

Washington and Lee University
"An Historical and Archaeological Consideration
of Brickmaking in Virginia"

by
Andrea D. Hickman

Senior Honors Thesis
May 1, 1989
Department of Anthropology

On my honor, I have
neither given nor received
any unacknowledged aid
on this thesis.

Andrea D. Hickman

"An Historical and Archaeological Consideration
of Brickmaking in Virginia"

Introduction

Of all ceramics, brick is surrounded by
the worst tangle of legend and folklore.
(Heite 1970: 43)

The above quote represents a statement written by Edward F. Heite in reference to the specific plight of bricks in an archaeological context. Indeed this statement provides a firm foundation for my proposal that it is a necessity for an historic overview of brick manufacture in the state of Virginia to be undertaken.

In undertaking such an historic overview, I shall be concerned primarily with the beginning of brickmaking in colonial America. After having recounted a history of this important occurrence, I will then refer to the rapid spread of the brickmaking industry throughout the earliest colonies. Having done this, I will then provide a brief history of the later brickmaking industry.

Certainly another important realm is that of the actual technology involved in brickmaking. It is amazing to note the important changes which have occurred- some simply to supply the products for increased demand. However, it is also interesting to see how closely the technology of colonial times corresponds to that of more contemporary times. Thus, I will discuss both

the eighteenth and nineteenth century technology and then the modern technology. This will clearly demonstrate how the modern techniques evolved from earlier methods.

In another section, I will synthesize much available literature dealing with brick clamp excavations in the state of Virginia. By manipulating the some of the data from these reports, I will also address two of the issues raised by Russ and McDaniel (1988) in "Archaeological Residues of Domestic Brickmaking: An Example from the Liberty Hall Academy Site Complex."

The final task which I will undertake should assist in addressing some misconceptions or the "legend and folklore" spoken of by Heite. In this section, I will discuss a major popular myth surrounding the origins of colonial bricks. This myth deals with the concept that colonial bricks were brought over as ship ballast (South 1964: 67). Another major concept which I will address is that of brick size and its variation through time. In this area, I will demonstrate that bricks do not have a regular pattern of size variation; brick size cannot be used as a dating tool.

Historical Background

Bricks are the commonest ceramics encountered in historical archaeology, but very little appears in the literature concerning their manufacture. (Heite 1970: 43)

In this section, I will be primarily concentrating on providing historical facts which will add to the literature on brick manufacture. The sub-section dealing with technology will also assist in adding to literary information which, as Heite suggests, is a great necessity.

Roanoke Island

In pursuing information regarding the earliest known date of brickmaking in colonial America, I was able to discover that "Brickmaking was the first industry attempted in English America. . ." (Heite 1970: 43) This fact alone allows us to see that brickmaking began almost as soon as Roanoke Island was settled in 1585.

Noel Hume specifically deals with the beginnings of colonial brickmaking on Roanoke Island in 1585. Roanoke Island is located ". . .off the Outer Banks of what is now North Carolina. . ." and was first explored in 1584 by Captain Arthur Barlowe and Captain Philip Amadas (Noel Hume 1963: 16).

Noel Hume writes of Hakluyt's Discourse of Western Planting (1584) as an important document which provides information dealing with brickmaking activities in the colony. One of the trades which Hakluyt listed as being most important for the survival of the colonists was that of brickmaking (Noel Hume 1963: 20).

Further support for the true brickmaking activities of these colonists can be found in "a deposition made under oath by. . .

David Glavin, Irish soldier. . ." (Harrington 1967: 1). As Harrington writes, one of Glavin's statements "has been translated as follows: 'There, as soon as they had disembarked, they began to make brick and tiles for a fort and houses" (Harrington 1967: 1).

Harrington tends to support the concept that brickmaking did begin as early as the 1585 settlement date of Roanoke Island. In further backing up his position, Harrington mentions Thomas Hariot's Briefe and true report of the new found land of Virginia which was ". . .written primarily to recruit settlers. . ." (Harrington 1967: 2). As Harrington reports, "Hariot noted the absence of suitable building stone in the vicinity of Roanoke Island, but until a source could be located he seemed confident that brick made from local clays was a feasible and acceptable substitute" (1967: 2).

Harrington is, in fact, so supportive of the 1585-86 date of colonial brickmaking that he sees only one major potential problem which would have prevented brickmaking at such an early date: "The time required to make bricks would have been the main problem. . ." (1967: 2). In other words, if the colonists had just arrived, how would they have immediately begun brickmaking activities? Harrington further addresses this question: "If work had started on arrival of the colonists in August, . . . summer weather would have speeded up the operation, and . . . the first kiln could have been fired within a month" (1967: 2). Thus, the argument for the colonists' 1585-86 brickmaking

activities may be supported with Harrington's assertion that a month may have been the amount of time for brickmaking to begin. To me, it seems logical that the colonists would have started preparation for a permanent settlement as soon as possible. Given this desire and the fact that the raw materials were indeed available (Harrington 1967: 2), I tend to agree with Harrington and his argument.

Virginia

Specifically relating to the later development of brickmaking in colonial Virginia, Heite states: "At Jamestown, several large kilns produced brick early in the seventeenth century" (1970: 43). Thus, we can see expansion of brickmaking activity into colonial Jamestown.

In discussing the Roanoke Island brickmaking activities, I cited documentary evidence which gave greater validity to the 1585 or 1586 date and practice of brick manufacture. Although there was no overwhelming wealth of information to support brickmaking's earliest occurrence at Roanoke Island, there is even less historical documentary evidence to support the trade's existence in Jamestown. As Harrington relates, he was only able to uncover one bit of information referring explicitly to the presence of a brick kiln in Jamestown. This evidence consists of a 1637 patent which had been issued to "Alexander Stomer, 'brickmaker,' for a parcel of land at the western end of the Island 'neare the brick kill.'" (Harrington 1950: 18)

In providing more support, Ewan elaborates upon the practicality of brickmaking in the first colonies. As he states, ". . . brickmaking. . . was not complicated, kilns required but simple equipment, the best quality of brick clay was at hand, wood for fuel was unlimited and dried wild grass for a binder was found in profusion" (Ewan 1970: 1).

As was the case on Roanoke Island, brickmakers in Jamestown were certainly important, nearly invaluable individuals. Harrington supports this idea by noting that brickmakers were able to sell their products to the colonists for as much as fifteen shillings for a thousand bricks (Harrington 1950: 18)

Not only were Jamestown's brickmakers men of means, but they were also apparently quite busy as well. For, by 1621, enough bricks were being manufactured in Jamestown that they were being exported as trade items to the Bermudas (Harrington 1950: 17).

Spread Through the Colonies

Ewan provides us with a summary of the brickmaking industry as it continued to spread through the early colonies. This spread was obviously important to the future of brickmaking. Because the industry did flourish so early, it seems logical that it would grow and (as later occurred) become a national industry.

