V. ARTIFACTS ANALYSIS AND FUNCTION

A. Analysis

Excavated artifacts from both the 1979 and 1981 excavations are cataloged in Appendices II and III. Both groups of material from the two seasons share common characteristics; a high proportion of cast and wrought iron artifacts was found in relation to the numbers of other kinds of artifacts. A great deal of effort has been expended by historical archeologists in attempts to define patterns in the ratios of the different kinds of artifacts found on historical sites. Notably, in the Carolinas Stanley South has defined various kinds of artifact patterns (South 1977:83-164), and other researchers have tried to develop site patterns in other areas (Tordoff 1979:38-47; Parrington 1980:161-176).

As a methodology, South's concept of defining artifact patterns could be applied to 18FR320. The specialized nature of the site as indicated by the documentary evidence and the artifactual evidence suggests that such an approach would produce a distinctive pattern. The value of that pattern for the Catoctin site, however, would be limited by the difficulties experienced in identifying the function of many of the cast iron artifacts which for the most part were featureless fragments of flat iron. Other problems would be created by the difficulty of distinguishing between artifacts being made on the site and those being used to make artifacts on the site. Given these problems, which for the most part can be attributed in general to the lack of research on areas of ancillary activity away from the more spectacular furnace remains, it would appear undesirable to attempt to define an iron working site artifact pattern for Catoctin.

Despite the problems of identifying many of the iron artifacts, a reasonably good interpretation of the industrial processes which were taking place on and in the vicinity of the site can be made. These interpretations are based on the presence of certain distinctive kinds of artifacts which are waste products of iron casting. Iron casting is an important aspect of the industrial process by which iron ore is converted into a finished product. The presence of gate metal (sprues, wedge gates, and runners) indicates the kinds of casting activities which were going on at the site. Finds of broken and imperfect castings indicate the range of cast iron products being manufactured.

The recovery of various tools during the excavations suggests that the cast iron artifacts were trimmed of waste metal and in some cases assembled at or in the vicinity of the site. Evidence was also recovered for the production of wrought iron artifacts to be used in assembling cast items. Wrought iron, which would have been used for other purposes such as horseshoes, ox shoes, and wagon parts, was also found, suggesting a blacksmith's shop might have been in the area of the site. Evidence for non-industrial activities in the form of ceramics and glass bottles was found which may relate to the workmen who were employed at the site.

Most artifacts from industrial sites have, in general, what has been defined as a technomic function (Binford 1962:217-226). That is, their function is strictly utilitarian and designed to counter a problem imposed by the environment. Tools are a good example of technomic function in that they extend the capabilities of the human hand and brain in order to carry out tasks which would be difficult or impossible without them. Tools are used to produce other kinds of artifacts such as structures, machinery, and household equipment of one kind or another. Industrial buildings and machinery will usually have a technomic function, but some of the artifacts they produce may have a socio-technic function (Binford 1962:217-226).

On an iron casting site, stoves with elaborate designs (cf. National Heritage 1975:Plate 3) which have no utilitarian purpose may have a socio-technic function when they are sold and displayed by the customer in a social context. Likewise, stoves with elaborate religious motifs cast onto them (cf. Mercer 1961:Plate 1, _et al._) have a similar social context, but because of the subject matter displayed on them, they have an ideo-technic or religious function (Binford 1962:217-226). Ceramics found on a site may be plain and utilitarian, indicating a technomic function, or may be finer and decorated suggesting a socio-technic function. The evidence of the excavated artifacts at Catoctin indicates a strong technomic function for the site with little evidence of non-utilitarian items. Apart from simple moldings around the edges of some fragments of flat cast iron there were no iron artifacts with any decorative motifs.

The vast majority of surviving eighteenth and nineteenth century stoves are elaborately decorated and this fact probably gives a misleading impression of their relative frequency in relation to plainer stoves. As Deetz has pointed out (1977:6-7), what has survived from the past cannot be regarded as a representative sample, as the more aesthetically pleasing artifacts may acquire heirloom status and be saved, whereas the commonplace is discarded. There is some evidence for socio-technomic function in the ceramics from Catoctin insofar as a small amount of pearlware and whiteware was found. What may be more significant, however, are the finds of Chinese export porcelain, conventionally regarded as a reliable indicator of higher social status (Miller 1980:3). The other excavated evidence from 18FR320 indicates that the main focus of the site was industrial and the finds of high status ceramics are anomalous. It is possible that these sherds are from trash deposits associated with the Auburn Mansion a little to the west of the site. Their linear distribution along the driveway leading to the mansion tends to confirm this hypothesis.

B. Function

Four main categories of artifacts were recovered during the 1979 and 1981 excavations; ceramics, glass, wrought iron, and cast iron. Ceramics and glass form a small proportion of the artifacts from the site, and most of the sherds came from fill layers or from the area of the driveway to the Auburn Mansion. With the exception of a number of fragments from a redware bowl found in the raceway (F44), most of the ceramic and glass artifacts were very small in size and interpretation of their function is difficult. Four main types of ceramics were identified: redware, gray salt-glazed stoneware, whiteware, and Chinese export porcelain. Redware formed the largest ceramic percentage, much of which was glazed either with a clear lead glaze or with a dark, metallic brown manganese glaze.

Chinese export porcelain sherds formed a small percentage of the ceramic assemblage from the site. Many of these sherds appeared to be from plates and were decorated with blue or white motifs. Unfortunately, the small size of these sherds made it difficult to identify the designs on them, which might have allowed an estimate of their date range to be made.

Gray salt-glazed stoneware formed another small component of the ceramic assemblage. Most of these sherds were small and plain but a few were decorated with cobalt blue designs. Whiteware formed a larger percentage, together with a few sherds of green-edged pearlware and blue-edged pearlware. Some of the whiteware was transfer printed and some sherds of annular decorated and machine-turned whiteware were found. Most of the whiteware and pearlware sherds were probably from plates, mugs, and cups, although their small size makes a positive identification impossible in most cases.

The glass assemblage was comprised of window glass and bottle glass sherds, with window glass predominating. Most of the window glass was aqua-tinted and of uniform thickness measuring less than one sixteenth of an inch. The distribution of the window glass was concentrated around the northeast and southeast walls of Feature 1, suggesting it originally formed the windows of this structure. Much of the bottle glass was from clear glass bottles with a few sherds of dark blue and green wine/beer bottle glass. Some relatively modern clear and amber bottle glass was also found. Few diagnostic features were found on the bottle glass with the exception of a base sherd from a green glass bottle which had a pontil mark.

The function and relationship of this material to the industrial site can be explained in two ways. It is envisaged that some of this material may be defined as "primary refuse" or material discarded at the place where it was in use, and "secondary refuse" or material dumped at a place where it was not in use (Schiffer 1972:161). The window glass around Feature 1, the fragments of redware bowl, and possibly some of the other sherds of ceramic and glass may be defined as primary refuse in use on the site. The majority of the ceramic and glass sherds were very small in size and were perhaps from refuse or midden deposits which were brought onto the site in fill layers and thus would be classified as secondary refuse. The high status nature of the Chinese export porcelain has already been remarked on and the possibility that this material came from the Auburn Mansion reinforces the interpretation of some of the glass and ceramic as secondary refuse.

Objects of wrought iron formed a high percentage of the artifacts found during both seasons of the excavation. These objects fall into three categories; hardware, which includes nails and unidentifiable scraps of iron, tools, and composite wrought iron objects which were riveted to cast iron artifacts. The largest percentage of the three was hardware, most of which was made up of nails. Many of these nails were badly corroded; those that could be identified were wrought or cut nails. Spikes of various sizes formed part of this group. Other miscellaneous iron artifacts included chain links, hinges, iron hooks, strap iron, horse and ox shoes, and nuts and bolts.

Some of the wrought iron nails and other hardware are presumably building debris from the wooden components of the structures which stood on the site. In view of the evidence for flask casting at the site, which is discussed below, it seems likely that some of the nails and other hardware may be from flasks. Wooden flasks would have been nailed together and some of them would have had hinges. Iron and wooden flasks would have been closed with hooks and eyes, and some of the smaller hooks from the site may have served this function (cf. Spretson 1878:Plates XXVII and XXXI). The horse and ox shoes would have served the needs of the large numbers of draft animals documented at the site which were used to haul finished goods to the various markets (National Heritage 1975:10), and to transport ore and fuel to the furnace (Thompson 1976:105). Some of the chain links and hooks found may also be related to transportation as wagon or harness parts.

Other items of relevance to this aspect of the site were two large wrought iron artifacts identified as skeins from a tar skein axle for a large wagon (Donald Berkebile; Smithsonian Institution: personal communication). These artifacts were designed to strengthen the wooden axle of a cart, were rounded to fit round the axle, and had square holes for a linch pin at one end and a groove for an iron restraining band at the other. A wagon box was also recovered, but this was a cast object and will be discussed below.

Hand forged butterfly nuts and bolts, usually of one-half inch diameter with square heads, were relatively common finds. These artifacts are identical with the type of hardware used to bolt eighteenth and nineteenth century stoves together (Mercer 1961: Plates 7 and 8). A backplate of flat iron was placed on the inside angle formed by two plates and the bolts were pushed through the plate and through a rounded cast gutter-shaped piece of iron. The gutter-shaped iron covered the joint and the butterfly nuts formed an external decorative element.

A variety of wrought iron tools were found which included cold chisels, punches or drifts, files, wrenches, slickers, a hammer, and a draw knife (Plate 10). With the exception of the draw knife, which had the maker's name "AMES" on it, all of these tools were probably made by a blacksmith. The draw knife was a tool used by woodworkers such as carpenters, coopers, and coachmakers; a wide variety of different kinds were used, each designed for specific tasks (Wildung 1957:54-55). The Ames Manufacturing Company was organized in Massachusetts in 1834 and is still in business today (Herskovitz 1978:64).

The cold chisels from the site ranged from four to eight inches in length with some possibly broken examples which were around two and a half inches in length. Widths ranged from three quarters of an inch to two inches with thicknesses of three eighths to three quarters of an inch. Most of the 21 examples identified had burred ends, indicating heavy usage. Cold chisels and hammers were the implements used for trimming gate metal from castings (Spretson 1878:368-369) and this may have been their function at 18FR320. Blacksmiths also used a variety of cold chisels (Albright and Souder 1974:30), but the basic similarities in the Catoctin chisels and comparative data from other ironmaking sites (Crossley 1975:Figure 30) suggest that they relate to the trimming of castings.

