Clay Tobacco Pipes from the Brimstone Hill Fortress, St. Kitts, West Indies

Brimstone Hill Archaeological Project Report No.23

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Introduction

At many historical archaeological sites, the clay tobacco pipe is one of the most abundant classes of artifacts. English clay pipes have been extensively studied and documented respecting their use in dating archaeological contexts. Detailed studies have been conducted to identify maker's marks, decorations, and historical changes in the shape of bowls and stems. The purpose of this report is to document clay tobacco pipes recovered from the 1996 through 1999 excavations at the 18th and 19th century British colonial fortress at Brimstone Hill on the island of St. Kitts in the eastern Caribbean.

Excavations undertaken at Brimstone Hill have four objectives (Schroedl 1997, 1998, 1999). The first is to discover and document the role enslaved Africans played in the construction and maintenance of the fort. Second is to obtain information about the buildings used or occupied by slaves during the fort's occupation. The third objective is to demonstrate that the history of Brimstone Hill was shaped as much by enslaved Africans as it was by British colonists and military personnel, while the fourth goal is to provide the people of St. Kitts information from which to learn about and better appreciate their cultural heritage. Ultimately, this information will be used by the Brimstone Hill Fortress National Park Society to better describe and interpret the lives of enslaved Africans at the fort for the people of St. Kitts and for visitors to the park. The tobacco pipe assemblage at Brimstone Hill can contribute to fulfilling these objectives because of the information they provide about the chronology of the site and the social relationships among its British and African occupants.

Two approaches are used here to study the pipes from Brimstone Hill. The first is the application of formulas for dating pipes using stem bore diameters developed by Harrington (1978), Binford (1971; 1978), and Heighton and Deagan (1971) to test the usefulness of these approaches for accurately dating late 18th century site contexts at Brimstone Hill. The second approach is to use the pipes to interpret social activities at the site and to examine whether British soldiers and African slaves had differential access to tobacco pipes.

Site History

The construction of Brimstone Hill, which began in 1690, was for military defense and also as a place of refuge in case of an invasion. Work continued into the 18th century, with particularly intensive building activities occurring in the 1730s, 1750s, and 1790s (see Smith 1994,1995). In 1782 the French attacked the British forces at Brimstone Hill and occupied the fort for a year. When the British recovered control of the fort in 1783 they initiated a massive rebuilding and expansion effort that reached its peak in the 1790s and continued into the early 1800s. Resurgence in construction took place in the 1830s before the fort finally was abandoned in 1854. Until emancipation in 1837, enslaved Africans provided virtually all the labor for the forts construction and maintenance.

Brimstone Hill was home to British soldiers as well as enslaved Africans. Some slaves served as laborers and craftsmen but others served in all African military units. It was difficult for the British to maintain a large and well-prepared army in the Caribbean because it was especially hard to recruit sufficient numbers of men in England, and because so many British soldiers died in the West Indies from climatic and nutrionally related diseases (Buckley 1979, 1998). To overcome these difficulties, the controversial policy was implemented to create the West India Regiments comprised of regular African soldiers and militia units made up of Africans recruited from local plantations. By 1795, a corps of 1100 men attached to these units was raised in St. Kitts alone (Buckley 1979: 14, 81). By 1800, the cost of renting slave laborers to perform military work was so expensive that frequently West India Regiments were ordered to perform these tasks (Buckley 1979: 128). By this time too, the St. Kitts colonial government sometimes forced plantation owners to provide slave labor to supplement the work of slaves owned by the British military and the members of the British West India Regiments (Schroedl 1998:21-22). Given the complicated history of enslaved African labor and the British military, the artifacts recovered at Brimstone Hill are significant as material evidence relating to the differences between British soldiers, plantation slaves employed at the fort, and members of the Black militia and West India Regiments.

Archaeological Excavations

Archaeological excavations by the University of Tennessee were conducted at Brimstone Hill from 1996 to 1999 and focused on three areas of the fort, designated BSH 1, BSH 2, and BSH 3. These areas were selected for excavation because a 1791 military engineers map of the fort identifies them as places that were occupied or utilized by enslaved Africans (Schroedl 1998). BSH 1 consists of the remains of stone buildings at the base of the hill adjacent to the Park's main entrance road. At BSH 1 five structures were numbered and identified: 1) a well, 2) lime storage building, 3) a limekiln, 4) and the ruins of two unidentified structures. No excavation work was done on Structure 1 (the well) or 3 (the kiln). Excavation on Structure 2 (lime storage building) involved three trenches and an additional unit that together uncovered three features. Work on Structure 4 consisted of two individual 1 meter squares and a trench measuring 7 m long and 1 m wide. Excavations could not conclusively determine the use of Structure 4, although historic evidence suggests it was a carpenters shop. The excavation of Structure 5 involved an individual 1 meter square and three contiguous squares uncovering four features (Schroedl 1997:5-16).

The area designated as BSH 2 is located on the western side of the fortress below the defensive wall that joins the Orillon and Magazine Bastions. Excavations were conducted here because the 1791 military engineers map shows four structures used by slaves and craftsmen (Schroedl 1997). These buildings also appear on a watercolor of the site made by James Lees in the 1790s. The four buildings at BSH 2 are labeled on the 1791 map from north to south as a hospital, a kitchen, a second hospital and a workshop (Schroedl 1997, 1998). The 1996 excavations at BSH 2 consisted of five 1 meter test pits. While no foundations were detected, a large number of artifacts were found (Ahlman and Schroedl 1997). In addition, the grave of a British soldier was encountered in the excavations.

In the 1997, excavation work centered on 34 1 meter units at BSH 2. The units were excavated in arbitrary 10 cm levels ranging from one to ten levels deep. During the course of the excavations, Structure 1 was identified as the second hospital located between the kitchen and the workshop. Preservation of the building's foundation

suggested that it may have been intentionally demolished. Eight features were also identified in 1997. Five of the features were associated with Structure 1 while the remaining three were associated with the three other structures indicated on the 1791 engineer's map of the fort. A second unmarked burial of a British soldier also was discovered during the excavations (Schroedl 1998:4-15).