Ewan notes that one report of early brickmaking in Maryland states that colonists were making brick before the mid-1600's (Ewan 1970: 11). Thus, they were not far behind the early date of Virginia brickmaking.

Ewan refers to J. Leander Bishop's "History of American Manufacture" as an important source revealing the practice of brickmaking in Massachusetts. As Ewan reports, Bishop mentions Salem, Massachusetts as the area with the first brick clamp of New England. This clamp was reported to have been constructed in the year 1629 (Ewan 1970: 3).

New York is the next area of interest for brickmaking. Although many New York bricks were brought from Holland, the colonists did manufacture their own bricks. As Ewan notes, in 1664, there were some brick kilns in New York. He calls attention to a quite early clamp located at Fort Orange (1970: 3). In his study of the colonial manufacture of bricks, Bishop further relates that a private colony (located near Albany) was practicing brickmaking before the colonists in the Manhattan settlement (Ewan 1970: 3).

Christopher Ward's "The Dutch and Swedes on the Delaware, 1609-1664" states that the Dutch of New Amstel (or New Castle), Delaware imported bricks from the previously mentioned Fort Orange clamp of New York. However, in 1659, the first brick kiln was established in New Amstel (Ewan 1970: 4).

In an article published in the Pennsylvania Magazine of History and Biography, Gillingham devotes attention to the entrance of brickmaking into Pennsylvania. He calls our attention to a letter written by Robert Turner to William Penn. In this letter, Turner refers to several men (Thomas Smith and Daniel Pegg -or Pege) who had begun manufacturing bricks during

1685 (Ewan 1970: 5).

The industry continued to flourish in Pennsylvania. The years 1687-88 saw an individual named Randall Spakeman gaining a grant of land in Philadelphia. As Gillingham notes, Spakeman was to use this land for his brick kiln and was to pay for the land with the products from his kiln (Ewan 1970: 6).

In an article entitled "Candle Days," Marion Nicholl Rawson states that Noah Webster requested (in a letter of 1792) information on the making of bricks. He noted that individuals in Connecticut wished to construct a State House and desired information on brickmaking (Ewan 1970: 11).

Thus, the practice of brickmaking spread. As each new colony was settled, the colonists recognized the importance of establishing a nearly autonomous settlement. Since they obviously had (or could obtain) the know-how and the raw materials, there was nothing to prevent them from creating their own brickmaking facilities.

Later History

The brick industry continued to flourish, reaching its greatest production nationally around 1911 (Gurcke 1987: 95). However, after this year, production fell off; the number of plants manufacturing brick had dropped (Gurcke 1987: 95). As Gurcke points out of the state of Oregon, ". . . the number of brickyards decreased from 68 in 1908 to 29 in 1913 and 18 in

1946" (1987: 95). Gurcke's information demonstrates that this phenomenon was also seen nationally (1987: 95). In explaining this decline in operating brick plants, Gurcke suggests that competition with steel and cement had become a major factor. Also modernization was forcing the less-modernized brickyards out of business (1987: 96). The depression forced an even lower production, and World War II caused further problems. However, Gurcke concludes that ". . . the industry has rebounded, but it continues to. . ." (1987: 96) fight in order to make up for the periods which sometimes nearly halted production (Gurcke 1987: 96).

Technology

In relation to the colonial brickmaking industry, Heite notes that "Most bricks used during the colonial period were made on or near the construction site" (Heite 1967: 8). Of the eighteenth and nineteenth century technology, Heite notes that "The first step in brickmaking is to refine the clay" (1970: 44). Many times the clay was also "weathered" or allowed to set for a short period of time. According to Heite, the clay acquired greater "evenness" through this aging process (1970: 44).

The next step consisted of placing the clay into a "pugmill- where it is reduced to a uniform consistency" (Heite 1970: 44). The pugmill mechanism ". . . usually consisted of a puddle of clay which was agitated by a rotating paddle pulled by a mule" (Heite 1970: 44).

After the clay had undergone the rigors of the pugmill, it was then put by the handful into wooden moulds. As Heite notes, it was important that only one handful of clay be put into each mould; if more clay was used (or added), there would be a weakened final product (1970: 44).

The moulds themselves sometimes received a light dusting of sand which rendered the brick easy to remove. The sand was also beneficial during the actual firing process; it formed a hard covering on the bricks (Heite 1970: 45).

After the bricks had been allowed to air-dry, which usually required a period of weeks (Heite 1967: 8), they were placed inside the clamp for firing. The true firing lasted from three to four days (Heite 1970: 45).

In order to close the channel ends before firing, brickmakers would cover the mouth with a "shinlog" (Heite 1970: 45). The shinlog was actually "a pile of bricks stacked at the opening to control the draft" (Heite 1970: 45).

Because technology was not advanced, these brickmakers had little quality control. A major factor which was quite beyond their management was that of shrinkage caused by the less-advanced kiln type (Heite 1970: 45).

As the industry became more advanced, "the modern method for making brick" became "more complicated than it used to be" (General Shale 1986: 2). Authors of the General Shale publication relate that technological changes were needed "to maintain quality control and produce a much better and more

uniform product" (1986: 2).

The raw material for modern brick has now frequently become shale which is a clay which has been transformed over the years into slate (General Shale 1986: 2). As was the case in the past, the raw material must be mined (obviously with the utilization of more complex, more mechanized tools) and then is ground to a powder form (General Shale 1986: 2). From this point forward, the technology has definitely evolved, only somewhat resembling the crude original colonial methods. Thus, the clay powder "is mixed with water until the material has a consistency of modeling clay" (General Shale 1986: 2). This material is then passed through an "extruder," after which it is cut with the use of a "cutting wheel" (General Shale 1986: 2). The bricks are then placed onto cars for their move "into a predryer- a large room heated with waste heat from the brick kiln" (General Shale 1986: 2). Since this process helps rid the bricks of moisture, one may conclude that much shrinkage (which had occurred in earlier manufacturing processes) can be eliminated. The predrying phase lasts approximately 30 hours before the bricks are moved into a dryer (General Shale 1986: 2).

When the bricks finally start to go into the kiln, they "pass through zones which increase in temperature until almost 2000 Fahrenheit is reached" (General Shale 1986: 2). After this firing process, the bricks are ready to be shipped (General Shale 1986: 2).

Clamps vs Kilns

Before addressing the next section which will deal primarily with actual brick clamp excavations, I feel that some attention must be devoted to a definition and differentiation of clamps and kilns. This consideration will provide additional insights into the clamp of colonial days vs the more modern kiln.

Since both kilns and clamps are structures used to fire bricks, one would tend to think that a kiln is tantamount to a clamp. However, it is important to note that there is a difference (Shott 1978: 184). Perhaps the following definitions will help clear up a popular misconception.

"A kiln is generally a permanent structure such as those in commercial brickyards" (Shott 1978: 184). The clamp, however, was never intended for such permanence. Thus, clamps were generally located at the specific site where the structure was to be built (Shott 1978: 184). As Neve (1726) describes a clamp in his dictionary: "A clamp is a kind of Kiln built above the Ground (of Bricks unburnt) for the Burning of Bricks" (Shott 1978: 185).