The presence of blacksmiths in the area of the site is, however, indicated by a number of other tools and it is not unlikely that they used some of the chisels. A number of small wrought iron punches were recovered during the excavations and it seems very probable that these are blacksmith tools. A side set hammer from the site is of a distinctive type used by blacksmiths for working an inside corner or welding two pieces of iron at right angles to each other (Richardson 1978:Vol. 1; Figure 180 No. 53; 188). The files, too, may have been used by a smith, but the relatively large number of these (eight) may be an indication that they were used for finishing castings.

A fragment of a wrought iron wrench which may be associated with stove assembly was recovered. The wrench head was square like many of the bolt heads from the site. A number of fragmentary trowel-like tools were also recovered during the excavation. These are identified as slicks which were tools used for smoothing molds after the pattern had been removed (Spretson 1878:Plate XXVII; Clemens 1924:Section 70; 31). Many fragmentary pieces of wrought iron may also represent portions of tools, but identification of them was not possible due to their small size and heavy corrosion. One very large object, an iron bar one foot, six and a half inches long with one round and one pointed end was recovered. The function of this artifact is uncertain; it may be a tool or some kind of building hardware. Another enigmatic object was a wrought iron staple-like object with dimensions of seven inches by two and a half inches. Again, no precise identification could be made of this object which may also be some kind of building hardware.

Three examples of composite cast and wrought iron objects were found. These consisted of angular fragments of cast iron with wrought iron bars riveted on them (Plate 11). These may be bases or plinths for large iron cooking pots (cf. National Heritage 1975:Plate 6). Alternatively, they may just be parts of stoves which had wrought iron legs on an angular cast iron body. No parallels for stoves of this pattern have been noted, but of the wide variety of stoves produced, many had wrought iron components in their stands or feet.

Cast iron formed a large proportion of the artifacts from Catoctin. Much of this material was flat, featureless cast iron, probably from plain stove plates. The only examples with any kind of decoration were those which had moldings of some kind around the edges, which presumably were to mask the joint between two plates. Two fragments with door latches were found in which the cast iron latch had been riveted on with a wrought iron rivet. One fragment of a cast iron door frame was also found with a wrought iron rivet forming a catch for the door fastener. Several fragments of cast iron feet were found which bore a strong resemblance to the feet on a stove known to have been made at the furnace in 1786 (National Heritage 1975: Plate 1). One fragment of flat cast iron had the numeral 3 cast onto it. This may have been a pattern or size number; such numbers are found quite often on stoves, usually in some inconspicuous place or sometimes in a prominent place (cf. Pierce 1951:Plate 121). Some of the flat cast iron had rounded molded edges, suggesting that these examples came from the rounded base plate of a Franklin-type stove (cf. Kent 1976:Plates 7 and 8). The overwhelming impression indicated by the artifacts associated with stove manufacture was of plainness and utilitarianism with no evidence of elaborately decorated stove plates.

Other evidence of casting was indicated by fragments of cooking pots of various sizes. Many of these pots were represented by fragments with feet and a semi-complete example excavated in 1979 which has three feet and an iron handle may be a representative example of this type (John Milner Assoc., Inc. 1980:Plate 15). Two examples, each with a triangular handle ear, were noted (Plate 18). Handles and feet varied in shape from round to triangular. The pot from the 1979 excavations had a casting scar from a circular sprue. It was more usual to cast pots with a wedge-shaped gate as these were easier to break off than the circular sprues (Tyler 1976:223). Another type was represented by an everted rim sherd with a perforated lug for the bail attachment.

Apart from stoves and hollowware, there were indications of other kinds of casting activity. A rectangular block of iron measuring approximately five inches by three and a half inches by two and a quarter inches with a circular groove in it was found. This is interpreted as a bearing block of some kind. A fragment of iron with cogs on it and some indications of a curve on the opposite side to the cogs appeared to be part of a gearing wheel (Plate 12). A casting scar on this artifact indicated that it had been cast in an open mold. Excess metal in the cogs and the remains of a runner on the inside of the gear wheel is evidence that the casting broke before the trimming of gate metal and finishing of the artifact was completed.

Another distinctive artifact was a cast iron wagon box with the remains of a runner attached (Plate 13). This, too, was cast in an open mold and had not been trimmed or finished. The casting had a bad blow hole on one side which was probably the reason why it had been rejected and not finished. A fragment of a very large hollow-ware vessel with a large trunnion handle was also excavated. The function of this vessel is uncertain, and it is difficult to speculate what it may have been used for.

Some evidence of cast iron artifacts which were probably used in the casting process was found. Examples of cast iron flask clamps designed to hold the two halves of a flask mold together (Plate 14) were found (Clemens 1924:Section 69; 20-21). Other items of cast iron are interpreted as gaggers which were used to reinforce the sand in large molds (Clemens 1924:Section 70; 19-20). The flask clamps from Catoctin are similar to those in use in modern foundries; the possible gaggers found were cast as right angled bars of iron, but other forms were in use depending on the kind of casting being made.

Three kinds of waste or gate metal from the casting process were found. In casting it is always necessary to have a channel for the molten metal to run through into the mold. In open molds the channel will be a groove formed in the sand and the gate metal will be rounded on one side and flat on the other. The gate metal from this kind of casting is called a runner. Several examples of runners were found including one with a stem and a number of branches, indicating multiple casting of objects (Plate 15).

In closed molds or flask molds, the channel or gate was either a tapering cone or sprue (Plate 17) or a wedge-shaped gate or wedge gate. Examples of both kinds were found at Catoctin with wedge gates being the most common. Forty-nine gates were identified as wedge gates against a total of 24 sprues.

It is not impossible that some of the gate metal recovered should be interpreted as vents for air and steam to escape from the mold cavity and for the molder to verify that the cavity was filled with molten iron. However, it is likely that green sand molding, as discussed in Chapter III, was the practice here since it was common at this time, and green sand molding generally did not require vents as the steam escaped through the sand (Overman 1872:45).

C. Analytical Program

The questions which prompted the program of analysis of slag, waste, and finished iron artifacts recovered from the 1981 excavations were outlined in the Introduction. To recapitulate, the fundamental aim of the slag analysis was to identify the metallurgical process which produced it; the fundamental aim of the metal analysis was to identify the type of iron produced and its effectiveness for certain purposes.

Slag Analysis:

Eight samples of slag were selected for analysis, including examples of the heavy rusty frothy type (ferrous slag), a greenish glassy variety (glassy slag), and one example of an earthy type. The contexts from which these samples were selected included the fill of F44, the hard-packed slag surface, the compact slag south of the stone embankment, the mixed slag and charcoal layer (all in the south of the site), and the charcoal and slag area (in the north of the site). The intent was to include as wide a variety of contexts and types of slag as possible in order to check for any change in process over time and space.

The analytical program focused on the identification of the composition of the slags, and on observations of their structures. Quantitative elemental analysis of the major constituents of the slag was obtained from proton-induced x-ray emission spectroscopy (PIXE), which was carried out by Charles Swann of the Bartol Research Foundation of the University of Delaware. A brief metallographic examination was made of polished and mounted specimens of all but Sample 17 by Gerry McDonnell of the Archaeometallurgy Group of the University of Aston in Birmingham, England.

Compositionally and metallographically the slags fall into four groups:

(i) Samples 17 and 18 are green glassy slags with small round vesicles and spherical metallic iron inclusions.

(ii) Samples 6, 7, 11, and 16 have externally an agglomerated appearance with surface corrosion products (Plate 16). In section they vary from gray/black to blue/gray in color and are variably vesicular. Samples 6, 7, and 16 are weakly magnetic, while Sample 11 is strongly magnetic. Under the microscope they present a structure of rounded iron oxide grains, probably mostly wustite (FeO), fayalite ($2FeO.SiO_2$), a glassy phase probably approximating to anorthite, and metallic iron inclusions.

(iii) Sample 15 has an agglomerated appearance, is gray/black in section, heavily vesicular and non-magnetic. Its structure is one of rounded iron oxide grains and fayalite laths in a glass matrix with metallic iron inclusions.

(iv) Sample 10 has an earthy appearance and upon fracturing shows an apparent agglomerated appearance with inclusions of charcoal, silica, and brick. The sample is friable and magnetic. The matrix is a fayalite slag with rounded iron oxide dendrites and some glassy phase.

Identification of the composition of Samples 17 and 18 and comparisons with published slag analyses (White 1980:Tables 2-4; Morton and Wingrove 1969:57)[1] make it virtually certain that these are examples of a fairly typical charcoal blast furnace slag (Table 1).

The other slags are more enigmatic. Dark iron silicate slags such as Samples 6, 7, 11, and 16 are characteristic of a number of iron-working processes, including bloomery production of wrought iron, refining of pig iron to make wrought iron, and remelting or reheating in a variety of furnaces (Morton and Wingrove 1969:56; Hallett 1981). The initial expectation, because of the association of these slags with casting debris, was that they would have been produced in a casting operation in a remelting furnace such as a cupola. In fact, composition and structure strongly suggest that these are refining slags. While somewhat higher in iron and lower in silicon and aluminum

Table 1. Composition of Catoctin Slag Samples

Sample No.	Elemental Composition (% by weight) Fe	Si	Al	Ca	Mg	Mn	P	S	K
6	81.8	8.0	1.16	5.0	≤ 0.05	0.27	1.64	0.050	1.28
7	93.1	2.0	0.13	2.5	≤ 0.05	0.45	1.08	≤ 0.01	0.24
11	89.2	3.5	0.14	4.5	0.45	0.25	0.84	≤ 0.01	0.48
15	65.1	18.2	2.21	7.8	0.60	0.28	0.034	0.029	4.9
16	94.2	3.2	0.27	0.82	0.36	0.31	0.37	0.24	0.056
17	5.1	49.1	13.8	18.2	3.9	1.51	≤ 0.01	≤ 0.01	6.3
18	3.1	46.8	10.0	26.6	5.2	0.58	≤ 0.01	≤ 0.01	5.8
10(S1)	92.9	2.0	0.23	1.15	0.13	0.21	2.41	0.050	0.104
10(S2)	19.6	48.7	13.7	6.3	2.24	0.21	0.079	0.83	6.9
10(S3)	1.4	98.5	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.05	≤ 0.01	≤ 0.01	≤ 0.05

Description and Contexts of Slag Samples

6	Ferrous slag	N30E25	Compact slag
7	Ferrous slag	N50E15	Hard-packed slag
10	Earthy slag	N40E35	Mixed slag and charcoal
11	Ferrous slag	N90W10	Charcoal and slag
15	Ferrous slag	N20W5	Interface of gray clay and charcoal in F40
16	Ferrous slag	N40E15	Mixed slag and charcoal
17	Glassy slag	N40E15	Mixed slag and charcoal
18	Glassy slag	N40E15	Fill of F44

than other analyzed refining slags (Morton 1963:264 and 267; Morton and Gould 1967:242f.; Morton and Wingrove 1971:27f.), the mineral constituents and their form are equivalent to those expected for slag deriving from the forging process, although whether in a finery or chafery hearth would require further investigation.