During the 1998 field season work continued at BSH 2, with limited additional investigations at a third site, BSH 3. At BSH 2, excavations of Structure 1 were completed. Structure 2, the workshop, also was identified and efforts were made to obtain information concerning its size, orientation and architectural design. Another goal at BSH 2 was to locate the second hospital and the kitchen that were shown on the 1791 engineer's map. At BSH 2, 48 1 meter units were excavated to various depths using between one and twelve 10 cm arbitrary levels. Six features were identified including a burial pit adjacent to Structure 1. Portions of the north and south walls of Structure 2 were identified along with part of the east wall and an associated mortar floor. Neither the kitchen nor second hospital were found. Artifact distributions suggested that some debris was deposited in and around the building after their abandonment and destruction, while other materials that eventually covered the ruins of the buildings had been discarded over the defensive wall from above (Schroedl 1999:4-11).

The area above Structures 1 and 2 and behind the defensive wall was designated BSH 3. Once located here, as shown on the 1791 map, were at least fifteen buildings including those occupied or used by slaves, barracks for married soldiers, and offices and accommodations for military engineers. An accidental fire removed most vegetation from this area in May 1998, making it possible to conduct a surface collection and to excavate three 1 m test pits. The materials collected from BSH 3 are important to the interpretation of artifact patterning at BSH 2 because persons occupying this area surely threw some of their trash and debris over the defensive wall where it accumulated in and around Structures 1 and 2 (Schroedl 1999:13-14).

Fieldwork in 1999 focused entirely on Structure 2 at BSH 2, particularly on exposing the east wall to determine the overall length of the structure. Although excavations did not reach the south end of the wall, it is estimated that the building was no more than about 36 ft long. The graves of four British soldiers were found exterior to

the south wall between it and the defensive wall connecting the Orillon and Magazine Bastions. Three additional burials intruded the interior of Structure 2. In 1999, there were 21 excavation units investigated at BSH 2.

Artifacts recovered from the Brimstone Hill excavations have been analyzed to provide observations and interpretations respecting the fort, its inhabitants, and the dating of artifacts, structures, and deposits. One of the most important goals of the artifact analysis has been to ascertain the date of primary occupation at BSH 1 and BSH 2. Historical documents and artifact analyses, particularly of the European made ceramics, whose dates of manufacture are well known, indicate that the excavated areas at Brimstone Hill date to 1795-1815. Few artifacts recovered from the excavations date either to earlier (1690 to 1750) or later (after 1815) periods of site occupation.

The Clay Tobacco Pipe as a Dating Tool

The English clay tobacco pipe was inexpensive, easily obtainable, and usually discarded within one or two years of its manufacture (Noel Hume 1970:296). A pipe generally consists of two portions, a bowl and stem (Figure 1). The point at which these are connected is the juncture. A heel or spur, sometimes found on the bottom of the bowl, may have been used to prop up the pipe when it was placed on a flat surface. Various pipe fragments, identified in archaeological contexts, are valuable for dating sites because historical changes in pipe morphology are so well known from documentary research. The pipe's availability, short-term use, extensive documentation and wide spread use combine to make it one of the most useful tools that exists for dating historical archaeological sites.

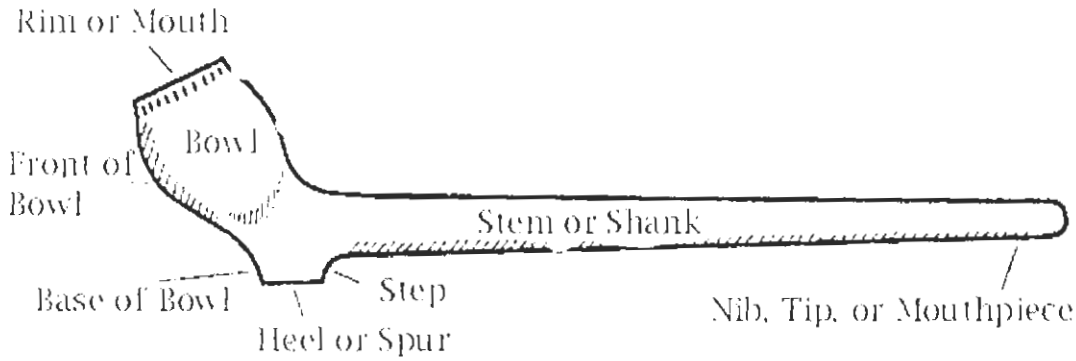

Figure 1. Different parts of a clay tobacco pipe (from Ayto 1994)

Bowl form is an attribute of pipes that shows clear changes from the early 17th through the 19th centuries (Noel Hume 1970:296). Bowl shape became less bulbous, the overall size of the bowl became larger, and the angle of the bowl to the stem became less obtuse by the beginning of the 18th century. Because the most pronounced changes in bowl form occurred before or very early in the occupation of Brimstone Hill, detailed observation on this attribute were not considered relevant to the analysis of the pipes conducted for this study. Informal observation suggests that very few if any early pipe bowls come from the Brimstone Hill excavations.

A reliable method used to date pipes of any period is a maker's mark. The obvious use of a maker's mark is to identify individual pipes with a specific manufacturer, and this in turn makes it possible to determine the time period in which the pipe was produced and used. The location of maker's marks on the pipe also changed over time. In the first half of the 17th century marks were usually placed on the base of the heel and consisted of initials or full name. The practice of using maker's marks declined in the latter half of the 17th century but was revived again before the century ended. By the late 17th century, marks were placed on the back of the bowl in relief cartouches or incised circles. Also popular at that time was the placement of two letter initials on the heel or spur. In the 18th century the side cartouche mark became popular but was subsequently moved onto the heel and back of the bowl during the late 18th and early 19th centuries (Noel Hume 1970:304-305).

Decorations also appear on pipe stems. A popular design for the middle 17th century was the fleur-de-lis. In the first half of the 18th century, stems were decorated with circles and initials stamped in circles. More popular in the late 18th and 19th centuries was the placement of the maker's mark in a rectangle on one side of the stem with the name of the town where it was produced on the other (Noel Hume 1970:305). Stem decorations are not as common as bowl marks, and most stem fragments collected archaeologically are undecorated.