Despite this now seemingly clearcut definition of the kiln vs the clamp, this differentiation is not destined to remain simple. For, in reality, a "scove or field kiln" (Gurcke 1987: 29) which is made of already dried but unfired bricks and which is also temporary is nearly the same as a clamp. In fact, these two terms are so related that one is simply substituted for the other (Gurcke 1987: 29). Figure 1, included by Heite (1970) in "Colonial Brick Technology," provides greater elaboration of the clamp structure.

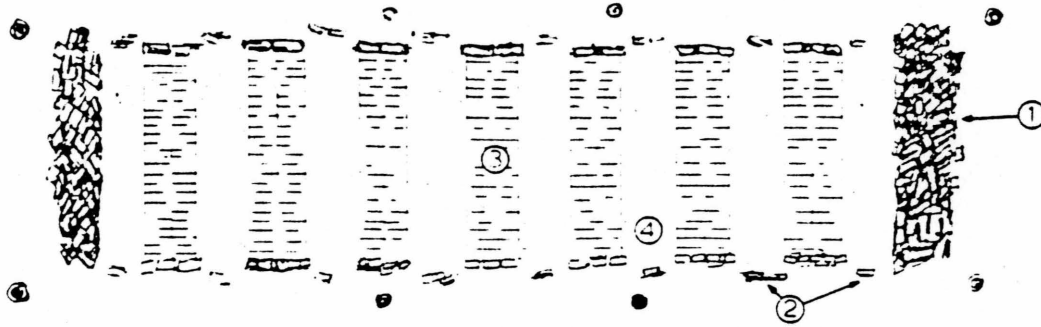
Figure 1

Structures Associated with Working Brick Clamps

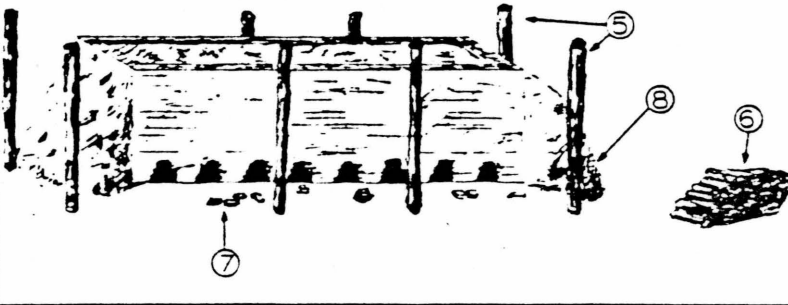
- A. Base Structure: The arches at the ends of the clamps, and the benches on which bricks were stacked, were usually made of unburnt broken bricks, rejected during the drying process. The benches (3) and the channels (4) usually were 18", or two bricks, wide. They generally were about the length of two fuel logs, if they were fired from both ends. Most Virginia channels were 18' long; the number of channels would vary in proportion to the number of bricks to be fired.
- B. Ready to Fire: The clamp has been prepared. The cover has been removed, but its upright posts (5) are left standing. Fuel (6) is stacked nearby, for the clamp cannot be permitted to cool during firing. Bricks (7) for the shinlog are stacked near the channel openings. The earthwall (8) was sometimes built up around the clamp ends, to retain heat and to strengthen the structure. This feature was omitted as often as not.
- C. Section: The usual clamp was 5 or 6' high, but they sometimes were taller. All of the bricks to be fired were stood on their edges, and the brickmaker was careful to assure that there were air spaces between them. Fire would ascend through the air spaces in a fairly even distribution.
- D. Excavated Detail: This drawing illustrates the sort of remains we usually find. The brickbat benches are frequently intact (3), although they could have been mined for fill material. The channel (4) usually is distinguished by charcoal dust and a black stain on the soil: even if all the brick has been displaced, the clamp outline usually can be traced by following these black streaks. Sometimes, brickmakers have left bricks (9) from the charge itself, although these bricks sometimes have deteriorated badly.

(From E.F. Heite, "Colonial Brick Technology"
(The Conference on Historic Archaeology Papers, Vol. 3, 1970).

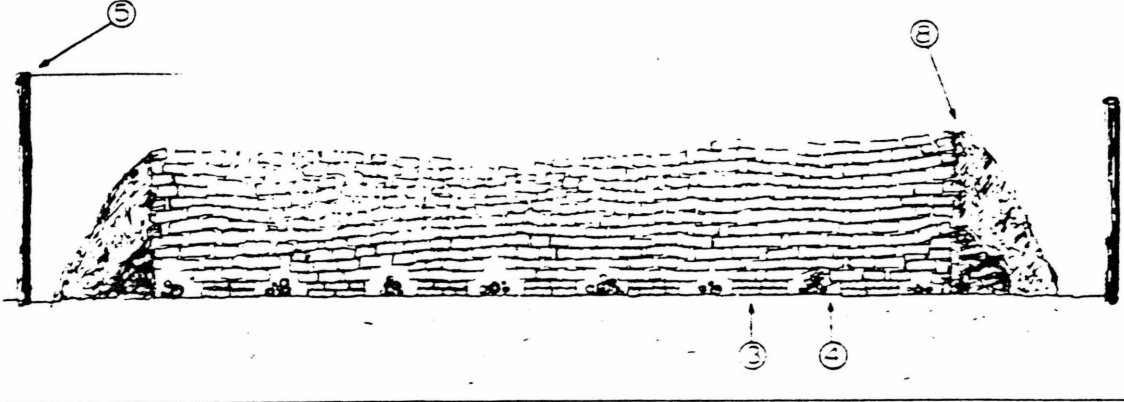
A. PLAN OF BASE



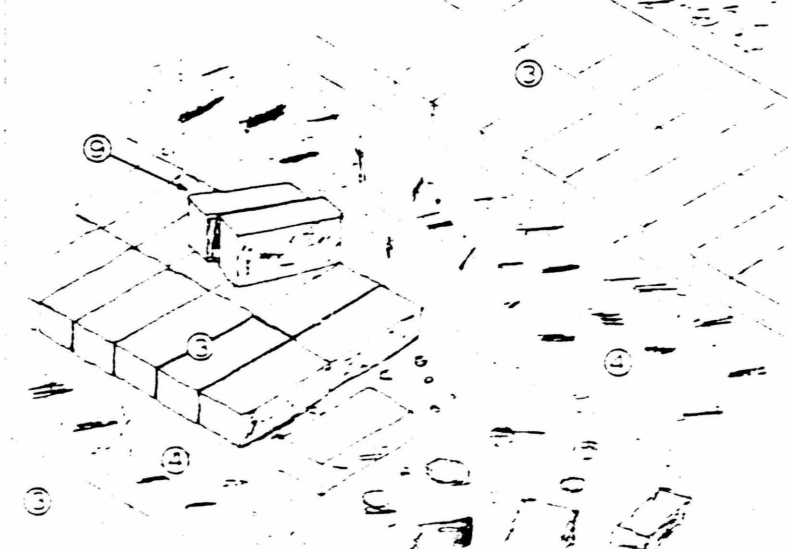
B. READY TO FIRE



C. SECTION



D. EXCAVATED DETAIL



In the following sections, I shall be concerned primarily with areas of interest expressed by Russ and McDaniel (1988) in "Archaeological Residues of Domestic Brickmaking: An Example from the Liberty Hall Academy Site Complex." Specifically, I shall be concerned with "The relationship of kiln type and size to the size of the building to be constructed" and "The relationship of kiln type and specific structural attributes to the period of use intended for the kiln" (Russ and McDaniel 1988: 3). In a final section, I shall be concerned with the ". . . changes in the size of bricks through time. . ." (Russ and McDaniel 1988: 3).