The mineral constituents of Sample 15 are similar to those of the second group, but the form of the minerals is different, indicating a faster cooling rate than for the second group. Accordingly, this sample may derive from either the same process under different conditions, or from a different process. The composition of this sample actually bears the closest resemblance to analyzed refining slags. As for Sample 10, it is distinguished by its earthy texture and inclusions, and may result from raking out of a furnace or hearth, which would account for the inclusions of refractory material and sand. Its composition was obtained at three sites on the sample: that at S1 bears a close resemblance to the composition of the first group, that at S2 probably is the fayalite matrix since it closely approximates that constituent's proportion of iron oxide to silica (1:2), that at S3 must have been a grain of sand.

The form that some of the slag took should be noted here as support for its identification as refining slag. As mentioned above, in the area south of F44, the ferrous slag occurred in the form of thick plates up to 18 inches in diameter. These closely resemble identified chafery slag plates called "mossers," where "a simple saucer-shaped hearth sufficed the needs of the bottom, and as the slag formed it overflowed the hearth, and onto the sand floor" (Morton 1963:267, Figure 10).

The initial resistence to the identification as refining slag was strong, because of the difficulties in understanding the association of refining slag and casting debris, the expectation as outlined in the Introduction of finding evidence for a foundry, and other incongruities, not the least of which is the unsuitability of Catoctin-produced iron for refining purposes (as will be discussed below).

Accordingly, a concerted effort was made to discover exactly what remelting (i.e., foundry) slag would have looked like and what its composition would have been.

Unlike historic smelting and refining slags, which have been well-studied, particularly by researchers in England, analyses of early remelting (in reverberatory or cupola furnaces) slags are conspicuous by their absence. The earliest description of cupola slag found dates to 1869. In it, the slags are described as being

> formed of the slag of the fuel, the sand and slag sticking to the pig-iron, particles of the furnace lining, the limestone added, &c.; they are blue, grey, brown, or yellow, vitreous, porcelain-like, stony or earthy (Crookes and Röhrig 1869:608).

Their analysis of a sample of cupola slag in which cast iron was melted with an addition of lime had 1.11 percent iron oxide (FeO).[2] Visual examination of cupola slag from the Highland Foundry site in Roxbury, Massachusetts (1845-1920)[3] confirmed this description, being slag of an extremely diverse nature which contained numerous inclusions, particularly of the fuel (coke). However, it is likely to have contained very much more iron than about one percent. No descriptions or analyses of reverberatory furnace slag have been located.

Cupola slag is likely to have changed quite drastically in nature and composition over the period that cupola furnaces were in use. While later cupolas operated with high lime slags and subsequently saw little loss of iron to the slag (Moldenke 1930:480), it is likely that in earlier cupola operation, the slag might have contained a good deal more iron. Contemporary observers noted the problem of the loss of iron in the remelting process. Overman writes that the loss would be invariably five to six percent with the reverberatory furnace consuming most iron (1872:222). Spretson notes that the "great waste in melting iron in a cupola usually occurs at the zone of the tuyeres" (1878:66), which were supplying the blast and which was where the iron would be most liable to oxidation.

Accordingly, it is not entirely ruled out that Samples 6, 7, 11, 15, and 16 might be early remelting slags. Sample 10, in particular, shares with the Highland Foundry slag and with the 1869 description, an extremely heterogeneous appearance and composition. But given the current state of knowledge of early metallurgical processes,[4] the identification of this slag as refining slag must be accepted, in the absence of any analyses of comparative historic remelting slags.[5]

To summarize, the analysis of the slag revealed the following:

(i) The nodules of green glass slag which were found in the fill of F44 and in most of the other layers on the site are quite clearly slags derived from the primary smelting process in a charcoal blast furnace.

(ii) All the ferrous slag can be provisionally identified as deriving from the refining of pig or cast iron in a finery and chafery forge, with the possibility of changes in the tapping procedure causing differences in cooling rate, creating slightly different structures.

(iii) Only Sample 10 is sufficiently heterogeneous and compositionally anomalous conceivably to have derived from a different process, but probably should be interpreted instead as furnace or hearth rake-out.

Metal Analysis

Ten items of cast iron were selected for the analytical program. They included a sprue or riser (Plate 17), a tripod kettle leg, a handle ear (Plate 18), a section of flat plate, a runner, three wedge gates of different sizes, a gutter or possibly a bad pig, and a fragment of pig iron (Plate 19). Again, the intent was to collect samples from varying contexts, and to examine both finished objects and artifacts representative of stages in the casting process. Because it was initially believed that casting was the only process represented at the site, the focus of the program was on cast iron. Because it was not conceived that the manufacture of wrought iron might have played a role at 18FR320, no items of wrought iron were studied.

Again, quantitative elemental analysis was obtained by PIXE, and supplemented by scanning electron microscopy, which was carried out by Heidi Moyer of Lehigh University. Metallographic examination was carried out by Helen Schenck of the Museum Applied Science Center for Archaeology, University Museum, Philadelphia, with material assistance by Reed Knox, retired metallographer, and Michael Notis of Lehigh University.

Cast irons are a class of iron-carbon alloys which have a sufficiently high carbon content to attain a relatively low melting temperature. Accordingly, they are used to cast objects which can be machined into final form, but may not be subject to plastic deformation. Thus their properties are determined by initial composition and by control of the casting process. Cast irons can be modified by subsequent heat treatment (malleabilizing), but as this process is irrelevant to the Catoctin specimens, it will not be further discussed. Cast irons are classified according to their microstructure, which is dependent on composition and rate of cooling. The crucial constituent is carbon: if the carbon occurs in the form of free graphite, then the iron is gray iron; if it is present combined with iron to form iron carbide or cementite, then the iron is white iron. Mottled iron describes an iron with a structure which incorporates both these phases.

The names of these types derive from their appearance when fractured, which was the only way to judge the quality of pig iron until the advent of the science of metallurgy at the end of the nineteenth century (Sanders and Gould 1976:523). Generally speaking, they were graded by number with No. 1, or dark gray pig iron, being the foundry iron; No. 2, equivalent to mottled iron; and No. 3, or white pig iron, being useful in the refinery but of no use in the foundry (Overman 1872:179-181; Overman 1854:288). Tomlinson identifies the same general categories but with additional subdivisions (1868:914).

With one exception the Catoctin irons were either gray or gray to mottled iron. Only Specimen 14 (pig) was white to mottled iron. The form that the graphite characteristically took in the gray irons was Type A, flakes of random orientation and uniform distribution (Plate 20) with some flakes forming rosette groupings (Type B) (ASTM standards A247;1975). The former type is the most desirable in engineering irons (Gagnebin 1957:51). In the gray irons, the flakes of graphite generally occurred in a pearlitic matrix. Pearlite is the eutectoid constitutent which consists of plates of iron carbide interspersed with plates of ferrite, or pure iron, and has a characteristic lammellar structure (Plate 21). The best strength in gray irons is associated with a matrix of pearlite, which gives them high hardness and good mechanical properties (Ungalik 1977:vi).

The other major constituent observed in the gray irons was the phosphide eutectic which has a characteristic conforming shape of a concave triangle (lenslike form). Because it has a low melting point, it is the last constituent to freeze and therefore occurs at the boundaries of the solidification cells (Angus 1978:27). It can be seen in Plate 22.

The formation of white iron depends on two factors: the composition, most notably the percent of silicon, and the rate of cooling. Silicon strongly promotes the formation of graphite, and rapid cooling promotes the formation of iron carbide. Thus, section size of a casting will have an appreciable effect on the likelihood of gray or white iron being produced, since the thinner the section, the faster it is likely to cool (Angus 1978:5). The characteristic structure of white iron is called ledeburite, and is the eutectic mixture of iron carbide and pearlite. It characteristically has the form seen in Plate 23.

Examination of the composition of these specimens (Table 2)[6] shows medium levels of silicon, except in the case of Specimen 14 (pig), where the extremely low level of silicon is obviously the reason for its structure of white iron. Because Specimen 3 (handle ear) has a reasonably high percentage of silicon, the thin section of the piece

Table 2. Composition of Catoctin Iron Samples

Sample No.	Elemental Composition (% by weight) Si	P	S	Mn
1	1.16	0.18	0.035	0.53
2	1.17	0.68	0.057	0.34
3	0.74	0.70	0.062	0.47
4	0.52	0.88	$\leq$0.01	0.68
5	0.42	0.75	$\leq$0.01	0.34
8	0.44	0.96	$\leq$0.01	0.95
9	0.31	0.95	$\leq$0.01	0.83
12	0.36	0.90	$\leq$0.01	1.14
13	0.74	0.91	$\leq$0.01	0.44
14	0.08	0.47	$\leq$0.01	$\leq$0.05

Description and Contexts of Iron Samples

1	Sprue or riser	N40E35	Mixed slag and charcoal
2	Tripod leg	N40E35	Mixed slag and charcoal
3	Handle ear	N30E25	Compact slag
4	Flat plate	N40E35	Hard-packed slag
5	Wedge gate	N40E35	Hard-packed slag
8	Runner	N90W10	Reddish-brown silty clay
9	Wedge gate	N90W10	Reddish-brown silty clay
12	Wedge gate	N90W10	Reddish-brown silty clay
13	Gutter	N80E10	Blacktop and macadam
14	Pig	N30E25	Compact slag

with concomitant rapid cooling must have been responsible for its mottled iron structure (Plate 24). There is quite a range in the level of manganese. Manganese is chiefly important as a neutralizer of sulfur, which is generally one of the worst impurities iron can contain. If sufficient manganese is present, which it is in all the Catoctin specimens, then it will combine with sulfur to form manganese sulfide, and prevent the formation of more harmful iron sulfide (Angus 1978:20). Manganese present in amounts over this tends to promote the formation of pearlite. The iron contained very low levels of sulfur.