Plain stem fragments are probably the most abundant type of pipe fragments recovered archaeologically. It was once thought that the reason for this was the practice of breaking off the mouthpiece when pipes were passed between users. Noel Hume (1970:302) dispels this myth explaining that stems are most often found because they are

the longest and most fragile part of the pipe. Pipe stems show dramatic but consistent temporal changes in length. The average length of the stem in the 16th century was between 1 ¾ in (4 cm) and 3 ½ in (9 cm). In the 17th century, stem length increased, averaging 11 in (28 cm) to 12 in (30 cm) long, with some examples reaching 13 in (32 cm) to13.5 in (34 cm). In the 18th century, pipe stem length decreased to an average of 9 in (22 cm), but some pipes, known as the "churchwardens," had stems as long as 24 in (60 cm). The stem length is important because it has a direct effect on the possible size of the stem bore, and this is directly related to the date of manufacture (Noel Hume 1970:296-297).

In order to form the stem hole, a wire was pushed through the stem while the pipe was still in the mold. It is believed that a thick wire, producing a large hole, was used for pipes with short stems. As the length of the pipe stems was increased, a progressively thinner wire was used for producing the hole to prevent the wire from accidentally piercing through the side as it traveled down the stem. A thinner wire obviously produced a smaller diameter stem hole (Noel Hume 1970:297).

The most frequent, as well as most debated, use of stems for dating is based on the diameter of the stem hole (Binford 1971, 1978; Harrington, 1978; Heighton and Deagan 1971). In 1951, J.C. Harrington proposed a technique for dating pipe stems based on clay tobacco pipes he recovered from excavations at Jamestown. Harrington was the first to suggest that early pipes had large stem bore diameters and that the diameter decreased through time. Harrington tested this idea on 330 pipe stem fragments found at Jamestown, Colonial Williamsburg, and Fort Frederica (Harrington 1978:63).

Harrington used simple technology to carry out his study. He used a set of steel drill bits ranging from 1/16 in to 9/64 in to measure the bore diameters. Harrington warned that accurate measurements could be skewed because the mouthpiece could be enlarged from the withdrawal of the wire that was used to make the hole. This problem could be avoided, however, because the fragments were usually long enough to take a more accurate measurement from the broken end. Using measurements of pipes from tightly dated deposits, Harrington identified five time periods ranging from 1620 to 1800 that corresponded with a particular stem diameter (Table 1). The sample he studied averaged 66 fragments for each of the five periods (Harrington 1978: 63-64). Harrington

successfully applied his chronology to pipes recovered from two sites. The first was a study of nine fragments found at Fort Necessity, Pennsylvania in a context positively dated through historical documentation to 1754. Five of the stems measured 4/64 in and four measured 5/64 in. According to Harrington's method, the pipe stems alone yielded a date of 1730-1780. While this did not provide a definitive date, the documented date of the site fell within the date range obtained from the pipe stems. Harrington suggested

Table 1. Harrington's pipe stem bore diameter chronology (after Harrington 1978)

Bore Diameter	Time Period
8/64 in	1620-1650
7/64 in	1650-1680
6/64 in	1680-1710
5/64 in	1710-1750
4/64 in	1750-1800

that a sample, like the one from Fort Necessity, could help substantiate dates based on other evidence or establish an initial age estimate when no other evidence was available (Harrington 1978:64). Harrington's second test was on a small but unidentified number of pipe stems from a military reservation on the James River. These yielded a date range of 1620-1650. Related material recovered from the same deposits tended to corroborate this date range (Harrington 1978:64-65).

Harrington readily admits the limitations of his technique. One problem, as previously mentioned, is that the bore diameter of the mouthpiece is often slightly larger, producing inaccurate dates if measured too often. Another complication is the occurrence of Dutch pipes in the sample. Dutch pipes are easily distinguished from British and American made pipes if a bowl fragment is present, but stems are not as easily sorted from one another. This poses a problem because Harrington (1978:64) believes that Dutch stem holes are much smaller than English stems from the same period; therefore, Dutch stems could skew the date of the sample to a later period. Harrington also admits that his small sample sizes might also produce erroneous dates.

Lewis Binford was intrigued by Harrington's research and decided to take it a step further. Binford found Harrington's system inadequate because it only provided broad time periods at least forty years long rather than an exact date. This led Binford to create a straight-line regression formula based on the Harrington sample. Binford began by converting Harrington's original percentages to mean hole diameters for each time period. This led to the calculation of the formula

$$Y = 1931.85 - 38.26X$$

The variable Y is the date to be determined. The number 1931.85 is the theoretical date at which stem diameters would disappear if the regression continued. The number 38.26 is the slope of the regression line and X is the mean pipe stem bore diameter for the sample. Measuring the individual diameters of each stem and taking the mean of the sample would determine the value of X. The formula calculates the mean date of the sample, and this is used to infer the age of the deposit or site from which the sample was recovered (Binford 1978:66).

Binford tested his formula on the pipe stem assemblages from two historic Native American sites in Virginia. At one site, where the historically known period of occupation was 1675-1702, Binford's formula produced a mean pipe stem date of 1683. When the formula was applied to a barracks at Fort Michilimackinac the sample of pipe stems yielded a date of 1776, which fell in the middle of the known period of site occupation, 1769-1781 (Binford 1978:66).

Binford, like Harrington, also conceded that his formula was not a perfect system. When he used the formula at Mackinac Island, a site dated at 1805, the pipe stems dated to 1732. This led Binford to assert that the dating procedure encounters problems at around 1780 because of the rising occurrence of American made pipes that do not correspond with the changes observed in English pipe styles (Binford 1978:66).

Binford identified two additional difficulties with his methodology. First is the need for an adequate sample size. Binford cautions that an adequate sample must be available to get reliable data but only defines this as "a large enough sample to be representative of the population being dated" (Binford 1978:66). In addition he cautions that the dating of specific contexts might be altered because the numbers of pipes are artificially increased from greater availability or increased consumption at a particular

time. Basically, a random sample must be obtained with equal distribution and representation across time in order to insure the accuracy of the formula (Binford 1978:67).