Excavations

There is little that can usefully be said about the archaeological relics of brickmaking other than to add my personal opinion that, of all the features one could find, a brick kiln or clamp is probably one of the most arduous to excavate and the least interesting. (Noel Hume 1968: 174)

In this section, I will present the synthesis of some available information dealing with brick clamp excavations in Virginia. Hopefully, we will realize that these data are not at all uninteresting. In fact, we will see that this information can lead us to formulate different hypotheses and address important questions.

Among the excavations of earliest brick clamp sites were those undertaken at Jamestown, Virginia. Both Cotter and Harrington report on these clamps:

Jamestown:

Structure 127

This brick clamp was discovered on Jamestown Island. It ". . . lies within 150 feet of the shore of the James River. . . ." (Cotter 1958: 147). It must also take credit as being "the earliest so far found" (Cotter 1958: 145) and of being "one of the first kilns constructed by the settlers" (Cotter 1958: 145). Figure 2 shows a photograph taken of excavated Structure 127.

The dimensions of the pit in which the kiln was built were reported to be 10.9 feet by 8.7 feet and 5.5 feet in depth. "Within the enclosure of this pit was a remnant of the three basal courses. . ." (Cotter 1958: 145). The courses in the kiln "were evidently a permanent base upon which the bricks were fired" (Cotter 1958: 145).

Kiln 'A'

Harrington reports that this was the first kiln to be identified at Jamestown. This clamp is "located near the ruins of William Sherwood's house in the 'New Towne' section" (Harrington 1950: 19). Figure 3 shows the exact location of this clamp.

The remains consisted of parts of benches; these scanty remains were, however, enough to allow archaeologists to determine that "the fire chambers, or arches, were approximately 20 inches wide" (Harrington 1950: 19). These bricks were placed in a popular herringbone pattern, "two bricks wide, between fire chambers" (Harrington 1950: 19). Harrington concludes that this

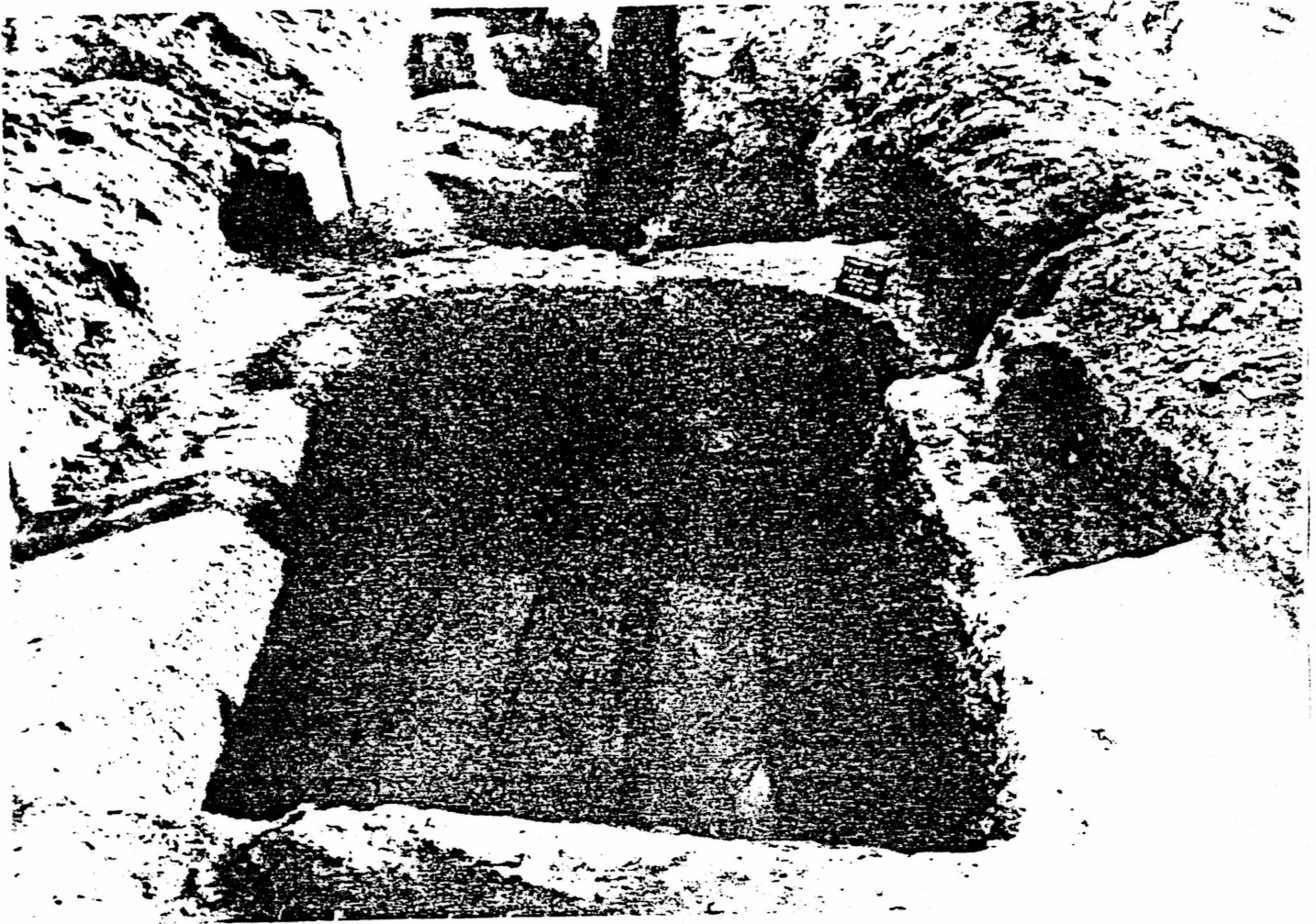


Fig. 2. Representation of photograph taken of excavated Jamestown Structure 127

(From J. L. Cotter, Archeological Excavations at Jamestown, Virginia (Washington, 1958).

