as it can be understood, the sequence seems to be as follows. Discontinuously interlensed with the charcoal and slag layer at the north of the site were layers of brown sand which seemed to be water-washed (Layer C) (Figure 10). This brown sand may be equivalent to that directly overlying the charcoal and slag layer in Figure 11 as well. Over that were two layers, a reddish-brown gravel (Layer D) underlying the dark grayish-brown clay with flecks of rust (Layer F).

The latter was the layer which in the south directly overlay the mixed slag and charcoal layer over most of the area. While it did not contain the flecks of rust to the north of the N60 line, it is believed to be the same layer, and the same designation is retained for the sake of clarity. The reddish-brown gravel is somewhat anomalous. It is possible that it is equivalent to the brownish gravel over the occupation surface and the red shale layer in the southeast. It is also possible that it may be similar to the brown sand (C) discussed above, as in Figure 8. It appeared that both these layers thinned towards the north, with the clay with flecks of rust (F) disappearing around the N95 line and the reddish-brown gravel (D) disappearing around the 105 line. The reddish-brown gravel must also have thinned out to the east, as it was not noted in N80E35 (Figure 12).

This stratigraphic sequence is made that much more confused by the presence of a stratum of brown sand (Layer E). In 1979, such a layer was encountered from about the N80 line north in T-3 (1980 Figure 6). In that profile, it appeared to have been an intrusion into the red clay and charcoal (A) and generally to underlay the clay with flecks of rust (F). A layer exactly corresponding to this was not excavated in 1981, and it is not at all impossible that it is identical to the reddish-brown gravel (D). However, in 1980 Figure 16 both that layer and the brown sand (E) seem to be represented in the profile, and here the brown sand seems to be an intrusive or contiguous layer, extending west of about the E15 line. It appeared in N60W10 (1980 Figure 13), and probably is represented by the brown sand with charcoal in N80E0 (1980 Figure 9), but these correlations must be considered problematic.

The task of sorting out the layers in this area was made easier by the presence of a lens about one to two inches thick of milky quartz gravel. This was discovered in 1979 and designated F5, and virtually all examinations of its disposition took place during that season. It was discovered in about an eight-foot wide swath from at least the N90 line (where it was picked up in T-3), south between the Auburn mansion pillars to T-5, which cut through it in about the southeast corner of grid square N50E35 (see 1980 Figures 6, 8, and 18). It was more or less oriented as T-3 was, which is why it is seen in almost the entire profile.

The presence of such a readily identifiable stratum is invaluable as a certain demarcation of a constant stratigraphic level. In 1981 it had been removed everywhere except in N70E10 and N80E10. There were layers, however, found directly under it in those squares and on either side of T-3 in the five northern squares through which it cut which performed the same service in 1981. These consisted of a hard-packed yellowish clay over varying and discontinuous lenses of brown sand, orange gravel, and a very bright yellow clay with shalestone chips (G layers). These layers overlay either the clay with flecks of rust (F) (Figure 11) or the reddish-brown gravel (D) (Figure 10), and are probably to be seen in 1980 Figure 9, though the stratigraphy is a little different. They were also given the feature designation F47.

Above the milky quartz gravel (F5) and its base layers (G), and above the clay with flecks of rust (F) and the reddish-brown gravel (D), was the same very dark grayish-brown loamy clay which had been the starting depth in the squares in the south part of the site (Layer H). This was found in all the squares.

This sequence of layers from the reddish-brown silty clay (A) to the brown loamy clay (H) has been described first to facilitate the stratigraphic locating of the features now to be discussed.

The stratigraphically earliest feature in the area was F43. This consisted of a small (15 inch wide) rubble wall, the construction of which was very similar to that of F6. The stones as excavated had cut into the dark reddish-brown silty clay with flecks of charcoal (A). Apparently, the charcoal and slag layer (B) had covered the wall (Figure 12), although this is somewhat uncertain as a trough which may have been the destruction trench for the wall was defined at that level. However, if the charcoal and slag layer did cover F43, it would be stratigraphically equivalent to F6 in the south part of the site, the destruction trench of which was filled with the mixed slag and charcoal. In any case, it and its possible robber trench were clearly overlaid by the clay with flecks of rust (F).