Binford's formula has been applied many times by other archaeologists with mixed results. Ivor Noel Hume's *A Guide to Artifacts of Colonial America* (1970) provides several sets of data to which the Binford formula has been applied. The formula was used on a pipe assemblage at Colonial Williamsburg that had been used as a walkway. All the fragments were from a single maker and had been deposited at the same time to serve as paving (Noel Hume 1970: 299). The 12,000 fragments collected from this feature were known to date to the 1740s. The Binford formula was applied to different sized samples ranging from as few as 19 to as many as 11,164 specimens. Not until the sample reached 295 fragments was the first accurate date of 1740.55 calculated. As evidence of how easily the results can be misleading, the sample of 290 stems produced a date of four years earlier than the actual date. The sample size had to contain more than 932 fragments before the formula consistently produced correct results of 1740 (Noel Hume 1970:299-300).

Noel Hume also shows data for fourteen other assemblages that were dated using the Binford formula. These data illustrate that the effective range of the formula is 1680-1760. Three of the samples are from sites that had been dated as pre 1680 using other materials. The dates produced by the associated pipes were 10 to 30 years earlier than the site's actual date. When actual site dates ranged between 1702 and 1760, the pipe stem dates always fell within the acceptable range. The pipes associated with contexts dating later than 1760 produced incorrect dates with discrepancies of up to sixty years (Noel Hume 1970:301).

In response to Binford's approach, Robert Heighton and Kathleen A. Deagan (1971) devised their own formula for dating pipe stems. Citing examples in which the Binford formula produced inaccurate dates, Heighton and Deagan proposed a formula based on data gathered from 14 sites containing 26 pipe stem samples. They first measured the stem hole diameters for each pipe fragment to the nearest 1/64 in and then calculated the mean diameters and dates for each sample (Heighton and Deagan 1971:221).

When the bore hole diameters and mean dates from these 14 sites were plotted on a graph, Heighton and Deagan observed that the numbers fit the "Compound Interest Rate Curve." By modifying the equation for this curve, they produced the first equation involved in their dating formula:

$$X = \frac{-\log Y + 1.04435}{.05324}$$

The Y variable represents the mean stem bore diameter of the sample. This equation is used to convert Y into its logarithmic form. The X value gained from the first equation is the used in the second equation

$$\text{Date} = 1600 + 22X$$

In this equation, X is the value to be dated. The number "22" represents the number of years in each period established by Heighton and Deagan (1971:221-222).

Heighton and Deagan (1971:222, 224-225) claim that the Compound Interest Rate Curve is more appropriate for dating pipe stems than is Binford's straight-line regression. They argue:

> Many persistent long-term movements or secular trends in the social and physical environment cannot be adequately approximated by a straight line. Quite often elements related to time, when graphed, will form nonlinear curves of growth or decay type where change takes place steadily at either an increasing or declining rate (Heighton and Deagan 1972:220).

They caution, however, that their results are highly experimental and that future work would hopefully improve their dating formula.

Pipe Stems from Brimstone Hill

The tobacco pipe group at Brimstone Hill consists of 3365 specimens, and is the second least common artifact in the site assemblage (Schroedl 2000). Following excavation, pipe fragments were washed in plain water, air-dried and then bagged and catalogued according to their horizontal and vertical provenience. Each fragment was then analyzed to determine its size by placing it on a chart consisting of concentric circles beginning at 2 cm in diameter and increasing in 2 cm increments up to 20 cm in diameter. Artifacts corresponding to circles less than 2 cm in diameter constitute Size 1,

with circles increasing to greater than 20 cm for Size 10 artifacts. The fragments were also recorded as to portion: stem, juncture, heel or spur, and bowl. No stem bore diameters were measured on fragments split longitudinally and recorded as half-stems or fragments. All complete stems were measured in the Harrington manner with a set of steel drill bits sized in increments of 1/64 in and recorded from 4/64 in up to 7/64 in. Any decorations found on a pipe fragment also were recorded. Table 2 provides the number of each portion of clay tobacco pipe fragments found in each year of excavation. It is readily apparent that the majority of the sample (n=1573), not surprisingly, is stem fragments followed by bowls (n= 1367), with half stems (n=271), junctures (n=152) and spurs (n= 2) occurring in far fewer numbers. Different portions of fragments are depicted in Figures 2- 5.

Table 2. Pipe fragments from Brimstone Hill, 1996-1999 excavations.

Year	Site	Bowls	Stems	Junctures	Half-stems	Spurs	Totals
1996	BSH1	19	27	1	0	0	47
	BSH2	64	130	6	0	0	200
1997	BSH2	267	321	26	17	1	632
1998	BSH2	357	409	55	61	1	883
	BSH3	40	47	6	4	0	97
1999	BSH2	620	639	61	186	0	1506
Totals		1367	1573	155	268	2	3365

Most pipe fragments found at Brimstone Hill are relatively small. Ninety percent of the sample is Size 1(n= 1686) or Size 2 (n= 1348) (Table 3). Most of the remaining ten percent are Sizes 3 or 4. Just nine specimens are Size 5 or greater, and none exceeds Size 7.

Table 3. Size categories for pipes from Brimstone Hill

Size	Dimensions (cm)	No.	Percent
1	0 to 2	1686	50.1
2	2 to 4	1348	40.0
3	4 to 6	265	07.8
4	6 to 8	57	01.7
5	8 to 10	7	00.2
6	10 to 12	1	>00.1
7	12 to 14	1	>00.1

Figure 2. Examples of bowl fragments recovered at Brimstone Hill

Figure 3. Examples of pipe stem fragments recovered at Brimstone Hill, showing range of lengths

Figure 4. Examples of pipe juncture fragments recovered at Brimstone Hill.

Figure 5. Examples of pipe spur fragments recovered at Brimstone Hill

For this research, the formulas for dating pipe stems devised by Harrington (1978), Binford (1978) and Heighton and Deagan (1971) were applied to various samples of the total assemblage. The original Harrington technique was applied only to the total assemblage. The Binford and Heighton and Deagan formulas were applied to the overall assemblage and to each specifically designated site or structure. Dates also were

calculated for selected contexts to examine spatial and stratigraphic differences within the sites. Individual excavation units were dated if they produced 30 or more stem bore diameters. In order to examine the stratigraphic occurrence of the pipestem sample, specific excavation levels at BSH 2 were combined according to their stratigraphic relationship with Structures 1 and 2 to form three groups of related proveniences. One provenience group included 29 levels from deepest, and presumably earliest portions of the site. A second group was comprised of 135 levels associated with the structure floors and their contemporary exterior areas, and a third provenience group was made up of 126 levels representing deposits dating after the abandonment of the buildings.