Finally, all the iron samples had high levels of phosphorus. The phosphorus content in currently produced gray iron castings is generally less than 0.15 percent (Krause 1968:6). Phosphorus was undesirable in wrought iron, but since it would increase the fluidity and melting range of the cast irons, it would have given them good castability. Kirk notes that "It is generally conceded that an iron for light soft castings should contain from 1 to 2 percent of phosphorus" (1911:110).

In sum, it can be said that these are phosphoric cast irons, almost all gray, the structure of which was one of soft flake graphite uniformly distributed in a matrix of pearlite with an intercellular network of phosphide eutectic. Both the type of the flake graphite and the matrix of pearlite would be the most desirable structures for engineering gray irons. Comparison with other analyzed specimens from North America (Henger 1970, Ungalik 1977) shows a surprising uniformity of structure. Only one of the specimens analyzed by Henger had a ferritic rather than a pearlitic matrix.

It should be noted that the silicon content of the St. Maurice Forges examples ranged between 0.4 to 0.8 percent, and those from charcoal furnaces in Henger's sample had a silicon content of between 0.06 to 0.7 percent. In contrast, the Catoctin samples had a range of 0.3 to 1.2 percent silicon (excluding the white iron pig). They therefore fall midway between the irons produced in a charcoal blast furnace and those produced in a coke fueled blast furnace. The samples from the latter have about a 1.6 to 1.7 percent silicon content (Henger 1970:46f.); Morton lists the silica content in "typical analyses" for charcoal and early coke pig as 0.39 and 2.15 percent respectively (1966:58).

The significance of these variations is that the higher the operating temperature of the furnace, the higher the percentage of silicon which will be reduced and end up in the finished iron (Schallenberg 1975:350). While the level of silicon is not as high in the Catoctin pieces as in coke-smelted iron, it is relatively high compared to cold-blast charcoal smelted iron such as that from the St. Maurice Forges. The very low percentage of sulfur would also strongly suggest that the iron was from a charcoal furnace rather than a coke furnace. Thus, the levels of sulfur and silicon are not incompatible with the hypothesis that the Catoctin examples were produced in a hot-blast charcoal furnace. It cannot be too strongly stressed, however, that variations in percentages of these impurities can be attributable to a number of causes and would depend on how efficiently the furnace was working and what flux was being used, as well as the operating temperature of the furnace.

The high level of phosphorus does definitely indicate that a high-phosphorus ore was the original source of these irons. This is entirely in keeping with the supposition that this iron is from the Catoctin ore banks. In 1911 Singewald described the ore in the Blue Mountain Ore Bank north of the furnaces as a good grade of non-Bessemer limonite with variable manganese content, low sulfur, and high phosphorus--between two to four percent (1911:195f.) A sample from the Auburn Bank south of the furnace and west of 18FR320 had a similar composition with a slightly higher phosphorus level (five percent) (Singewald 1911:201).

What are the general implications of these analyses? It seems a number of points can be made. Most importantly, it is clear that smelting, refining, and casting are all activities of which evidence was found at 18FR320, in the form of the two types of slag and the casting debris. Smelting, however, clearly did not have the same impact on the site as the other two processes, since only a relatively few nodules of this type were found. In comparison, numerous heaps of slag are found around the standing stack to the north, of which the largest measured over 200 by 500 feet and stood 25 feet above grade (Struthers 1981:46).

It is difficult to be certain of the relationship of the iron and the two types of slag. It will have been noted above that there was an implicit assumption in discussing the iron that it would have been cast directly from the blast furnace and not from a foundry furnace. Fundamentally, this assumption rests on the presumed chronological position of the layers of interest at the site in the first half of the nineteenth century (as will be discussed below), the lack of any documentary evidence for a foundry at Catoctin before the mention of a steam driven foundry in the 1860 Census (see above), and the absence of identifiable remelting slag.

It should be noted, however, that it is not possible to distinguish between iron as cast from a blast furnace and iron as remelted and cast from a foundry furnace. Hallett notes, "when pig iron is remelted in a cupola and even more so in an air (reverberatory) furnace, there is a loss of some 10% in the carbon, silicon, and manganese contents but unfortunately blast furnace iron (pig iron) varies from case to case more than that" (1981). The only point that can be made is that the low sulfur content of the Catoctin irons makes it virtually certain that they could not have been produced from a coke-fueled furnace, whether blast or cupola. While cupola furnaces were generally fueled by coke (Tomlinson 1868:344), they apparently might sometimes be fueled by charcoal (Overman 1854:204). Charcoal was the only fuel found at site 18FR320 with the exception of a very few nodules of coal in upper levels.

It might be asked if the iron could have been produced by the furnace which produced the glassy slag: it could, but it need not have. In other words, there is nothing conclusive which either urges that the slag and metal are related, or makes it impossible for them to have been associated.

A much trickier point is what the association of the refining slag and the casting waste means. One possibility is that the gate metal was being refined to wrought iron in the finery and chafery. It does not seem that this practice would be metallurgically unfeasible, but it must be admitted that it does not appear as suggested practice in any of the contemporary manuals. Perhaps it is as simple an association as the forge being next to the shed or structure where castings were finished or fettled, so that waste and scrap from both establishments tended to be carted off together.

Another possibility is that there actually was a foundry furnace in operation in conjunction with the forge, and that there was simply very little slag produced by it in comparison to the volume of slag produced by the forge. The reference to the forge where castings were made might be remembered at this point (discussed above in Chapter II), and a comparable site might be the nineteenth century Potts and Wilson Iron Foundry/Forge at Matildaville, Virginia.[7]

Finally, the point that is the most difficult to resolve is the refining process. High phosphorus "cold-short" pig iron was difficult to work in the finery and would produce a brittle cold-short wrought iron. "Metals which contain phosphorus or sulphur are not adapted for the charcoal forge," writes Overman, "because of the inferior iron they produce, and because of the amount of time consumed in converting them into bar iron" (1854:281). Thus, while the high phosphorus iron would have been superior for the production of thin-sectioned castings with fine detail, such as stove plates and hollowware, it would not have produced good quality wrought iron. This discrepancy cannot be resolved. It might be suggested that what is evidenced at 18FR320 is an experimental try at refining which was abandoned when the wrought iron produced proved to be not of acceptable quality. A test of this hypothesis would include the analysis of some of the wrought iron found on site.

A last point to be discussed is the identification of the flecks of rust in the clay overlying the site. It was initially believed the flecks might represent "hammer scale," the slag which forms in thin scales during heating of bar iron under oxidizing conditions prior to rolling it or working it under a hammer (Tylecote 1962:254). It was also called "mill scale" and as discussed in Chapter III, it would be expected in forges and smithies. It was postulated that the clay with flecks of rust may relate to a period when site 18FR320 was called the "forge field" (John Milner Assoc., Inc. 1980:7), and when it was believed a forge dating to the second half of the nineteenth century was in existence to the east of the site.

However, survey of comparative examples suggests strongly that hammer scale in the immediate vicinity of the hammering or rolling would build up in relatively thick concreted slabs (Tylecote 1962: 254; "scoria" in Lenik 1974). The flecks of oxidized iron in the clay may be from sparks of flying iron, but they are not equivalent to those slabs or crusts.

VI. SITE INTERPRETATION

The significant features and soil layers of 18FR320, and their stratigraphic relationships, were described in Chapter IV; and the collection of artifacts from the site as a whole was identified and analyzed in Chapter V. The background to nineteenth century iron technology, including smelting, founding, refining, and working, was discussed in Chapter III. In this chapter, stratigraphically and artifactually determined site phases will be defined and the processes occurring in the phases identified. Finally, an attempt will be made to equate those phases with the documented history of Catoctin outlined in Chapter II. Throughout this section reference should be made to the phase maps, Figures 14 through 18.

A. Phasing

Phase 1a (Figure 14)

The earliest utilization of 18FR320 seems to have been in connection with the water channel, F44, running through the area downhill from west to east. This water channel is postulated to be a raceway and its purpose would have been either to direct the flow of water towards a waterwheel to power some operation (head race), or to channel the water coming away from a waterwheel (tail race), or conceivably both. It probably was created by channelling water from an existing stream. Examination of large scale contour maps of the area reveal that a watercourse (probably that currently running in the drainage ditch to the south of 18FR320) originally dropped down from the slopes of the mountain almost directly to the west of 18FR320 to join with Little Hunting Creek some 1,600 feet to the east of Maryland Route 806. The raceway must have been divided from the stream to the west of 18FR320, with the diminished stream continuing east to the south of the raceway. The stone embankment obviously was designed to build-up and buttress the south bank of the raceway, dividing it from the streambed, and so must be contemporary with it.

Certain features suggest that F44 functioned as a head race. F40, the water channel encountered at the west end of F44, should probably be interpreted as a sluice, designed to control the volume of water passing down the main raceway by diverting excess volume to the south back into the stream. The height of the floor in the "break" in the stone embankment was one foot, three inches above the floor of F44 at that point, which suggested the usual depth of the water in the race would be about one and a quarter feet. Above that level, it would spill into the "break" and drop down into F40. Through the measured comparison of elevations along the bottom of the raceway (F44), it was possible to calculate an approximate slope for this feature as it dropped from west to east. As a cautionary note, however, it is important to note that variations in the depth of the race may render the resulting figure inaccurate. As Evans (n.d.:118f.) noted, it was important for those employing water power to maintain a constant volume and velocity of water in a raceway, a process which often necessitated modification to depth and width in accordance with natural obstructions. An ideal velocity was felt to be one to two feet per second, but the slower the better. Using the standard formula for calculating the percent of slope, dividing the vertical drop by the horizontal distance, the slope of the raceway at site 18FR320 was determined to be approximately 3.3 percent, a figure which seems quite high.