An important feature here was the northern half of F1. At the northwest corner of F1 (the south half) another wall was detected extending northwest from the corner. Its construction seemed somewhat more irregular than the walls of F1, consisting of somewhat smaller stones than the south half, mortared together. It measured about one foot, six inches wide. It cornered in N70E0 and this northern wall extended about 11 feet to the northeast. At this point, later intrusions seem to have removed traces of the wall (Plate 6). If the stone seen in the west profile of T-9 (1980 Figure 9) at grid point N79E22 was part of it, then F1 (north half) must have encompassed an area equivalent to that in the south half (stratigraphically, however, that stone is not equivalent to F1, as discussed below). No wall, however, ran north from the northeast corner of the south half of F1 to make the north half's fourth side.

It appeared, after careful observation of the juncture of the two walls in grid square N50E5, that there was a butt joint between the west wall of F1 (south half) and the wall between the two halves. This might suggest that F1 (north) was the initial construction, and that F1 (south) was an addition, perhaps chronologically later. Opposed to this hypothesis is the fact that F1 (north) with its open side has more of the appearance of an addition.

Unfortunately, the stratigraphic sequencing was not clear. The foundation stones in the northernmost wall were sitting on the charcoal and slag layer (B), while those in the wall between the two halves were sitting on a layer which probably equates to the mixed slag and charcoal layer (1980 Figure 14). It will be remembered that the southernmost wall was on this layer. There did not appear to be an occupation surface inside the walls of the north half, such as the yellow sand with clay within F1 (south), although there was some suggestion of a loamy surface with patches of reddish shale and charcoal directly overlying the charcoal and slag layer (B) both inside and outside the walls. Stratigraphically then, all that can be said is that the construction of both F1 (south) and F1 (north) post-dated the mixed slag and charcoal/charcoal and slag layer, but the chronological relationship of their construction was not further clarified.

As far as the period of their destruction, this is unfortunately also not clear. The walls of F1 (south), as will be remembered, were covered either directly by the clay with flecks of rust (F) or in some cases by a spread of dark reddish-brown crumbly clay with gravel under the clay with flecks of rust. The north wall of F1 (north) was covered by a layer variously described as ashy dark gravel or reddish-brown gravelly soil. It seems likely that this is either the brown sand (E) or the reddish-brown gravel (D), both of which would predate the clay with rust flecks (F). However, it might be remembered that at various points above it was speculated that the dark reddish-brown crumbly clay with gravel might have equated to the brownish gravel found in the eastern squares which might have been equivalent to the reddish-brown gravel (D). And in 1979, it seemed that in the five-foot grid square N60E5 "yellowish-brown clay mottled with charcoal" (=F) overlay the west wall of F1 (north). It seems safest, therefore, to conclude that the two parts were abandoned at the same period and at a time which certainly predated the deposition of the clay with flecks of rust (F).

A stone in the west profile of T-9 (1980 Figure 19) superficially appears to be aligned with the north wall of F1 (north) as mentioned above (or perhaps with F43 to the east). However, as it interrupts both the charcoal and slag layer (B) and probably the clay with flecks of rust (F) and is covered by the brown loamy clay (H), it is clearly not stratigraphically equivalent to either.

F4 was perhaps the most perplexing and difficult to understand feature on the site, despite being the best preserved. It consisted of two relatively massive walls, one running southwest/northeast, the other running southeast/northwest (Plate 7) which met in grid square N90E10. Both the north/south branch and the section to the east of the intersection were of somewhat slighter construction. Examination of the junction did not elucidate if all three parts had been constructed at the same time. In 1979, the wall fragment in T-7 to the northeast of the stump was designated F9. The east/west branch of F4 was over two feet wide and made of large boulders; the north/south branch was somewhat smaller, about one foot, six inches wide. Both were set in yellow mortar. Both branches of F4 continued outside the area of excavation, indicating the foundation enclosed an area at least 35 by 25 feet. F9 extended 15 feet to the northeast and seemed to end in T-7.

The construction trench for F4 clearly cut into the dark reddish-brown silty clay with flecks of charcoal (A). The top of the stones of the east/west branch were at this level. Unfortunately, its destruction trench obscures the postulated construction trench above the preserved level of the stones; but it is possible that it also cut through the charcoal and slag layer (B) above the reddish-brown silty clay, as was revealed in N70W10 and N60W5 where a spread of charcoal was uncovered on both sides of F4. Figure 10 also demonstrates that a layer of or containing charcoal was found on either side of the north/south branch of F4. However, in both cases, the charcoal surfaces on either side of F4 were not identical in appearance and composition, so it is difficult to be certain if they are the same layer, cut through by F4, or if they represent charcoal deposited on either side of an existing wall.