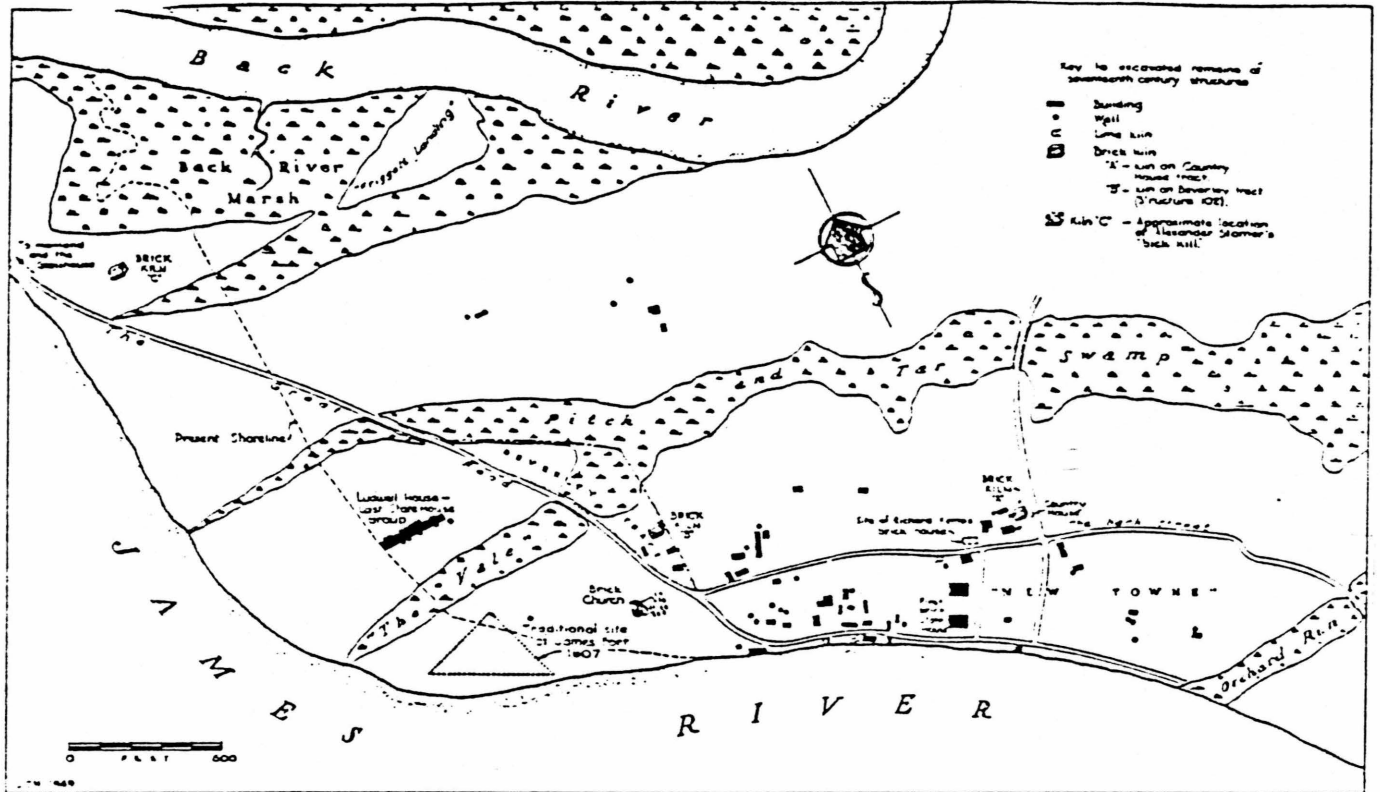


Fig. 3. Map showing location of Kilns 'A' and 'B'

(From J. C. Harrington, "Seventeenth Century Brickmaking and Tilemaking at Jamestown, Virginia" (The Virginia Magazine of History and Biography, Vol. 58, 1950).

kiln consisted of some 12 arches and was 18 feet in depth. He further hypothesizes that this excavation could be of two kilns rather than a single clamp (Harrington 1950: 19).

Kiln 'B'

This clamp was discovered ". . . on a triangular tract of land lying along the "Great Road" (highway connecting Jamestown to the "mainland") (Harrington 1950: 19). Figure 3 also shows the location of this clamp.

Harrington reports that "Overall dimensions of the outside walls of the kiln are roughly 24 1/2 feet in width by 19 feet front to back" (1950: 25). The dimensions of the inside are 22 by 15 feet (approx) (Harrington 1950: 25). The fire channels were from 20 1/2- 23 1/2 inches wide and 20- 26 inches high (Harrington 1950: 25).

Harrington concludes that this kiln was operational before 1694. As he states, ". . . based upon all the evidence at hand, it is the opinion of the author that this brickyard operated around the middle of the seventeenth century" (1950: 29). Figures 4 and 5 represent photographs taken after excavation of Kiln 'B.'

Lower Westover Church:

The next site I would like to discuss is that of Lower Westover Church. This site is located in Charles City County, Virginia (Heite 1967: 1).

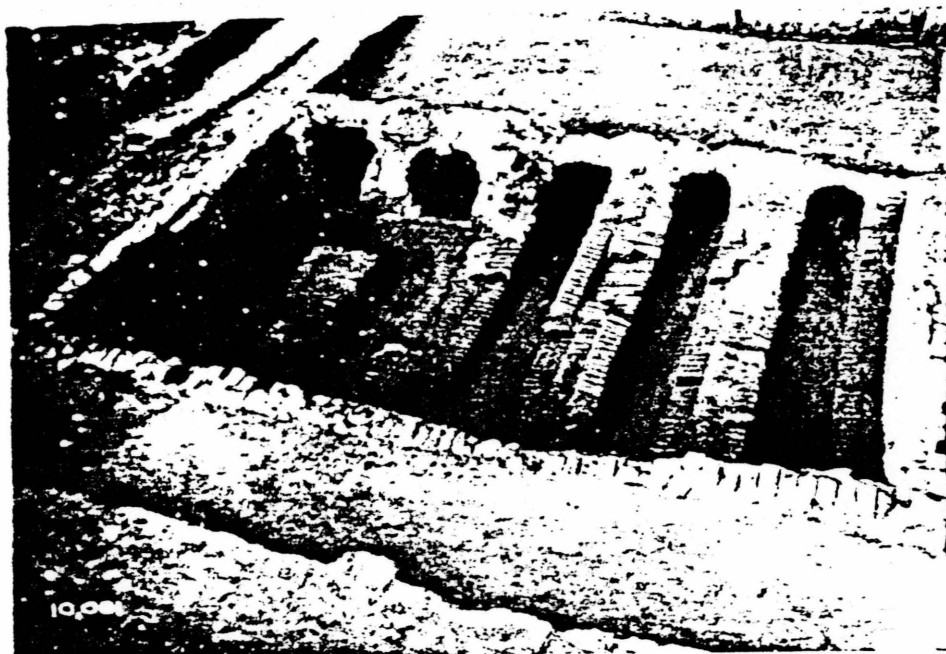


Fig. 4. View of excavated Jamestown Kiln 'B'



Fig. 5. Another view of excavated Jamestown Kiln 'B'

(From J. C. Harrington, "Seventeenth Century Brickmaking and Tilemaking at Jamestown, Virginia" (The Virginia Magazine of History and Biography), Vol. 58, 1950).