The slot (F39) beside F40 might represent a beam slot for a water control mechanism (sluice gate). The finds of some 250 nails and nail fragments in the clay at the top of the stone embankment right at the west of N30W5 may suggest the former location of a wooden mechanism or machinery related to the sluice.

The three stone features spaced along the south wall of the raceway might have served as supports for posts, with the finds of wood in the fill of F44 being the remnants of a flume.[8] Both posts and planks were found. It is tempting to see the post found at the edge of the stone embankment in N30E15 as being connected as well, but it is preserved to such a height that it is probably much later.

The profile of the race fill suggests deposition in two stages: the edges and the middle. This might be accounted for by the following sequence: the race uniformly silted up with the mottled clay seen at either side, a narrower channel was dug or dredged out, and that, too, in time silted up. In was not, however, possible to detect any real difference in the pattern of deposition in wood or artifacts in those two contexts, so this sequence is speculative.

At the time the raceway was open, and at the time it was silting in, the area to the south of the stone embankment was probably an open, low-lying, somewhat swampy area with the stream flowing through it.

Phase 1b

Subsequent to the silting of the race, it is postulated that the reddish-brown silty clay with flecks of charcoal (A) was laid down to the north of the race. This layer is somewhat enigmatic. It closely resembles the reddish-brown siltstone or mudstone which is the natural subsoil. Generally speaking, the surface of the stratum did not have the appearance of a surface being walked on and on which artifacts were being dropped. Moreover, artifacts within the layer tended to be dispersed through the upper few inches. Only in one square (N70E10) did a possible surface seem to be defined by a scatter of stones and artifacts lying at a uniform depth in the layer. This "surface," however, was two inches below the top of the stratum, and not demarcated by any change in color or texture. The layer seems best identified as a fill layer, possibly brought on site for levelling purposes before construction of F4, although it must be admitted that this explanation is not entirely satisfactory.

In sum, little was occurring at site 18FR320 at this time, though one can envision quite a lot of activity off-stage, as it were. Obviously, some process requiring water power was in operation to the east of the site. At the end of this period, it seems the area to the north of the site began to see some use, possibly with a fill layer being brought on site. Perhaps the most important point to be made about this phase, and one which will be expanded upon subsequently, is that while there were a few nodules of glassy slag, there was virtually no ferrous slag found in the lower levels of the race fill, in marked contrast to the layers relating to the next phase.

Phase 2a (Figure 15)

Subsequent to the silting up of the raceway (F44), a large number of rocks were purposefully brought in and laid down in an elongated rectangular platform, superimposed on the race fill and on the reddish-brown silty clay. The purpose for this is unclear, but it might be postulated that it was intended to serve as a causeway over what must have been a low-lying wet area. This hypothesis presupposes the continued existence of some functional locus to the southeast or east of the site (since the causeway did not appear in the N30 trench), as well as one either to the northwest or possibly directly on site, since the causeway ends 12 feet from the western edge of the trenches. Describing the rock platform as a causeway implies some type of passage along it, and this supposition is supported by what might be a worn and hardened path along the center of the rock platform (as in N40E25 and photographed in Plate 2), where there is a gap in the rocks and a very compact surface with many pieces of wood.

The existence of this layer also might suggest a slight time lag before the hard-packed slag surface was deposited on and over the rock platform. This hard-packed slag was clearly related in its horizontal extent to the causeway: that is, while it spilled down off the rocks around the edges of the platform, the layer generally ended within two to three feet of the platform. This association is clearly not fortuitous.

The identification of this hard-packed slag, and in fact all of the ferrous slag on-site, as refining slag (as discussed above) is one of unexpected results of the excavation, and its implications will be expanded upon below. For this section, it is sufficient to say that the existence of this slag strongly suggests the very near presence of a refining forge of the finery and chafery type. It might be suggested that this slag is on-site as fill only and that it was brought from a forge some distance away to serve filling, levelling, and paving purposes. However, it was noted that in the field on a number of occasions that this hard-packed slag conformed to the outlines of the rocks beneath, suggesting that at least some of it was in a molten or near-molten form when brought on site.

As for why it was carted here, there are two possibilities. Either it was being brought to be used as surfacing and fill, that is, its presence was ancillary to the existence of the rock platform; or the rock platform existed to facilitate its disposal, i.e., the causeway was ancillary to the slag. Probably both these functional sequences are true, in that one can postulate that the causeway was in existence prior (perhaps for only a short time) to the generation of the refining slag, serving as a communication link between two separate but functionally integral parts of a complex; and that once the forge was in operation the causeway was being used to wheel carts or barrows of slag to disposal areas. Occasionally, loads must have been accidentally or deliberately tipped out on the rocks, but it is difficult to imagine it being a desirable surface for men, draft animals, or wheeled vehicles to traverse.

Vast quantities of the same type of slag exist to the south of the stone embankment, where it is clear it was not functioning as any kind of a surfacing. Probably this area represents a disposal area and access to it might have been gained not only along the causeway, but along the stone embankment as well (although the gray clay and wood chip layer was not traced along its surface west of the causeway).

As discussed above, the stratigraphy south of the race is not well understood. Moreover, the heavy slag and charcoal stratum there is not closely defined, since in N30E25, it was lying on the mottled clay (assumed to be present at the time the race was open) and overlain by the clay with flecks of rust, which capped all the historic iron working levels at the site. Thus, stratigraphically it could have been deposited at any time during that period. However, it is postulated that it is most likely that its deposition corresponds to that of the hard-packed slag surface, and the mixed slag and charcoal layer (to be discussed shortly), because of the extremely high proportion of ferrous refining slag in the layer. It is possible that the same division between hard-packed and looser slag layers may be seen in this area in the existence of the flat circular plates, or "mossers" which occurred below the mixed slag and charcoal layer. The fact that F6 cut through both the hard-packed slag surface of the causeway and the compact slag to the south of the race, also suggests their contemporaneity.

Possibly contemporary with the causeway and its slag surface is the stone construction in N50E45, since its stones were lying on the race fill, and it was overlain by the mixed slag and charcoal level to be discussed below. Unfortunately, its purpose is entirely unclear. It appears to be a base of some sort but beyond that, not much can be said.

As described above, F4 is an enigmatic and ambiguous structure. There is no clear stratigraphic justification for placing it in this phase, but there is some circumstantial evidence. It cut into the reddish-brown silty clay, but this intrusion, of course, merely indicates that it post-dated that layer. One salient point is that the only area in the north of the site where a sequence other than that of the charcoal and slag directly overlying the reddish-brown silty clay was encountered was in N90W10 and N100W10, where an extremely thick layer of the ferrous slag was discovered cutting into the reddish-brown silty clay, below layers with pebbles and charcoal veining. This is within the area postulated to be enclosed by F4.

Another point already discussed is the likelihood that the charcoal layers encountered on either side of F4 are not the result of the same process. In 1981 this was best observed in N60W5 and N70W10, N100E0 and N110E0. In those squares, the charcoal layer outside F4 (i.e., to the south or east of the F4 walls) has small lumps of slag but was otherwise relatively uniform. It was thin and it lensed out relatively quickly away from the walls. Within F4, the charcoal layer was thicker, covered the area more uniformly, but also had more inclusions and showed more banding with other layers, particularly brown gravel and lenses of red shale. It did not exist in N100W10 or N110W10 and became noticeably patchy to the north of N100E0. Most significantly, the artifact distribution differed markedly with almost no artifacts being recovered from the charcoal layers within F4, in contrast to the charcoal and slag layer outside the walls.

The obtuse angle formed by the two branches of F4 has already been remarked upon, as has the relatively late date for the destruction of the north/south branch compared to that of the east/west branch. One possible reason for these anomalies might be that the north/south branch of F4 was built after and lasted longer than the east/west branch, and/or that the two branches are not related and do not form walls in the same structure. This is extremely unlikely. While it was not possible to establish if the two walls butted together or were bonded together, they were clearly associated and had identical construction. Moreover, both walls demarcated an identical break in the stratigraphy, as already described. No reason for the obtuse angle has become evident.

The extension of F4 to the northeast (F9) might have a different period of construction, but nothing can be established about it stratigraphically or in terms of differential artifact recovery.

The final piece of evidence indicating that F4 should be included in this phase is very simply that, as pointed out above, the presence of the causeway suggests the need to link an activity area in the southeast or east with one in the northwest. The latter could be outside the site boundaries and long buried under U. S Route 15, or it could be F4.

What was F4? Given that it did not have a floor surface such as that identified for F1, and given the nature of the deposits within it, and given its substantial stone construction, it is not unreasonable to identify it as a charcoal house. Charcoal houses at other nineteenth century ironworking sites were huge, as much as 100 by 50 feet, as at Catharine Furnace, Virginia (Gruber 1978). Since they could not be made of wood because of the danger of fire, they characteristically were stone-built and of massive construction. Since they were used for storage, a compacted floor surface would not be expected; rather, a gradual accumulation of charcoal dust with some lumps of charcoal would be likely to build up. Conceivably, there might even have been a wooden floor inside and, thus, the layers above the reddish-brown silty clay represent material that sifted down through the cracks.

This identification finds support in the oral tradition of a charcoal house which stood at the foot of the Auburn driveway in the immediate vicinity of the Auburn Mansion stone pillars (William Renner:personal communication).

During this phase, therefore, the race was no longer in existence except as a low, probably wet, depression running across the south of the site. A causeway was put down to facilitate communication between the area to the southeast or east and that to the northwest, and at some point was also being used to enable ferrous refining slag to be dumped in the low-lying areas of the site. As workers tipped out the slag to each side of the causeway and to the south of the stone embankment, they fortuitously or purposefully were not only getting rid of a waste product, they were also filling in wet areas and surfacing the causeway.

There may have been a number of industrial loci to the southeast; one at least was probably the refining forge producing the slag. Needless to say, it could not have been powered by the now non-functioning raceway. It is suggested that F4 was already in existence at this time, although the stratigraphy is not conclusive on this point; and it may have been one of the reasons for the existence of the causeway.

Phase 2b (Figure 15)

The causeway may have continued in use for some time: it is postulated that the gray loamy clay with wood chips and patches of charcoal, which was a compacted layer, represents the stratum that was created by the movement and passage of men over the causeway. It was perhaps equivalent in formation to the gray clay with much wood that was found at the base of the hard-packed slag surface.