While there was no "floor" such as was uncovered within F1 (south), there was a series of complex, obscure and discontinuous lenses of red clay with charcoal, yellow clay with gravel, charcoal, brown loam, very dark gravel with charcoal, etc., which lay uniformly to the north and west of the intersecting branches of F4 directly over the reddish-brown silty clay (A) (Figure 10 and 1980 Figure 6).

There were also two cross-cutting shallow troughs in N100E0, one of which received the feature designation F46, seemingly cut in the charcoal there, which were both covered by the reddish-brown gravel (D). These details may suggest that, rather than F4 cutting through the charcoal and slag layer (B), the charcoal and slag layer proper butted up to it on the south, and a different charcoal layer and series of lenses were created to the north and west of it.

Another problem is raised when trying to establish stratigraphically the date when F4 went out of use. The destruction trench for the east/west branch was quite clearly established in N60W5 to be under the clay with flecks of rust (F). In the middle section, the brown sand (E) overlay the stones directly (1980 Figure 6). For the north/south branch, however, the destruction trench cut through all the layers below the brown loamy clay (H) which overlay the trench and a spread of fill from it extending to the west (Figure 10).

The probable reason for this discrepancy is a period of time between the abandonment of F4 and dismantling of its south wall (the east/west branch), and the dismantling of its east wall (the north/south branch). Another perplexing point about F4 is that the north/south branch and the east/west branch do not meet in a right angle, but in an angle of about 105 degrees.

Since both F1 (north) and F4 (east/west branch) were covered by the clay with flecks of rust (F), the period of their abandonment was probably the same. The question of the chronological relationship of their periods of construction depends, of course, on whether F4 precedes or succeeds the charcoal and slag layer (B) which F1 was built on or in. The crucial grid square where it had been hoped to examine the two features and their relationship was N70E0. Unfortunately, this square also contained a large tree, one of the Auburn Mansion pillars, F8 and F48 (to be discussed below), and these later intrusions totally obscured the stratigraphic relation between F1 and F4 here. It is worth pointing out the quite different orientations of the two features, but further discussion of their relative chronology will be postponed to the interpretive section.

A narrow stone-lined trough was discovered in 1979 and designated F8. It was found in the 1979 half grid square N60W10, and extended to the southwest beyond the bank of that unit. To the northeast its course was traced to N70E0, and in 1981 what appeared to be its terminus was excavated in N80E10. To the west of the E5 line, it took the form of two parallel rows about 25 inches apart of ovate stones set on edge separated by a floor of smaller stones tightly fitted together, also with the longest axis vertical. Its depth was about ten inches. To the east of the E5 line, the northwest vertical side was absent and the floor stones were somewhat larger. In N80E10, a stone placed on edge seems to mark the end of the trough, as its location was perpendicular to the southeast side. The stratigraphic position of this feature (as for all of the features in the area of and to the northwest of the Auburn Mansion pillars) is somewhat unclear, but it seems that it was in the brown sand (E) (see 1980 Figure 16: the stones in that section are F8; and 1980 Figure 13) and overlaid by the clay with flecks of rust (F). It definitely post-dated the abandonment of F1 (north).

It appeared that its construction cut into the destruction trench for F4, in which case it must have post-dated that as well, although this was not at all clear as the juncture took place in the vicinity of that large tree and there was much root disturbance.

C. 18FR320 Upper Levels

As described above, the milky quartz gravel (F5) and its base layers (G) provided a definite horizon for the site. F5 and the features that are assumed to be associated with it all occur at the interface of the clay with flecks of rust (F), or the reddish-brown gravel (D), or the brown sand (E), with the very dark grayish-brown loamy clay (G). These features include F48, two very large postholes; three smaller unnumbered postholes; three pits designated F30, F33 and F36; and a wall designated F7 (in 1979) and F38 (in 1981). Two anomalous features, one a trench designated F31, one a square pit designated F37, may also be associated.

F48 was given to both of the large postholes directly beside the Auburn Mansion pillars, one first uncovered in 1979 in grid square N70E0, and one uncovered in 1981 in square N80E10. Both consisted of stone rubble packing around a central hole which measured about a foot in diameter. Only the northeast one was excavated: the stone packing which appeared at the level of the clay with flecks of rust (F) was revealed to have been deposited in a pit about three feet in diameter and almost three feet deep, indicating that it had been excavated to support a substantial post.