Clamps found at Lower Westover were similar to those of the Fort Belvoir site in that both clamps demonstrated "bricks. . . laid in double rows on their edges, about 18" apart" (Heite 1967: 8).

The author further reports that "the only foundations (consisted of) a course of brickbats laid in the clay without mortar" (Heite 1967: 8). The remainder of descriptive data indicate that more bricks formed an arch which created a cover for the clamp flues (Heite 1967: 9).

The clamps here were responsible for producing the bricks for the church built in the 1730's (Heite 1967: 1). Thus, we can conclude that these clamps had been operational in the eighteenth century.

Kiln A

The remains of Kiln A consisted of: "Eight double rows of bricks. . ." (Heite 1967: 9). However, after archaeologists noted a continuation of burned soil (indicating a continuation of the kiln), they concluded that this clamp had actually been 38' 7" rather than the excavated 23' 7" (Heite 1967: 9). Indeed, evidence to confirm this hypothesis was discovered upon excavation of the church foundations: this extra portion of the clamp had been used as fill (Heite 1967: 9).

Kiln B

This area had not only experienced a degree of root disturbance but also had been disturbed ". . . across its south and east sides by the bulldozer" (Heite 1967: 9). The

investigators ". . .were able to identify 18 double rows and what apparently was the east wall of Kiln B" (Heite 1967: 9).

Fort Belvoir

The Fort Belvoir site is located along the Potomac River "between Pohick Creek and Accotink Creek on the south and Dogue Run on the north" (Shott 1978: 1) "It is situated on bluffs overlooking the Potomac River" and is located in Fairfax County, Virginia (Shott 1978: 1).

Excavations undertaken from 1972 to 1976 by the United States Army Engineer Museum revealed that four brick clamps had indeed existed. Because Shott realized that the four clamps were similar in their building plan, he chose only to describe the one clamp which had enjoyed the most structural integrity (Shott 1978: 184). Shott notes that the brick "benches or stacks" were divided by 18 inches with the bricks arranged in the "truss-over" or "over-span" pattern (1978: 184). In his "Builder's Dictionary," Neve (1726) describes this particular patterning as being achieved by laying "the end of one Brick about half way over the end of another. . . 'till both sides meet within half a Brick's length, and then a bounding brick at the top finishes the Arch" (Shott 1978: 185).

In this report, Shott does include specific descriptive data dealing with the clamps. I would like to reproduce this table for the important information it provides about these brick clamps:

TABLE 1

Clamp	No. of Courses	Dimensions	No. of Channels	Width	No. of Benches	Width
A	6-8	27' x 24'	6	18"	6	18"- 24"
B	3-8	22' x 18'	6	18"	7	24"
D	5-8	22' x 18' (approx).	4	18"	3	24"
E	2-4	15' x 8'	3	18"	4	24"

The author ultimately concludes: "The presence of brick styles corresponding to those in the estate features makes it probable that these clamps provided the brick for the manor construction" (Shott 1978: 188). Since this is the case, we may conclude that these kilns were operational at least between the years 1736-1741 (Shott 1978: 1).

Carter's Grove:

Excavations were undertaken by William Kelso at Carter's Grove Plantation ("...six miles southeast of Williamsburg. . .") (Kelso 1970-71: Introduction) in 1970 and 1971. This site is located in James City County, Virginia (Kelso 1970-71: Introduction). Figure 6 shows the location of Carter's Grove. In the investigations, "Eighteenth-century archaeological features related to crafts were. . .found, including: . . .at least five clamp (temporary kiln) sites used c.1750. . ." (Kelso 1970-71: 2).

Clamp 1

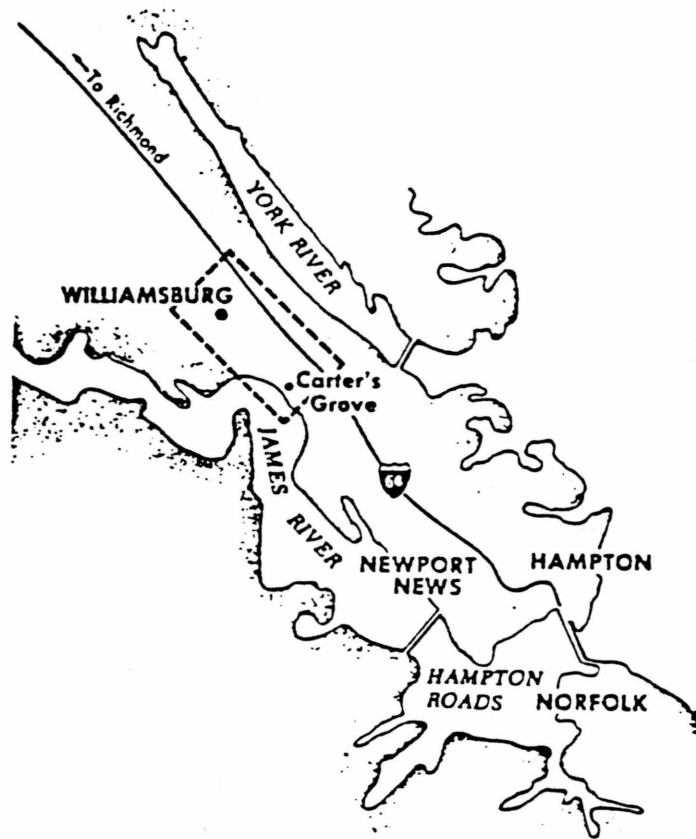


Fig. 6. Map showing location of Carter's Grove Plantation

(From W. Kelso, A Report on Exploratory Excavations at Carter's Grove Plantation/James City County, Virginia (Williamsburg, 1970-71).

Excavations uncovered ". . . a rectangular area of burnt clay subsoil measuring 43' 0" x 17' 0" " (Kelso 1970-71: 44). The only evidence which suggested fire channels consisted of ". . . clay (which) had been scorched black, . . . in alternating sections or strips 9' wide on an average" (Kelso 1970-71: 44). Benches were further suggested by the ". . . black scorched earth and some brick dust. . . found in the intervening areas vaguely forming strips 3' 9" wide on an average" (Kelso 1970-71: 44).

Clamp 2

This kiln was discovered quite near (10' 0" away) and parallel to Clamp 1. "The burned area was. . . only 18' 0" x 12' 0" " (Kelso 1970-71: 44). Unlike Clamp 1, this clamp showed none of the alternate burning (Kelso 1970-71: 44).

Clamp 3

This clamp is ". . . located 85' 0" west of Clamps 1 and 2" (Kelso 1970-71: 45). The archaeological evidence supporting the kiln's presence consisted of five main physical features. First, archaeologists noted "burnt clay subsoil 190' 0" x 14' 0"-16' 0"" (Kelso 1970-71: 45).