It is suggested that there still would have been problems with controlling the flow of water into this area, and that maintaining a relatively dry walkway might have required some expenditure of effort. This is an empirical observation since in both the 1979 and 1981 seasons, a constant seepage of water into the southern trenches was a perpetual concern (as is demonstrated in Plates 1, 2, and 3 where the race is graphically defined--full of water). It is perhaps demonstrated in the archeological records as well: the layer of red water-washed gravel in N40E15 represents, it is suggested, the "delta" of the race which despite its silting still might have been channelling water onto the site. As water flowed from west to east it would encounter an obstacle in the form of the causeway and the rock pile, and the heavy particles would be dropped in the triangle between the causeway and the stone embankment to the south (the top of which was at about the same height). The force of the water may also have aligned pieces of wood along the edge of the rock platform (see Figure 7 and Plate 4).

F6 probably was constructed in an attempt to divert water away from the causeway. The east/west branch is more or less parallel to the southern edge of the rock platform, and the north/south branch may have been an additional barrier at a particularly troublesome spot. F6 is a relatively slight wall, narrow and loosely constructed. It seems unlikely to have served as a foundation for any kind of substantial construction, and the possibility of its being just a low wall to control water is quite good. Opposed to this interpretation of the red gravel and F6 is the fact that there was no build-up of gravel to the west of either branch of F6, as might have been expected.

Since F4 is presumed still to be in existence at this time, it might not be too speculative to suggest that the east/west branch of F6 might have intersected with the south wall of F4, somewhere off the site to the west, to create something of a yard into which the causeway would have provided access.

Other features which may belong stratigraphically to this phase include F43, a wall which, as already noted, bears a close resemblance to F6 in its construction. Because of its position, isolated from the other features of the site, its function is unclear. There was some suggestion of a lens of mortar on the south side of the wall which might have demarcated a surface, but too little of the wall or the lens was uncovered to allow further investigation. It is also possible that the stone base in N50E45 should belong to this phase rather than the previous one.

Phase 3a (Figure 16)

All the layers and features previously summarized, with the exception of F4, had in common that they were covered by the mixed slag and charcoal/charcoal and slag layer (B). The tendency in dealing with this stratum, which has already been touched on, was to regard it as a single layer created by a single process because of the similar inclusions of slag and charcoal, and because of its more or less uniform stratigraphic position. It is probably best to envision it as a combination of layers sharing similar charactertistics being created over time by activities of filling and levelling, and general use. It is believed that this layer was grade level at 18FR320 throughout the period following the creation of the causeway, the building of F4, and the construction of F6. In some peripheral areas of the site which did not see much activity, it was relatively loose with fewer slag inclusions, and had more of the nature of topsoil. In the central core of the site, in the area bounded by F6, the causeway and F4, it was more compact and included more slag.

In the southeast corner of the area excavation, F45 was laid down over the slag and charcoal layer. It is quite difficult to interpret F45. The yellow clay with sand and flecks of mortar which defined it was identical to the surface defined as a floor within F1 (south); thus there is a tendency to regard F45 as a similar floor surface. The disposition of artifacts on F45 also gave it the apppearance of a surface. However, the surface was not as level or even as that within F1 and it is difficult to see how the stones randomly scattered on the clay with sand relate to the feature as a whole. Most importantly, no postholes, beam slots, foundation trenches, etc., such as might have served as evidence of walls or supporting members, were found. The plank of wood lying across N40E35 seemed superficially to define the southwestern edge of the clay with sand, but in fact, F45 overlay it.

So, at this period of the site, what is envisaged is that the slag and charcoal layer began to be created/deposited by a steady deposition of charcoal dust and nodules of slag onto the surface of the site. Possibly the causeway was no longer much in use if the success of F6 as a water control mechanism meant that the area to the east of the walls was now relatively dry, and movement over it could take place freely, without recourse to the causeway. Thus, churning and scattering of the deposited slag, together with artifacts within it and being dropped in it, was spreading it and them over the land surface. F6 itself was seemingly dismantled and the slag and charcoal layer used to level the area over it.

At some stage a spread of clay with sand and mortar (F45) was laid down over the charcoal and slag and over the hard-packed slag surface of the causeway, but for what purpose is not known. It may have been a working surface, or it may have been the remnants of an area where this material (sand with clay) was being piled or stored before being utilized elsewhere. F4, meanwhile, is assumed still to have been in existence.

Phase 3b (Figure 16)

Directly overlying F45 was a layer of red shale with inclusions of slag and charcoal. This layer is quite similar to the reddish-brown silty clay. It almost certainly was excavated from the latter and from possibly the natural subsoil below it somewhere in the region and brought here to level this area of the site before the construction of F1. Because F45 is directly covered by the red shale without anything approximating the slag and charcoal layer between the two strata, it is suggested that F45 was in existence only a brief time before the red shale was deposited over it, and that F1 was built almost immediately after that.

The problem of the relative chronology of the two halves of F1 has already been discussed. Without ruling out the possibility of their having been built at separate times, it is suggested that there does not seem to be any meaningful chronological distinction between the two halves in stratigraphy or in mode of construction. Only the presence of the uniform surface of yellow clay with sand in F1 (south), and the lack of an east wall in F1 (north), distinguish between the two. The possible butt joint at the northwest corner not withstanding, it is believed that F1 (south) formed an integral unit and that if any part of F1 was an addition, it was the north half.

With the exception of the wall on the north, the walls of F1 were at a uniform height, and it is postulated that, unlike F4, they may have been foundation walls for a superstructure of some other material, probably wood (suggested by numerous finds of nails). Finds of large quantities of window glass around the south and to some extent the east and west sides of the south half strongly suggest the presence of windows in the south wall at least and, incidentally, lend credence to the hypothesis of one-period construction for the whole of F1, since what might be envisaged as a shed-like open-fronted storage area (north half) would be unlikely to have windows, and, of course, the wall between the two halves would also not need windows.

The stones along the south wall of the structure may be interpreted as the entrance to the south half of F1, where the sand with clay was tracked out over the wall. Alternatively, they may represent the first stages of the decay of the structure, inasmuch as they and the spread of yellow sand with clay covered many of those pieces of window glass.

F41/34, the trench or trough cut down from the red shale layer to the hard-packed slag surface, must belong in this phase as well. As discussed above, its course corresponds to the south wall of F1 and, therefore, probably was associated with it, although its fill was covered by the stones and spread of sand with clay to the south of F1. Its fill also contained large amounts of window glass and nails. Thus, it might have immediately pre-dated F1, or might have been contemporary with it, filling up with debris which included broken glass and rubbish from F1 itself.

What its purpose was is unknown. It might have served as some sort of drain along the foundation of F1, but it is difficult to see how it would have functioned.

In this phase, therefore, both F1 and F4 were standing and the area around them must have served the purpose of a yard area. It does not seem that there was active deposition of large quantities of ferrous slag on the surface of the site anymore; rather, what seems to have been happening is that on the surface of the slag and charcoal layer (certainly to the south of F1 and possibly between F1 and F4) an occupation surface showing some compaction and some evidence of artifacts lying on it (mainly window glass) was developed. This is not a clear cut stratum, however, and in various parts of the site the charcoal and slag layer probably was undergoing no change.

Phase 4a (Figure 17)

It was in this period, at which point it is suggested that the buildings were not being used and were beginning to fall into disrepair, that various layers of reddish-brown gravel and brown sand (D and E layers) appeared on site. The problems surrounding these layers and their relationshp have already been discussed in the description of the excavations. Suffice it to say that partially overlying the walls of F1, the east/west wall of F4, the charcoal and slag/mixed slag and charcoal layers and (in the southeast) the red shale fill, were these layers which all included more or less sand and gravel within various matrices.

The reddish-brown gravel included more artifacts and looked like sheet wash, while the brown sand was quite clean and may represent a water-deposited wash of gravels and sands spreading across the site after partial abandonment. The intrusive nature of the brown sand, which seems to have cut into earlier layers, may be explained by excavation in this area before water was allowed to flow over it, or possibly by scouring action. The brown sand may relate to the feature thought to be a raceway located by Kenneth Orr in 1979 in machine trench 6 (Feature 1), to the northwest of the site (Orr and Orr 1980:93 and Figure 39).

What follows is quite speculative although it fits well within the site chronology and with various other points. It is suggested that at this time the north part of the site was undergoing a radical transformation in connection with the construction of the Auburn Dam. This conceivably involved such activites as dismantling the walls of F4 and using those stones in the construction of the stone facing for the embankment, and also diverting the flow of water (which would eventually be used to fill the impoundment) around the construction area proper. It should be remembered that the dam was constructed on the layer interpreted as the northernmost equivalent of the charcoal and slag layer.

It is suggested that it is not inconceivable that while the east/west wall of F4 was robbed out, the north/south wall was allowed to remain standing to act as a sort of coffer dam, keeping the flow of water to the southwest and away from the dam construction. The brown sand might then be the actual particulate matter carried in the water, while the reddish-brown gravel might be material washing down from the construction of the earthen berm. Possibly some portions of the walls of F1 were still standing, albeit in derelict condition, and might have acted as a break to the flow of water, since the end of the brown sand layer in the T-3 profile (1980 Figure 6) is approximately at the point where the F1 north wall would have existed.

At around this time or shortly after, the stone trough (F8) was constructed. It seems clearly to have functioned as some sort of a drain, dropping from east to west, but it is difficult to decide if it relates to this period of dam construction or to the next phase which involves the Auburn driveway features. The break in the 1979 T-7 profile (1980 Figure 16) between the brown sand and the layers to the east comes at the point where the F8 stones appear in the profile, which might suggest that it had some connection with the drainage modifications. The trench is quite small, however, and was obviously not designed to handle large quantities of water. It is included in this phase because it was covered by the clay with flecks of rust, but its alignment perpendicular to the admittedly later driveway (F5) suggests that it somehow related to that. Though there were no signs of any cover for it, it is not impossible that it might have had one at one time, in which case it would have been designed to carry water under the driveway.

Phase 4b

The layer of clay with flecks of rust was brought in as a fill layer and uniformly deposited over the site at this time, covering all layers and features previously discussed. This marks the close of any connection of site 18FR320 with any kind of ironworking activities.