Two small postholes were discovered in 1979 and a third in 1981. One was in the 1979 half grid square N60W10, south of F8; and two in N60W5. They formed a line extending to the southwest of the Auburn Mansion pillars and parallel with their northwest faces, and were each five feet apart. They also were stone packed, but the cavities for the posts were much smaller than in F48, varying between four to seven inches in diameter. The stone packing also appeared at the level of the clay with flecks of rust (F). In the middle one of the postholes, a post was found which extended up into the brown loamy clay (H).

A narrow rubble wall was encountered in 1979 and designated F7. The same wall was also discovered in 1981, but as it was not immediately identified with F7, it received a separate feature designation (F38).

It was constructed of dry-laid small stones, was about 14 inches wide and one course (six to eight inches) deep. It extended from directly to the northeast of the southwest Auburn pillar where the stones were sitting on the stone packing of F48, northwest to the west baulk of N90W10. Its construction trench cut into the clay with flecks of rust (F) and it was overlaid by the brown loamy clay (H) (Figure 11); it definitely overlay F8, the stone-lined trough in N70E0.

Three pits were found in 1981: in N100W10 where the pit underlay the west baulk (F33); in N90W0 (F36); and in N110W10 (F30) (Plate 8). F36 and F30 were circular, and measured about one foot, six inches and two feet in diameter respectively; F33 was sub-rectangular and measured one and one-half feet long. F30 was a foot deep, F33 five inches deep, and F36 one foot, two inches deep. All were filled with a similar loose humic fill with charcoal and slag inclusions. They all cut down from the reddish-brown gravel (D) or clay with flecks of rust (F) into the reddish-brown silty clay (A), and were covered by the brown loamy clay (G). F30 and F36 formed a line with the northeast Auburn Mansion pillar.

F37 was also a pit, but somewhat different than the three described above. It was located in N90W10, was sub-rectangular, straight-sided and flat-bottomed. It measured one foot, six inches by two feet and was about one foot, three inches deep. It was filled with stones with loose dark humic fill around them. It cut down into the reddish-brown silty clay (A) and in excavation it was thought that it was covered by the clay with flecks of rust (F). However, there was a gap in the wall (F7/38) directly above it, and it is possible that it actually had been cut from the level of the brown loamy clay (H) through the wall. It definitely cut through a trough of yellow clay that was below the wall and postulated to be the base of its construction trench.

Finally, another stratigraphically anomalous feature was F31 (Plate 8). This was a trough varying between one foot, nine inches and one foot, four inches wide and about eight inches deep. It was traced from the northern baulk of N110W10 along a course to the southwest of and converging with the north/south branch of F4, as far as the N90E10 square. In that 37 feet, its bottom depth dropped (from north to south) over one foot, six inches. It was cut into the reddish-brown silty clay (A) and in N110W10 was overlaid by the brown loamy clay (H). However, further south, as can be seen in Figure 10, it was overlaid by some of the discontinuous lenses noted in this area, including that from the destruction trench of F4. However, it still cuts through the reddish-brown gravel (D). It was filled with slag in a dark grayish gravel.

As can be seen in 1980 Figure 6, and as described for both the north and south of 18FR320, a thick layer of dark grayish-brown loamy clay (H) covered the entire site. In 1981, even where the pre-excavation surface remained (which it did in parts of N30E25, N50W5, N60W5, N70E10, N80W10, N80E10, N90W10 and N110W10), it was generally quickly shovelled off to this surface without much note being taken of the levels. In 1979, it was established that the general sequence for the upper levels was one of a reddish-brown topsoil over a yellow sand over a dark brown sandy humus over the brown loamy clay (H) (1980 Figure 6). Two horizons within this sequence should be further discussed. A layer of asphalt or black-top over a macadam surface was encountered at the interface between the humus and the brown loamy clay (H), in an area at least as far north as the southern border of T-7 (1980 Figure 16), as far east as T-3 (1980 Figure 6), as far west as T-9 (1980 Figure 19), and as far south as the N55 line between E30 and E40 (1980 Figure 8).

The other significant layer was one of large, rounded cobbles and stones up to two feet long between the dark brown sandy humus and the loamy clay (H). This layer was found in the northeast half of T-4 in 1979, and in N30E25 in 1981.