Most excavated units typically produced fewer than sixty pipe fragments. A small number of excavation units, however, had unusually high numbers of pipe fragments. For example, at BSH 2 six excavation units, 207-208N/100-101W, 202-203N/100-101W, 202-203N/101-102W, 203-204N/100-101W, 203-204N/101-102W, and 205-206N/100-101W, each contained 90 or more pipe fragments, including 39 to 67 datable stems. In two instances, these units are adjacent to one another. It may be coincidence that the number of pipes in these units is so high or it may be that these units were excavated between nine and thirteen levels deep. Nevertheless it indicates that pipes are not evenly distributed through the sediments, and it is possible that some pipes may have been discarded as single or related trash deposits.

Results of Pipe Stem Dating

Application of the Harrington dating method to the complete assemblage yielded the following percentages: 4/64 in=9.20%, 5/64 in=80.45%, 6/64 in=10.20% and 7/64 in=0.11% (Table 4). With the majority of the stems measuring 5/64 in, the Harrington technique dates the material collected from BSH 1, BSH 2, and BSH 3 in the 1710-1750 range. For his technique to produce a date of 1750 to 1800, the expected dates of the Brimstone Hill sites of 1795 to 1815, stems with bore diameters of 4/64 in would have to predominate, and only 161 examples of these are represented in the sample.

Dates calculated from the Binford and Heighton and Deagan formulas are presented in Table 5, where it is clear that dates calculated using the Heighton and Deagan formula are almost always two years later than the Binford formula dates. The

Table 4. Frequency of pipe stems by bore diameter

Diameter (in)	No.	Percent
4/64	161	9.20
5/64	1404	80.45
6/64	178	10.20
7/64	2	0.11
Total	1745	100.0

dates range from the earliest of 1737.80 (Binford) to the latest of 1751.93 (Heighton and Deagan). These dates are also earlier that the expected dates of the site established by documentary sources and other archeological evidence. Despite applying the dating formula to different portions of the sample, the dates are always a minimum of 20 to 50 years earlier than the documented occupation period. This is well illustrated in Table 6,

Table 5. Pipe stem dates at BSH 1, BSH 2, and BSH 3.

Site	Sample	Binford Date	Heighton & Deagan Date
BSH 1	28	1750.11	1751.93
BSH 2	1670	1740.11	1742.22
BSH 3	55	1737.80	1740.18
Combined Samples	1753	1740.09	1742.30

for example, where dates were obtained on 19 selected contexts. At BSH 1 individual dates for samples of 1 to 17 specimens from Structures 2, 4, and 5 range from 1740 to 1761. At BSH 2 fifteen contexts each containing 30 or more specimens produced dates between 1734 and 1750, with 25 of the dates falling in the 1740s. Dates for the combined sample from BSH 3 are 1737 and 1740. As shown in Table 7, the greatest effect on the dates is the overwhelming number of bore diameters measuring 5/64 in. This is true for all dates calculated.

Table 6. Pipe stem dates from selected excavation units at BSH 1, BSH 2 and BSH 3

Site	Excavation Unit	Sample	Binford Date	Heighton & Deagan Date
BSH 1	Structure 2	10	1759.68	1761.63
	Structure 4	17	1745.06	1747.00
	Structure 5	1	1740.55	1742.72
BSH 2	184-185 N/100-101 W	45	1743.11	1745.13
	196-197 N/100-101 W	31	1744.26	1746.21
	200-201 N/100-101 W	34	1745.00	1747.00
	200-201 N/101-102 W	26	1747.90	1749.75
	201-202 N/100-101 W	38	1742.58	1744.63
	202-203 N/100-101 W	67	1743.38	1745.39
	202-203 N/101-102 W	39	1748.39	1750.24
	203-204 N/100-101 W	45	1743.11	1745.14
	204-205 N/100-101 W	43	1744.99	1746.92
	204-205 N/101-102 W	40	1742.63	1744.52
	205-206 N/100-101 W	67	1741.12	1743.26
	207-208 N/100-101 W	54	1734.89	1737.50
	209-210 N/102-103 W	30	1740.55	1742.71
	218-219 N/100-101 W	34	1746.17	1748.08
	224-225 N/101-102 W	33	1734.77	1737.37
BSH 3	All Contexts	55	1737.80	1740.18

Table 7. Numbers of stems per bore diameter

Site	Context	Stem Diameter (inch)				Total
		4/64	5/64	6/64	7/74	
BSH 1	Structure 2	5	5	0	0	10
	Structure 4	2	15	0	0	17
	Structure 5	1	0	0	0	1
BSH 2	All	149	1350	169	2	1670
BSH 3	All	5	41	9	0	55
Total		162	1411	178	2	1753

Because stem bores decrease over time, specimens with 6/64 in bores should occur more often in the lowest levels of the excavation and those with 4/64 in bores should be more prevalent in higher levels. This was not the case as stems measuring 4/64 in and 5/64 in were collected from the surface to an elevation as deep as 85.30 m below

datum, while stems measuring 6/64 in were found at elevations no deeper than 97.70 m below datum. To further investigate possible temporal differences at site BSH 2, dates were calculated for selected samples for each of the three stratigraphic provenience groups defined at the site. A total of 990 pipe stems were used with a sample of 563 from the lower elevations of the site represented by provenience group 1, a sample of 341 from deposits associated with the structures designated provenience group 2, and a sample of 86 from deposits dating after the occupation of the buildings (Table 8). Dates calculated on these samples range from 1734 to 1743 (Table 9). These data further demonstrate the difficulties obtaining accurate dates for contexts from the later portion of the 18th century, and they also show that pipe stem dating at BSH 2 does not discriminate stratigraphically ordered deposits.