Phase 5a (Figure 18)

It is suggested that the clay with flecks of rust was brought in to level the site immediately prior to construction of the driveway to Auburn Mansion. Early on the drive probably consisted of no more than lenses of various fills thrown down as needed and compacted through use (the G layers). The anomalous pit (F37) filled with stones may relate to this phase, though it is not known with what purpose.

In time, however, an imposing entrance was created, which included a quartz pebble driveway, landscaping represented by probable planting pits (F30, F33, F36) and a stone edging wall (F7/38). It is not impossible that the north/south wall of F4, still standing in this period, could have been utilized as a matching wall. It may even have dictated the course of the driveway in this area. F31 probably was a drainage ditch beside the driveway, possibly leading to F8. Three small unnumbered postholes indicate the location of a fence defining the property line of Auburn. The large postholes (F48) obviously marked the location of gates, possibly related to the stone pillars. All these features (except the pillars) are stratigraphically between the deposition of the clay with flecks of rust (F) and the brown loamy clay, although it cannot be determined with certainty if they are all contemporary. The pillars, for example, are likely to be late.

Phase 5b (Figure 18)

Over the driveway features and the whole site, various fill layers relate to the modifications of the roads in this area. Over the loamy brown clay, lenses of macadam topped with asphalt or blacktop may represent a later driveway extended down to an earlier alignment of Maryland 806, the base level of which might be represented by the layer of cobbles at the same level. Alternatively, the macadam itself may be Maryland 806. The other significant fill layer was the heavy slag fill encountered in 1977 and 1979, the top of which was at the same level as the macadam and cobbles. So it undoubtedly also represented fill prior to the construction of the earlier Maryland 806, as described in the 1930's by W. H. Enslow (Orr and Orr 1977:78, and see Chapter II this report).

B. Artifact Discussion

The discussion of the artifacts in Chapter V was prefaced by Chapter II, in which the technology of which the artifacts are a product was outlined. For an industrial site in which the primary research goal is to explicate the technological processes which are taking place, the analysis of the artifacts must be oriented towards understanding and explaining how they were made. On a stratified site like 18FR320, the possibility of identifying technological changes in the activities taking place through time gives an added perspective to the analysis. In this section, an attempt is made to identify and describe the industrial practices taking place during the time the various stratigraphic layers were laid down at 18FR320.

As an aid to analysis and interpretation, the spatial and stratigraphic distribution of certain kinds of artifacts is shown in Figure 19 and Table 3. These are artifacts which are considered significant in the interpretation of the techniques and technology of casting and finishing the products of a furnace and consist of wedge gates, sprues, stove plates, hollowware, chisels, files, and other tools. The spatial distribution of these artifacts (Figure 19) shows a fairly random distribution across the site with the exception of the area defined by F1 where there is a noticeable absence of artifacts. Apart from F1 there seems to be no obvious difference in the distribution of artifacts inside or outside buildings and no areas with unusually high concentrations of specific types of artifacts. The only other relatively blank areas are those excavated by machine where the absence of artifacts is a reflection of the difference in recovery techniques between a hand excavated and a machine excavated area. The plotting of the artifacts on Figure 19 does not take any stratigraphic factors into account, and is a representation of the total assemblage found in each square.

The stratigraphic distribution of artifacts is shown in Table 3 where the preponderance of objects related to ironworking in the

Table 3. Distribution of Diagnostic Artifacts

Context	"Wedge" Gates	Sprues	Stove Plates	Holloware	Chisels	Files	Other Tools
Race Fill (F44)	3	--	--	1	2	1	--
Reddish-brown silty clay (A)	20	3	4	10	1	--	2
Slag and char-coal layers (B)	21	7	21	15	4	5	7
Yellow sand with clay(F45)	--	--	--	3	--	--	2
Red shale fill	4	2	--	1	--	--	2
F41	--	2	--	1	--	2	1
F1	1	--	1	--	1	--	1
Reddish-brown gravel (D)	6	3	1	4	4	--	3
Clay with flecks of rust (F)	1	1	--	--	1	--	--
Driveway layers (G)	--	--	--	1	--	--	1

reddish-brown silty clay and the slag and charcoal layers is obvious. Both these layers are interpreted as periods when fill was being deposited on the site and no clustering of significant artifacts was noted during the initial tabulation of this material. The small sample size in the other layers and the lack of significant clustering in the silty clay and slag and charcoal layers indicates that little information of value in defining activity areas would ensue from plotting the spatial and stratigraphic distribution of artifacts from 18FR320. The most valuable information to come from the stratigraphic table is the definition of the temporal horizons in which ironworking debris is deposited on the site. As indicated above, these are the silty clay layer and the slag and charcoal layers. A small amount of material relating to ironworking came from the other layers which can probably be defined as residual material from the earlier fill layers. Both the red shale and reddish-brown gravel have somewhat higher amounts of ironworking debris, perhaps indicating larger scale disturbance of the earlier layers.

As discussed above, the way in which the stratigraphic layers were deposited on the site is very relevant to the interpretation of the activities taking place there. Artifacts brought in with fill layers are representative of the processes which resulted in their deposition in their primary context, not to the site where they are redeposited as fill. At 18FR320 the majority of the artifact-bearing strata appear to be fill layers, and as such are not directly informative about the activities taking place on the site. The nature of the activities which created the artifacts, however, gives their analysis great value in understanding the industrial processes taking place off site. In the remainder of this section of the report, an attempt will be made to define and date the activities represented by the artifacts within the temporal framework of the site stratigraphy. The interpretation of the significance of these definitions will be assessed in relation to 18FR320 and to the ironworking complex at Catoctin as a whole.

In the description of the stratigraphic contexts of the artifacts which follows, it should be noted that given the identification of all the ferrous slag as refining slag, it is assumed that the various layers which contained significant proportions of slag, or were within those layers, represent one temporal horizon and have been grouped together as "charcoal and slag layers." This would include, therefore, the hard-packed slag, the mixed slag and charcoal (in the south of the site), and the charcoal and slag (in the north of the site).

In the earliest recognizable period of activity, that of F44, very few artifacts were found. Objects associated with ironworking consisted of three wedge gates, two chisels, a hollowware fragment, and a file. This material is indicative of iron casting and the trimming of castings at the time this layer was deposited. These artifacts, however, actually relate to a period when F44 was silting up and not to its period of use as a race or water channel. Other artifacts found in the race fill are also associated with the period when the race was silting up including ceramic sherds of redware and whiteware, one of which had a blue transfer print design. A green glass bottle base with a pontil mark was also recovered, as were four leather fragments which included a portion of a strap. A large wrought iron object measuring 15 inches by four inches by two and a half inches and found in the raceway was identified as a skein from a tar skein axle. Other items of interest included a copper alloy gun powder flask (Figure 20) found on the bottom of the race, a large spike implement 18-1/2 inches long, and a cast iron object with a groove in it which may have been a bearing block. Noticeably missing from this context was ferrous slag, although some glassy slag was found.

Although the function of this large spike is uncertain, and it was suggested above that it might be a tool or building hardware of some kind, its location in the race indicates another possible interpretation. The various sluices and water control mechanisms in a raceway were operated by levers (cf. Zimiles and Zimiles 1973:12) and the spike may have been used for this purpose. The iron bearing block which came from the same context may also be assigned a function as part of a water control apparatus. The finds of wood in the race, as already discussed above, affirm the likelihood that parts of the mechanisms which controlled the water would be likely to be found in the fill.

Additional artifacts were found in the reddish-brown silty clay layer. These included a small, flat, broken casting, possibly a door plate, and fragments of casting waste. Among the casting waste were 20 wedge gates and three sprues. Four fragments of stove plate and ten fragments of holloware were also identified. Wrought iron tools including one chisel, a molder's slick and a hook were found in addition to a fragment of a "Berry's Premium Firebrick." Ferrous slag and a small amount of glass slag, one fragment of which had the impression of a piece of wood in it, were also recorded.

The assemblage from this layer suggests an increased amount of iron casting activity with the presence of the molder's slick perhaps indicating flask molding. The ferrous slag is indicative of iron refining in the vicinity of the site and the brick, which is presumably from a furnace lining, also indicates some kind of ironworking activity. The number of artifacts recovered is relatively small, but the general conclusions about the activities represented by the material in this layer seems valid.

As discussed above, the slag and charcoal layers, because of their homogeneity, are grouped together. These layers contain the greatest numbers of items associated with ironworking, including 21 wedge gates, seven sprues, 21 fragments of stove plates, 15 holloware fragments, four chisels, and five files. Among the stove parts were fragments of feet and door plates with rivetted latches and a hinge fragment. Stove bolts with butterfly nuts were also found, as was a flat plate fragment with a "3" on it. Holloware comprised fragments of pots with feet, portions with cast handles, and fragments with cast ears for handle attachements. Tools, other than the chisels and files, included a wrought iron draw knife with the maker's name "AMES" stamped on it (Plate 10), screwdrivers, and punches.

Of relevance to the casting process was a portion of a cast iron flask and a complete cast iron flask clamp (Plate 14). Other items associated with casting included a flask hook, a possible gagger for supporting a casting core, and fragments of runners, including one which had been used in casting a multiple number of artifacts (Plate 15). Among the items being produced other than stoves and hollowware was a gear wheel (Plate 12), and a wagon box (Plate 13), both of which had runner scars on them and had not been trimmed of excess metal. Other miscellaneous iron objects included portions of probable cast iron cooking pot stands with rivetted wrought iron feet.

Other items include three horseshoe fragments, an iron pig fragment, "shot" (waste iron spilled during casting), a large number of cut nails and an equally large number too corroded to identify the manufacturing technique, chain link fragments, hinges, spikes, a hook, and various unidentifiable fragments of cast or wrought iron. Non-metal artifacts included window glass, one sherd of salt-glazed stoneware, one sherd of whiteware, and three fragments of "Berry's" firebrick, including one which was marked "fireproof."

The majority of the artifacts, however, were items associated with casting. Both flask casting and open mold casting are indicated; the wedge gates, sprues, flask clamp, gagger, and the flask remains themselves are evidence of flask casting. The runners and the castings which showed evidence of runners indicate open mold casting. The products being produced included stoves, hollowware pot stands, wagon parts, and machinery parts. The various tools found suggest that stoves were "fettled" and then assembled using the stove bolts. The draw knife is somewhat anomalous and presumably relates to some kind of woodworking activity being carried on concurrently with the ironworking. The nails and other hardware may be from wooden flasks and conceivably the draw knife may have been used in making flasks. The window glass, however, indicates some evidence of structures and some of the nails could be from these structures. The firebricks, too, are from structures, but these structures, as suggested above, are presumably associated with some ironworking function.