The next physical evidence consisted of a row of postholes. Investigators further noted "narrow shallow ditches each side of the burnt area" (Kelso 1970-71: 45). Finally, they discovered a number of postholes smaller than those first encountered as well as another ditch ". . . along the east side of the clamp. . ." (Kelso 1970-71: 46). Figure 7 shows the posthole feature.

Kelso concluded that the above-mentioned layout or design of

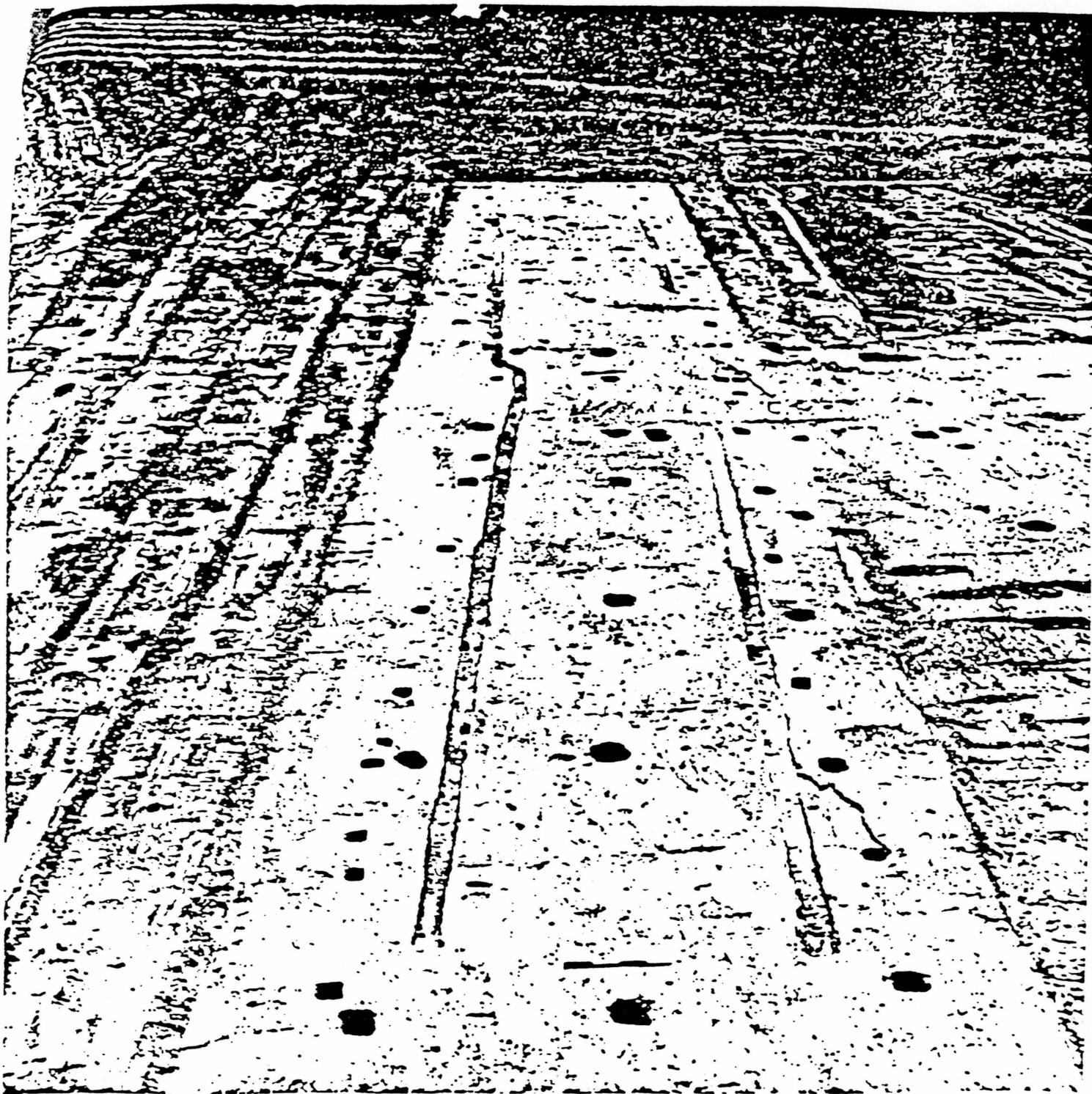


Fig. 7. Representation of photograph showing posthole feature of Clamp 3 at Carter's Grove Plantation

(From W. Kelso, A Report on Exploratory Excavations at Carter's Grove Plantation/James City County, Virginia (Williamsburg, 1970-71).

Clamp 3 ". . . suggests that it was made up of at least three separate clamps (units), set up on roughly the same line but probably burned at separate times" (1970-71: 46). He ultimately hypothesizes that the three clamps would have measured (separately): 87' 0" by 14' 0" , 100' 0" by 17' 0", and 77' 0" by 14' 0" (1970-71: 46).

Datable artifacts found in association with this clamp ". . . suggest that the clamp was used about c.1740-60, and perhaps after 1750" (Kelso 1970-71: 47).

Clamp 4

This clamp intruded into Clamp 3, ". . . cutting into the west side (of Clamp 3). . ." (Kelso 1970-71: 47). Postholes and two ditches (one north to south and one east to west) were also found at this clamp (Kelso 1970-71: 47).

Kelso concluded that Clamp 4 may have been composed of more than one clamp. As was the case with Clamp 3, the postholes did not all align. This suggested that there may have been separate kilns (Kelso 1970-71: 48). Kelso further hypothesizes that one clamp may have been 90 feet by 14 feet, with the second clamp measuring 40 feet by 14 feet (1970-71: 48).

There were no "datable artifacts" found for Clamp 4. However, its intrusion into Clamp 3 does suggest that it was built after Clamp 3 (c. 1750) (Kelso 1970-71: 48).

Clamp 5

Clamp 5 was discovered 135 feet north of Clamps 1 and 2 (Kelso 1970-71: 48). This clamp also exhibited the

characteristic "central post holes" as well as the ditches along the burned soil. Kelso notes, "It is probable that this clamp was set up and burned as one 62' 0" x 14' 0" unit" (1970-71: 48). Clamp 5 was not dated.

Liberty Hall (Structure 5)

Excavations of this clamp located in Lexington, Virginia were undertaken in 1977 and 1978 by the Washington and Lee Laboratory of Archaeology. The reasons for dating the kiln as an eighteenth century structure were twofold: 1. "Documentary research indicates that a kiln was established on Academy property to provide brick for the construction of a Rector's house, circa 1799" (Russ and McDaniel 1988: 1) and 2. ". . . archaeological data corroborate a late eighteenth century chronological affiliation for the kiln" (Russ and McDaniel 1988: 1).