D. Determination of Site Boundaries

As previously mentioned, one of the goals of the 1981 excavation season was a more accurate determination of site boundaries. It was further noted that the strategy adopted for satisfaction of this goal involved the use of machine excavation of narrow trenches extending north, east, and south from the area excavated in 1979. Briefly, these investigations involved the machine excavation of four elongated trenches; one extending into the Auburn Dam to the north; two extending to the east of the excavation area; and one located to the south of the highway drainage ditch. The stratigraphy noted in these trenches was, where possible, correlated with that in the area excavation, and also in the machine trenches of 1979, to define the boundaries of the significant layers and features of 18FR320.

1. The Auburn Dam Trench and the North

A trench extending through the south face and into the interior of the Auburn Dam was excavated in an attempt to define the northern boundary of site 18FR320, to reveal a representative profile of the dam and its interior basin, and to permit a determination as to the presence or absence of structural features pre-dating construction of the dam. Due to the presence of numerous natural obstructions, especially trees and stumps, together with the necessary width of the trench itself, it was possible to excavate only one trench through the embankment of Auburn Dam. Beginning at a point 130 feet north and eight feet east of N030, the trench extended northeast (perpendicular to the face of the dam) for a distance of 70 feet (Figure 3).

Under close archeological supervision (Plate 9), the backhoe cut first through the face of Auburn Dam and worked toward the interior of the impoundment. The resulting section, illustrated in Figure 9, revealed that the dam had been constructed upon a charcoal surface which is postulated to be the northernmost manifestation of the charcoal and slag layer. Below it was the layer postulated to be equivalent to the dark reddish-brown silty clay with flecks of charcoal. The layer of charcoal and slag disappeared about 35 feet from the face of the dam, and this is considered to be the northernmost extent of site 18FR320. No evidence of structural features was encountered, and no artifacts were recovered.

Contrary to expectation, the surface upon which the dam had been constructed, which showed no signs of preparation, rises in elevation toward the interior of the impoundment before gradually leveling off near its center. From a point beneath the face of the dam to a point approximately 38 feet to the north, the surface of natural or undisturbed subsoil rises in excess of four feet. The manner in which the dam had been constructed was readily discernible from the exposed face (Figure 9). The embankment was comprised principally of an earthen embankment faced with stone, the two being separated by a deposit of packed stone rubble. Lying against the foot of the facing stones, presumably as a reinforcement, was a smaller embankment of the same material as that on the interior of the wall.

The area within the confines of the embankment was marked by an accumulation of clay measuring approximately two feet in thickness and covered by a six inch layer of loamy topsoil. The clay, together with occasional lenses of gravel, is undoubtedly a result of sedimentation during the period in which Auburn Dam was in use. No artifacts were recovered from these deposits.

Lying directly beneath the deposits of charcoal and slag is undisturbed subsoil. As can be seen in Figure 9, this subsoil extended without variation to a thickness of at least seven and one-half feet. Subsoil here, as beneath site 18FR320 in general, is comprised of dark reddish-brown siltstone or mudstone which is thought by Fauth (1980:14) to be of the Newark group and of Triassic age.

2. The West

On the west, the immediate proximity of the ditch and berm of U.S. Route 15 prevented pursuing the numerous features which extended in that direction, including the water channel, F44; the stone embankment to its south; the east/west branch of F6; the east/west branch of F4; the stone-lined trough, F8; the north/south branch of F4. These features made it clear that the western boundary of the site must be under the road.

Trench 6B in 1979 encountered a "trough-shaped depression cutting through deposits of charcoal and shale," the bottom of which was lined with large stone rubble (John Milner Assoc., Inc.) 1980:25). It is hypothesized that this could have been F4, in its destruction trench (the other possibility is F31). Machine trench 7, excavated by Kenneth Orr in 1979 in site 18FR331 (Figure 3), apparently cut through a "retaining wall" as well as some sort of trough (Feature 1: thought to be a race) to its west (Orr and Orr 1980:94 and Figure 40). By its alignment, the "retaining wall" could well be a continuation of F4 (north/south branch). If true, this would also extend the site boundaries of 18FR320 in this direction.

3. The East Trenches

Two trenches, each measuring approximately four feet in width, were excavated with the aid of a backhoe to the east of the area excavated in 1979 (Figure 3). The first of these extended from point N15W10 to point N15E60, and the second from N30E25 to N30E68. In each case, machine excavation extended to an initial depth of three to four feet.

It was soon realized, however, that this depth was insufficient for the testing of site boundaries due to the thickness of various fill layers and a significant drop in the elevation of historic grade. Accordingly, a cut nearly eight feet deep was excavated at the east end of the N30 trench and a profile drawing made of the south face of the exposed soil. This drawing is reproduced herein as Figure 13.