Most of the artifacts from the yellow sand with clay surface of F45 were cut nails. Three fragments of hollowware were found, in addition to five fragments of casting waste, a large threaded nut, a chain link, a punch, a wrench, and a fragment of a "Berry's" firebrick. The paucity of this assemblage makes any interpretation of the functional activities taking place in this area difficult. The wrench would have been suitable for assembling stoves, but could also have been used for a number of other purposes. No valid conclusions as to the function of F45 appear justified on the basis of the artifactual evidence.

The red shale layer contained a small quantity of significant artifacts including four wedge gates, two sprues, a hollowware fragment, a screwdriver, and a side set hammer. Nails, spikes, sheet metal fragments, and a chain link were also found. One enigmatic object was a large staple-shaped piece of wrought iron for which no identification has been possible. Again, this is a small assemblage and interpretations of the activities represented are tenuous. The hammer is of a type used by a blacksmith and the wrought iron staple-like object had obviously been worked by a blacksmith. What evidence there is points to the activities of a smith, as well as the evidence for iron casting embodied by the gate metal.

Few artifacts were recovered from F41 other than nails and window glass: a sprue and a stove plate fragment, two chisels, and a punch represent the evidence for ironworking. A chain link was also found. Evidence from F1, the structure beside which F41 ran, was more substantial, comprising one wedge gate, one stove plate fragment, a chisel, and a punch. This layer also contained a fragment from a cast iron pot stand with a rivetted wrought iron leg (Plate 11), and a heavy cast iron bush. Wrought iron objects consisted of a skein from a tar skein axle measuring 19-1/2 inches by five inches by two inches, a horseshoe, a chain link, 40 nails, and a spike. One small fragment of bottle glass was found, as were approximately 40 small sherds of window glass. Ceramics comprised 18 tiny fragments of redware.

Little more can be said about the few artifacts from F41. The material from F1 indicates a variety of ironworking activities may have been taking place when the assemblage was laid down, but the similarities between these artifacts and those from earlier layers may indicate that they are residual objects dating from an earlier period of activity which became incorporated in the F1 layer during its demolition.

Artifacts from the reddish-brown gravel layer included six wedge gates, three sprues, one stove latch fragment, and four hollowware fragments. Tools from the layer consisted of four chisels and three punches. Casting waste in the form of a runner and a gutter was found, as well as "shot." Two wrought iron hooks and a horseshoe fragment were found; ceramics were represented by one sherd of gray, cobalt-blue decorated stoneware. This assemblage is consistent with casting activity, but the nature of the matrix in which it was found is suggestive of sheet wash, and it may be that some of this material is derived from earlier deposits.

Material from the clay with flecks of rust included few of the ironworking artifacts common to the rest of the layers. One wedge gate, one sprue, and a chisel were the only objects associated with ironworking. The remainder of the artifacts included nails, spikes, two horseshoes, and an iron ring. One sherd of Chinese export porcelain and some sherds of plate glass were also found. Two coins came from this deposit; an 1842 dime was found at the interface between the clay with flecks of rust and the slag and charcoal layers, and an 1875 dime came from within the clay with flecks of rust layer.

This layer is interpreted as a fill layer and the majority of the layer appears to be derived from an area where there was little evidence of ironworking. This is indicated by the sparseness of the material associated with iron in contrast to the rest of the site.

The driveway layers represent the greatest contrast with the earlier layers on the site in their artifact content. Ceramics, which included Chinese export porcelain, annular pearlware, engine-turned whiteware, and ironstone, comprised 61 percent of the assemblage. Glass consisted of 45 fragments or 16 percent of which 42 were window glass and three bottle glass. Bone, which was noticeably absent from the earlier layers, represented four percent of the material found, and the remainder was made up of metal artifacts. One fragment of hollowware and a molder's slick were the only metal objects indicative of ironworking. The remainder of the metal consisted of items such as nails, strap iron, a hinge, and an iron ring. Two coins came from the driveway layers, an 1877 penny and an 1890 nickel.

This assemblage of material is consistent with a trash deposit, and its only connection with the ironworking component of the site is the residual material in the deposit. Presumably, most of this material was either discarded by people using the driveway or was incorporated as fill into the driveway layers.

C. Dating

The dating of the stratigraphic layers at Catoctin is important for the interpretation and integration of the excavated evidence with the documentary sources. For virtually all the earlier layers on the site, however, secure dating evidence is not available. Four coins were found during the two seasons of excavation; an 1842 dime, an 1875 dime, an 1877 penny, and an 1890 nickel. These are perhaps the most reliable evidence for dating the layers excavated at Catoctin.

Another dating aid which is also useful is the draw knife with the maker's name "AMES" on it. This company commenced business in Massachusetts around 1834 (Herskovitz 1978:64), so the draw knife has to be later than that date. Other artifacts of some use for dating are described in more detail below, and comprise a number of brick fragments with the maker's name on them and a copper alloy gun powder flask.

A number of firebricks usually in a fragmentary condition were found during the excavation. Some of them had portions of an impressed brand name on them, and from the more complete examples it was possible to determine that the bricks were "BERRYS PREMIUM FIREBRICK." One variation was noted in which the brick was described as "FIRE-PROOF." On any industrial site where extreme temperatures are required, firebricks will be utilized because of their superior refractory qualities.

It seems likely that these bricks were manufactured in Baltimore. There is evidence that the furnace was trading in Baltimore and also that "back loads from their trading expeditions included bricks" (National Heritage 1975:12-14). Firebrick makers named Berry are listed in Baltimore from early in the nineteenth century. A Thomas L. Berry, brickmaker, is listed in 1819 (Baltimore Directory 1819), and a J. and T. L. Berry, patent firebrick manufacturers, in 1829 (Matchett's Baltimore Directory 1829). The same people are listed in 1849 as fireproof brickmakers (Matchett's Baltimore Directory 1849).

John S. and George R. Berry, firebrickmakers, are listed in the 1860 directory, and every subsequent year through 1891, when they appear to have gone out of business (Wood's Baltimore City Directory 1860; Polk and Co. Baltimore City Directory 1891). The date range of these bricks would appear to be from 1829 until 1891, although it is, of course, possible that some unknown Berry was brickmaking before the first directory reference, and the bricks could have been in use well after 1891. The bricks appear to have been made in a brick molding machine, a device which was first patented in 1793; similar machines were in general use by the first decades of the nineteenth century (McKee 1976:84-84). The brick brand marks on the bricks from Catoctin were, of course, used to advertise the makers; brands on bricks became common after 1870, but were in use by 1830 (Kelly and Kelly 1977:86-87). As a dating guide, the bricks are not very useful, although it could perhaps be assumed that they date from the 1830's onwards. The same brand of brick was found during the earlier excavations carried out at Catoctin at the main furnace (Orr and Orr 1975:18).

One other object of interest was a copper alloy powder flask (Figure 20). This object is decorated with an embossed shell and bush design and has a pivoted gate closure. This type of flask was made in Birmingham, England during the nineteenth century and appears to be a fairly common type (cf. Riling 1953:286, 289 No. 33; 291 No. 364). Metal powder flasks appear to have come into use in the early nineteenth century (Riling 1953:14), and continued to be used throughout the century, although their number declined with the introduction of percussion cap cartridges and other forms of cartridge from the 1860's. In use the flask allowed a measured amount of powder to be introduced into the weapon by operating the gate mechanism.

Dating evidence from the raceway (F44) relates to the period when the feature had gone out of use and was silting up. The copper alloy powder flask found at the bottom of the race would probably not have been made before 1800, as it is representative of a type of artifact that started to be mass produced during the early nineteenth century (Riling 1953:13). The one sherd of blue transfer-printed ceramic is the only other dating guide, and this, too, is consistent with a nineteenth century date. While the dating evidence is far from conclusive, a date in the first quarter of the nineteenth century for the period when the race was silting up may be appropriate.

Other than the firebrick which suggests a post-1830 date, there is little dating evidence which could be applied with confidence to the reddish-brown silty clay layer. For the slag and charcoal layers, the presence of the draw knife, which must have been made after 1834, indicates that the specific layer in which it was found must have been laid down after that date. Some of the other layers within this group stratigraphically below the one in which the draw knife was found may, of course, be earlier. The 1842 dime which came from the interface between the slag and charcoal layers and the clay with flecks of rust is assigned to the stratigraphically higher level, but it is not inconceivable that it might have originated in the lower slag and charcoal layer. This would be more in keeping with the 1875 date of the other coin from the clay with flecks of rust, a date which suggests that the 1842 coin is somewhat anomalous in the layer to which it is assigned. The dating evidence from the slag and charcoal layers is far from conclusive, but it appears that the layers were deposited sometime between 1830 and 1850. This would be consistent with the evidence of the three Berry's firebricks, which are unlikely to be any earlier than 1830.

The yellow sand with clay inside F45 cannot be dated with any confidence on the basis of the available evidence. A firebrick fragment from the layer suggests a post-1830 date, but other than that, no other datable material was found. The red shale layer, F41, F1, and the reddish-brown gravel layer are all undatable on the basis of the artifactual evidence, but some dating help is provided by the layer stratigraphically higher, the clay with flecks of rust. The 1875 dime from this layer indicates that it could not have been laid down earlier than this date. It has already been suggested that the slag and charcoal layer had accumulated between 1830 and 1850; the four layers were stratigraphically higher than the slag and charcoal layers, but have to date before c.1885 when the clay with flecks of rust may have been deposited. The dating for the clay with flecks of rust is, of course, based on the coin evidence, and on the assumption that the coin may have been in circulation for ten years before it was lost.

The final layers to be discussed are those associated with the driveway. The presence of fairly large quantities of ceramics and two coins dated 1877 and 1890 allow a more precise end-date to be allocated to these strata, and it is suggested that these layers were laid down before c.1900. The ceramics included a range of material in use from the mid-nineteenth century onwards, so the date range for the deposition of the driveway layers is postulated as c.1850 to 1900.