Table 8. Pipe stem samples from each provenience groups

Provenience Group	Stem Diameter (inch)				Total
	4/64	5/64	6/64	7/74	
1	68	438	57	0	563
2	29	284	28	0	341
3	2	69	14	1	86
Total	99	791	99	1	990

Table 9. Pipe stem dates for provenience groups at BSH 2

Provenience Group	Sample	Binford Date	Heighton & Deagan Date
1	563	1741.32	1743.44
2	341	1740.66	1742.78
3	86	1734.31	1736.95

Discussion of Pipe Stem Dating Techniques

There are many possible explanations for why the pipe stem bore diameters from Brimstone Hill yielded dates that do not correspond with the dates based on other artifact classes or age estimates based on historical documents. Many researchers, even Binford and Harrington, have cautioned that the technique becomes less accurate at the end of the 18th century, the time period in which the Brimstone Hill sites were occupied. Ivor Noel

Hume writes that the range of acceptable accuracy is usually 1680-1760 "with the probability of error increasing rapidly as one moves away from that bracket in either direction" (Noel Hume 1970:300). Audrey Noel Hume (1960:23) demonstrated this in a study of six positively dated sites in Williamsburg dating to the 1763-1820 period that produced pipe stem dates ranging from 1747-1759. The decreasing reliability of the technique for assemblages dating after 1760 is the most probable reason for the inaccurate dates at Brimstone Hill.

In his excavation of Fort Moultrie, Stanley South (1974:208-209) used the Binford formula on pipes from an American context dated post-1776 and a British context dated through historical documents to 1780-1782. The date for the American deposit was 1736.30 and the date for the British deposit was 1745.10. South points out that it is not unusual for the Binford formula to yield inaccurate dates for late 18th century sites. He goes on to suggest that if 40 years were added to both Binford dates, they would come much closer to the actual occupation dates. While he suggests that this may work on other sites, he recognizes that this is no more than the addition of an arbitrary number to obtain a correct result. Interestingly, if 40 years were added to the dates calculated for pipes at Brimstone Hill, they would also fall within the more acceptable range of 1795-1815.

There are other reasons proposed by researchers to explain the failure of the dating techniques to produce consistently accurate dates. Some have argued that to obtain an accurate mean date, the sample has to have been deposited at a steady rate over time to avoid samples biased to a narrow specific period (Walker 1971a:117). It has also been proposed that a sample of 900 to 1000 stems might be necessary to compute consistent dates, but it has also been shown that differences of even a few pipe stems can lead to wide differences in results (Noel Hume 1970:297).

Researchers have also suggested that the dating system has inherent problems because of documented variability in stem length. Adrian Oswald (1960:10), for example, agrees that bore diameter did *generally* decrease through the 18th century, but that a late 18th century reversion to shorter stemmed, larger diameter pipes could alter the overall pattern. In a study of Bristol clay pipes it was found that early 18th century manufacturers signed an agreement to produce stems in three different lengths, 16 in, 14

in, and 8 ½ in (Alexander 1983:239). In addition, a 1799 advertisement reveals that short pipes were specifically manufactured for American markets (Jackson and Price 1974:84). Alexander (1983:239) argues it is impossible that there was any sort of agreement among manufacturers as to stem length through the 17th and 18th centuries. He shows that the Tippet family of Bristol was simultaneously using piercers that produced 5/64 in to 8/64 in stem bores throughout their 60 years in business. Finally, Walker (1971a:118) reports that at the Fortress of Louisburg, Canada that by the late 18th century, the use of long and short pipes had become a question of varying social custom. This would create a mixture of both long and short stem pipes with bore diameters of varying sizes in archaeological deposits.

Makers Marks and Decorations

Research was also conducted to identify decorations or maker's marks that could be assigned to a manufacturer or stylistic period. There are only 71 (2.1 %) decorated pipe fragments in the entire Brimstone Hill assemblage. Decorative treatments occur on bowls, stems, junctures and a few were found on the base of heels and spurs (Table 10). Examples of the some of the decorations found at Brimstone Hill are depicted in Figure 6.

It seems that the pipe makers in Bristol may have been major suppliers of pipes to Brimstone Hill. The first recorded pipe maker in Bristol appeared in 1619 (Walker 1971b:4). From 1660 to 1760, Bristol was the major supplier of pipes to all of Britain's North American colonies (Walker 1971b:4; Oswald 1960:5). It is generally believed that the Bristol industry declined between 1780 and 1810 due to the loss of the American colonies and because the popularity of smoking seemed to decline. In contrast, records show that Bristol exports to West Indian markets did not decrease significantly (Jackson and Price 1974:21). The number of boxes of tobacco pipes shipped to West Indian markets seemed to follow the same trends after ca. 1780 as before (Jackson and Price 1974:21). Therefore, while the industry was in a reported decline, it is possible that Bristol pipes still reached St. Kitts in large numbers.

By looking at makers and decorative styles, the few decorated fragments appear to fit in the correct time period of 1780-1810 that could not be established through the stem dating formulae. This corroborates the belief of many pipe experts that in dealing

Table 10. Decorated pipe fragments from Brimstone Hill

Site	Portion	Decoration	Number
BSH 2	Bowl	"I6" Embossed	1
	Bowl	floral	4
	bowl	fluted	9
	bowl	fluted w/ dots	1
	bowl	fluted w/ cut marks	1
	bowl	molded leaves	1
	bowl	"T"	1
	bowl	horizontal hash marks	1
	bowl	"I.C./13"	1
	bowl	laurel stem	1
	bowl	flutes, dots, "I"	1
	bowl	linear stamp	3
	bowl	scallop stamp	1
	bowl	leaf design	6
	bowl	scallop and leaf design	1
	bowl	stamped circle	2
	bowl	curved linear	1
	bowl	"C" remnant	1
	bowl	"CARY"	6
	bowl	half-circle, stamped	1
	stem	leaf design	1
	juncture	linear stamp	1
	juncture	"IC" stamp	3
	juncture	reddish-brown, painted	1
	bowl	scratched	1
	bowl	decorated	4
	bowl	rouletted, one w/ spur decoration	3
	bowl	partial marks	2
	bowl	spur mark: backwards "S" and "I" on opposite sides	1
	bowl	rouletted w/ "USCHU"	1
	juncture	"I6" and crown	1
	juncture	"I6" in circle	1
	juncture	"IC" stamp	1
	juncture	"IC" or "IO"	1
	juncture	"CARY"	1
BSH 3	bowl	"IC" stamp	1
	juncture	fluted	2
	stem	"E. CHURCH" and "LATE FORD"	1

Figure 6. Various decorative techniques observed on pipe fragments at Brimstone Hill

with sites from the late 18th and 19th centuries it is best to rely on well-documented makers marks if possible rather than pipe stem dating.