Two thick and distinct layers of fill, one a mixture of yellow clay and gray soil and the other composed of decomposing reddish-brown shale or mudstone, extended from the surface to a depth of approximately three feet. A third layer, separated from those above by a thin band of dark gray plastic clay, was comprised of quartz pebbles in a brownish-yellow matrix and is also thought to have been deposited as fill. While it is likely that the uppermost of the two layers are a result of modification in grade stemming from the construction of present-day Route 806 and U. S. 15, together with attendant drainage ditches, the third layer may have been deposited as a result of earlier road or even railroad construction--possibly the earlier alignment of U. S. 15.

At a depth of approximately three feet, six inches below the existing surface, a deposit of dark brown clayey sand, equivalent to the clay with flecks of rust was encountered. The stratum is here about six inches below the same layer as encountered in N30E25. The layers below it are not closely equivalent to those encountered in the area excavation. The heavy layer of slag which was below this layer in N30E25 had been encountered in this N30 trench, but had not extended beyond its intersection with T-3, about 17 feet to the west of this profile.

Worthy of note is that a piece of flat cast iron was collected from the lower layer of dark reddish-brown sand. The dark reddish-gray clay beneath appears to be the natural subsoil in this area, the surface of which is seven feet, three inches below the surface of natural deposits in the dam impoundment. All this affirms that in the historic period, the area to the south of the stone embankment was then, as it is now, a very low-lying area, and that there has been considerable build-up of overburden. There were no structural features or working surfaces in these deposits, however; most notably, there was no trace of the rock platform or its hard-packed ferrous slag surface.

Accordingly, while that feature clearly extended beyond the baulk of the area excavation at E55, either it ended to the northwest of T-N30 or turned from its southeast course to head directly east. F44 also continued outside the area of excavation to the east, as did F45.

To the east of 18FR320, the presence of the heavy layer of slag fill, as much as seven feet thick, which was noted in Kenneth Orr's tests (1, 2, and 3) of "Check 3" (18FR320) in 1977 (Orr and Orr 1977:8-10, Figure 4), and again in T-2 in 1979, made the investigation of this area difficult.

A rubble wall designated F2 was located at the south end of T-2, apparently at the surface of a "reddish brown crumbly clay" (John Milner Assoc, Inc. 1980:9), which may have been the same as that described directly overlying the walls of F1 (south) or may have been the red shale with slag inclusions which overlay F45. In any case, it seems to imply that the activities of 18FR320 may have extended as far as this point (about 65 feet east of the 0 line).

4. The South Trench

In order to further define the south boundary of the site, a narrow trench was excavated by a backhoe in the area lying to the south of the drainage ditch which runs between U. S. 15 and Route 806. This trench was excavated along the east side of a line stretching for a length of 20 feet from a point 145 feet south and ten feet east of N0E0 (see Figure 2). The location selected is adjacent to the south edge of a former fish pond in a low-lying and somewhat marshy area.

Excavated to a depth of approximately five feet, the exposed soil proved to be very similar to that described by Orr and Orr (1977:7) in their earlier exploration of this area. That is, the surface is marked by a thick black organic accumulation of topsoil, beneath which is a yellow sandy clay containing occasional large stones. This deposit appeared very homogenous and contained neither artifacts nor visible evidence of iron-working activity. Accordingly, it is estimated that the south boundary of site 18FR320 is either coincident with or slightly to the north of the aforementioned drainage ditch.

In summary, the perimeter of site 18FR320 can be defined as follows. While the area to the south of the stone embankment was clearly utilized for the deposition of slag from E5 at least as far east as E40, the rock pile itself seems to have been the southern limit of activity areas and structural remains. Most of the significant features of 18FR320 continued beyond the western baulk of the excavations, and site 18FR320 must have extended, perhaps for a considerable distance, under U. S. Route 15 to the west and northwest. Directly to the north, charcoal bearing layers extended under the dam, but no structural remains were located. To the northeast and east, no satisfactory boundary has been established between site 18FR320 and the conjectured forge, while to the southeast, the site features again extended beyond the bounds of the excavation.

Stratigraphically, the historic iron-working levels at site 18FR320 are those soil layers and features between and including the dark reddish-brown silty clay with flecks of charcoal, and the mottled dark grayish-brown clay with flecks of rust and charcoal.