CARY, IC and IO marks

The most prevalent mark (n=7) in the Brimstone Hill assemblage is found on bowls that are marked with the letters "CARY" (Figure 7). The "IC" stamp was identified on three bowls and one bowl was identified as being either "IC" or "IO." Between 1780 and 1810 there were at least six British pipe manufacturers with the initials IC (Oswald 1960:26). The most likely source, however, is the Carey family of Bristol. Israel Carey began making pipes in 1757 and the business continued with his son, John Carey, as the head of the company from 1780-1815 (Jackson and Price 1974:35). The Careys not only produced pipes during the occupation of Brimstone Hill, but they also exported pipes to the West Indies. An advertisement reproduced by Jackson and Price (1974) indicates that John Carey along with three other Bristol manufacturers offered pipes for export to American, Irish, Spanish, and most importantly, West India markets (1974:84). The Careys used a variety of marks on their pipes, including the initials IC within a circle and the name "CARY" as found on pipes at Brimstone Hill. Given the time period, the exporting history of Bristol pipe makers, and the similarity in marks, the Brimstone Hill pipes are almost certainly attributable to Isaac and John Carey of Bristol. The mark that could not be positively identified as "IO" or "IC" could represent the IC mark of the Careys or the IO initials of John Oakley, also of Bristol. Oakley began manufacturing pipes in 1768 and his marks also are illustrated by Jackson and Price (1974:126; see also Oswald 1960:47).

Marked Spur

One bowl was found with a spur marked with a backward "S" on one side and a probable "I" on the opposite side (Figure 8). A bowl with a similar mark, representing one of a series of bowls in the collection of the Bristol City museum, is illustrated but not specifically identified in Jackson and Price (1974:108). This mark is further evidence that Bristol pipes found their way to St. Kitts and to Brimstone Hill.

"I6" or "16" mark

The second most frequent mark (n=3) was identified as either an "I6"or a "16." One occurred above a crown, another was inside a circle, and the third was embossed.

Figure 7. Bowl fragments with various “CARY” marks

Figure 8. A decorated stem and two bowls from Brimstone Hill. Middle specimen has reverse “S”.

The “16” with a crown symbol was found on pipes recovered from Fort Michilimackinac (Stone 1974) and Fort Moultrie (South 1974). Both Stone and South report that, based on the findings of Iain C. Walker, crowned numeral marks are characteristically Dutch.

Stone (1974:151) indicates that during the French occupation of Fort Michilimackinac, Dutch pipes were used more frequently than those manufactured in England. This is important because at Brimstone Hill very little French or Dutch material has been recovered despite the fact that the French occupied the fort from 1782-1783. Furthermore, St. Kitts is only 10 km from the Dutch island of St. Eustatius where the British acquired merchandise through periodic trading and warfare in the 18th century (Ahlman and Schroedl 1997:25).

The small number of fragments from Dutch pipes in the Brimstone Hill archaeological assemblage is not likely to have led to the failure of the Harrington, Binford, and Heighton and Deagan methods to provide accurate dates for the site. Although Dutch pipes can cause the formulas to yield incorrect dates, their bore diameters are generally smaller than the English pipes of corresponding time periods and therefore, if included, would cause calculated dates to be much later than actual dates of occupation. The dates from Brimstone Hill, of course, are consistently 20 to 50 years earlier than expected. As Stone (1974:151) points out, the English controlled Michilimackinac during most of its history and too few Dutch pipes were deposited there to significantly alter the dates obtained from the large sample of English manufactured pipes. Brimstone Hill represents a similar situation: so few Dutch pipes were deposited compared to British material that they have no impact on the dating formulas used.

E CHURCH and LATE FORD

The mark of "E CHURCH" and "LATE FORD" was found on a stem from the BSH 3 surface collection. The pipe makers Ebenezer Church and John Ford are documented as working in London. John Ford was one of the many Fords either working together or separately beginning as early as 1810. Ford opened a branch of his business in Pentonville, England in 1826 and exported pipes from there from 1857 to 1865. In 1865 the business was taken over by Ford's son-in-law, Ebenezer Church and was continued by him and subsequently by his widow following Church's death until 1894. Some trade directories report the Ford firm as exporting at least from 1856 to 1870 or 1877 and then again from 1880-1909 (Walker 1975:181-182). Given the late date when

Church took over the Ford business, in addition to the fact that this stem is a surface find, it is likely that this pipe was deposited after Brimstone Hill was abandoned in 1853.

Miscellaneous Makers Marks

Many other identified maker's marks were so widely used by pipe manufacturers that they are hard to pinpoint to a specific time period or maker. The mark "USCHU" on a stem could not be identified. One fragment of a "T" could have two possible sources. The initial "T" is seen most often on colonial pipes usually as part of the ubiquitous "TD" mark often found but hard to attribute to a particular maker because it was frequently copied (Alexander 1978: 3-5). The "T" also could represent the initials of Robert Tippet, another Bristol exporter, whose pipes are often found on colonial sites (Stone 1974:146-149). Fluted bowls, while hard to pinpoint to a maker, have been tentatively identified as becoming popular in the 1770s and grew in popularity through the 19th century (Alexander 1978:20-21).

Personal Decoration

The vast majority of pipe fragments at Brimstone Hill are undecorated. Pipes were probably a valued personal possession to both slaves and soldiers, and there are some indications that individuals may have taken steps to distinguish their pipes from the plain pipes of others. Four pipe fragment have been recovered exhibiting signs of personal marking that include scratches, cut marks, and coloring. The marks most likely represent an effort by either African slaves or British soldiers to personalize their belongings in a close-quarters, disciplined environment of a military barrack. Research on ceramics from Brimstone Hill also has identified personal marks, some of which may represent cosmograms like those identified in African and African slave contexts elsewhere (Ahlman 1997; Schroedl 1997:2; Schroedl and Ahlman 2002.). The marks on the pipes, however, do not resemble African cosmograms.

Pipes, African Slaves, and Soldiers

Excavations of African American and African Caribbean sites indicate that pipe smoking was practiced by slaves, or in the case of Brimstone Hill, surely members of the

Black militia and soldiers of the West India Regiments. Documentary and archaeological evidence suggest that tobacco and pipe smoking were probably introduced circa 1600 to the West African coast by either French or English traders (Phillips 1983). Emerson (1994) believes that tobacco could have been introduced as early as the 16th century and that pipe smoking was established in coastal areas by the early 17th century. Documentary evidence shows that cheaply made pipes were sometimes even provided for slaves in their voyages from Africa to the New World (Walker 1975:166). The Bristol area had ties to the West African coast because many of its merchants were slave traders and many of its pipe makers were the main suppliers of pipes to Africa (Walker 1975:167). This suggests that pipe smoking, for many African slaves and African soldiers in St. Kitts, was a tradition in their own culture or was recently acquired in West Africa. In archaeological contexts, forensic evidence such as pipe wear facets on the teeth of slave remains excavated in Suriname and Barbados is further evidence that smoking was a longtime habit of African slaves in many different regions (Kudabux 1999

Pipe assemblages, like the one recovered at Brimstone Hill, also represent social and cultural patterns relating to smoking among African slaves. Jean Howson (1990), for example, believes that smoking pipes in slave contexts indicate breaks during work or longer periods of leisure time such as Sundays off from work. In this context, pipes constitute a symbol of personal time that belonged only to the slave and that was not specifically controlled by an owner. Howson also believes that smoking was a social activity that brought slaves together in fellowship helping them to maintain their personal identities and acting as strong identification of their shared hardships as a group. Finally, she cites the presence of pipes in burials reflecting their use as valuable and important status symbols for slaves. When particularly large numbers of pipes have been found in slave contexts, they are also often interpreted as a sign of good treatment of slaves by masters (Kudabux 1999:311).

At Drax Hall Plantation, Jamaica, Armstrong (1990) reports that the majority of pipes were found around work areas such as kitchen and activity sheds. This supports Howson's belief that pipes symbolized break time, and further suggested to Armstrong that pipe smoking was probably practiced by both male and female slaves (Armstrong

1990:187). Both Armstrong and Otto (1984) indicate that tobacco pipes were often referred to as "Negro Pipes." This reflects their popularity among slaves but also implies a social distinction between their smoking habits and those of their masters. Otto (1984:74) compares the acquisition and use of pipes to owning other items such as glass beads and nice Sunday clothes endowing them all with particular social meaning and the status of a luxury item.

The nature of slavery at Brimstone Hill, however, is more complex than at plantation sites because there were African slaves as well as African and British soldiers living and working there. This complicates the interpretation of the entire artifact assemblage since it is difficult to positively sort out the items that may have been used or owned by these groups and to determine what, if any, differential access to goods they might have had. Slaves hired to work at the fort surely were treated much like they were on the plantations from which they came. Buckley (1979:65), however, argues that African soldiers received equal treatment to British soldiers such as using the same or comparable hospitals, wearing similar uniforms, receiving the same daily rations, earning equal pay, and having the same privileges. It is possible, nevertheless, that tobacco pipes were so common and so abundant that everyone –British soldiers, African soldiers, and enslaved Africans—had equal access to them.

The pipe assemblage at Brimstone Hill also reflects the popularity of smoking among British soldiers. Excavations at Fort Moultrie, South Carolina, Fort Michilimackinac, Michigan, and Fortress Lousiburg, Canada demonstrate that pipe smoking was prevalent among British troops. South suggests that as far as differential access to goods among British ranks, officers and enlisted men alike probably received pipes.

Conclusions

The history of the archaeological deposits at Brimstone Hill, particularly site BSH 2, is very complex. It is difficult to distinguish between individual artifacts that may have been used by slaves or soldiers, or whether the artifacts deposited at BSH 2 are from activities that took place there or represent trash deposits from BSH 3. Despite these

difficulties, a large number of pipes and other artifacts were recovered in the immediate vicinity of the foundations and floors of Structures 1 and 2, where most of these materials were surely left by the enslaved Africans who worked around these buildings. Tobacco pipes and other artifacts recovered from deposits that accumulated over and above the walls of these buildings more likely represent debris from BSH 3 thrown over the defensive wall. Here there are several buildings shown on the 1791 map that were occupied or utilized by enslaved Africans; and the barrack building paralleling the defensive wall immediately above BSH 2 could have been occupied by African soldiers at some time in its history. This means that even the debris thrown over the defensive wall might still relate directly to African presence at Brimstone Hill.

Another problem in the analysis of smoking pipes from Brimstone Hill is the application of the pipe stem bore dating technique. The Harrington, Binford, and Heighton and Deagan formulas do not produce consistently accurate dates after about 1760. The dates for Brimstone Hill are well within the historically documented occupation of the fort, but other evidence, particularly ceramics, suggest that BSH 1, BSH 2, and BSH 3 date to the late 18th and early 19th centuries. The calculated dates are mostly in the 1740s. As mentioned previously, South suggests adding 40 years to dates calculated with the Binford formula on late 18th century sites. An addition of this magnitude to the Brimstone Hill dates calculated using all techniques, would yield a more accurate 1795-1815 date range. Making such an adjustment, as South clearly understood, is completely arbitrary. Nevertheless, the Brimstone Hill dates are consistent with his observations and further research may demonstrate the justification for this adjustment to late 18th century pipe stem dates.

Maker's marks and decorative techniques identified at Brimstone Hill correspond well with the period of the forts occupation. Most pipes have no decoration indicating that they were probably a generic type bought and supplied by the military. Decorated examples could have belonged to higher status individuals who had access to better, or at least different, goods than the average slave or soldier. The maker's marks that point to Bristol as the manufacturing point for at least some of the pipes provide interesting insight into trade throughout the British empire at the time. Perhaps most interesting are

the pipes that appears to be Dutch indicating that some artifacts could have come from the Dutch island of St. Eustatius or from the French occupation of the fort.

Smoking was a habit widely enjoyed by both African slaves and British soldiers in the late 18th and early 19th centuries. Smoking was undoubtedly a way for soldiers and slaves alike to take a break from the labors of military life. It could also have been a social activity that brought people together in a common experience. The few personal marks that were found on the pipes, although they could not be identified as British or African, reflect an attempt in a military context to assert some individuality and to identify personal property in a communal environment.

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