Information regarding dimensions of the Rector's house was discovered by McDaniel, Watson, and Moore (1979). They found that the structure was to be ". . . 20 by 25 feet in size with a stone foundation and brick walls nineteen feet in height and divided into 2 stories" (Russ and McDaniel 1988: 5).

The actual excavations ". . . revealed five brick benches. . ." (Russ and McDaniel 1988: 6). Each of the benches was approximately 12 feet in length and two and one half feet wide (Russ and McDaniel 1988: 6). "Each bench was made of three or more layers of brick stacked upon one another" (Russ and McDaniel

1988: 6). Dimensions of this clamp were reported to be twenty-two feet by sixteen feet (Russ and McDaniel 1988: 6).

Burwell's Mill:

These kilns, speculated to be late eighteenth century, are located in York County (44Y0394 and 44Y0395- VDHL Survey Forms). The entire site has faced possible disturbance from logging activities (44Y0394 and 44Y0395- VDHL Survey Forms).

Clamp 1

According to the survey form, the area containing the clamps is 15 feet by 15 feet. "The brick kiln consists of concentrated rubble exposed on the surface" (44Y0394- VDHL Survey Form). Investigators also reported that "Minimal shovel testing of the area revealed excellent site preservation" (44Y0394-VDHL Survey Form).

Clamp 2

The approximated kiln area is 30 feet by 30 feet. This brick kiln reportedly has experienced a greater degree of disturbance from the associated logging activities (44Y0395- VDHL Survey Form). The shovel testing which was undertaken ". . .revealed charcoal-stained stratum beneath (the) rubble" (44Y0395- VDHL Survey Form).

Shenandoah Farms

This particular site is located in Clarke County. Excavations were undertaken here in October of 1967 (Heite 1973:

49).

Despite the fact that this structure was excavated in what was determined to be a plough zone, it did enjoy a great degree of structural integrity (Heite 1973: 50). Heite refers to this clamp, which demonstrated the typical herringbone pattern previously mentioned, as Kiln D (1973: 50).

Although no dimensions were reported for this clamp, Heite does conclude that this was a nineteenth century kiln and hypothesizes that ". . .this clamp probably was partly underground" (1973: 50). He further states that this clamp was responsible for producing the bricks needed for construction of the "Greek Revival House" (1973: 50).

Shirley

This excavated clamp was found in Charles City County, Virginia. Investigations were begun at Kiln E in the fall of 1967 (Heite 1973: 50).

Heite notes that ". . .Carters of Shirley were making bricks well into the second quarter of the nineteenth century" (1973: 51). Thus, this clamp may have been operational for a number of years from the earlier part of the nineteenth century up to the period which Heite recognizes (the second quarter of the nineteenth century). In dealing with the actual excavations, he refers to the fact that Kiln E may have been partly located under a road bed. Heite also notes that the remainder of Kiln E was in poor state of preservation (1973: 52). Despite this factor, Kiln

E still had a discernable trace of the typical herringbone pattern (Heite 1973: 52).

Of the kiln's dimensions as they relate to the large project being undertaken, the author concludes that such a ". . . small clamp could not have been the only source of brick for such a large building site project as Shirley" (1973: 52).

Drewry Point

This kiln known as Kiln C is located in Surry County (Heite 1973: 49).

Specific measurements of this clamp are reported as being 27' x 12'. In referring to these dimensions as they relate to the structural magnitude of the project, Heite states that a clamp so small ". . . could hardly have made enough bricks for a brick house, and barely enough for a chimney" (1973: 49).

Heite does present us with an interesting architectural fact, however. The courses of this clamp were not placed in the usual herringbone pattern. These courses were, instead, flat (1973: 49).

Moses McClintic/Jacob Greaver Mill

The remains of this brick clamp were discovered in conjunction with archaeological investigation of the "Moses McClintic/Jacob Greaver Mill Site" in Bath County, Virginia. A "miller's house, . . . mill, . . . and a pair of outlying foundations" were among the other features which were

investigated (Geier, Mullen, and Schroer 1982: 13). Both the brick clamp and ". . . the foundation remains of a small cellar and food storage house. . ." were placed in subarea B for separate study (Geier, Mullen, and Schroer 1982: 13).

Archaeologists concluded that the clamp was certainly the oldest structure in this area. This conclusion was based on the investigations which revealed that partial foundations from the miller's house "extended into the kiln's northwesternmost end." (Geier, Mullen, and Schroer 1982: 26). Figure 8 represents a drawing which shows the general plan of the kiln as well as the foundation which disturbed part of the clamp.

Geier, Mullen, and Schroer further address the period of kiln operation. As they note, ". . .the kiln dates to the period of major mill renovation authorized by Moses McClintic in the 1820's" (1982: 29).

Although the kiln was not completely excavated, the investigators concluded that the kiln was 30' in width and 35' in length and was rectangular in shape. More detailed information states that this clamp ("a typical clamp-type") consisted of "eight parallel rows of brick oriented almost due east-west" (Geier, Mullen, and Schroer 1982: 26). Benches were approximately 35' in length, 2' in width, "and consisted of two tiers of brick" (Geier, Mullen, and Schroer 1982: 26). The fire channels were two feet in width (Geier, Mullen, and Schroer 1982: 26).



FIGURE 8
SUBAREA B: BRICK KILN

Fig. 8. Drawing of Moses McClintic/Jacob Greaver kiln showing general design of kiln as well as the foundations which disturbed part of the kiln (From C. R. Geier, H. Mullen, and C. Schroer, "The Moses McClintic/Jacob Greaver Mill Site" (James Madison Occasional Papers in Anthropology, #8, 1982).

Clamp Products

In this sub-section, I want to elaborate upon the products fired in clamps. Although clamps were used primarily for firing bricks, some were utilized for firing other items.

Kilns at Jamestown were used not only for firing bricks but also for firing roofing tiles used on Colonial buildings. As Harrington notes, "In addition to the bricks, flat roofing tiles were found in the kiln, placed there for firing along with the bricks" (1950: 24).

Cotter notes that some brown clay pipe stems were found in association with two of the clamps in Jamestown. As he states, ". . . fragments of a definite brown clay pipestem 'waster' . . . were found in Ditch 16, 60 feet to the north (of the clamp). This bit of evidence supports indications that pipes were fired in local kilns. . . ." (1958: 80).

Despite the fact that he thinks the brick kilns may have been used for the firing of pipes, Cotter dismisses the idea that pottery (fragments) found in association with Structure 127 was fired in the brick kiln. He relates that ". . . the absence of pottery kiln equipment. . . leaves us with no proof that the brick kiln ever was actually the scene of pottery firing" (1958: 146).

In his report of excavations at Carter's Grove, Kelso does consider the fact that there were six datable artifacts found during excavations of Clamp 3. He notes that besides "A sherd of English Buckley coarse earthenware of c.1750. . .," there were several pipe stems (one found in association with the clamp and

another in the ditch located at the clamp's east side) (1970-71: 47). Since the pipestems were dated to the years 1710-1750 (Kelso 1970-71: 47), it is not inconceivable that pipes were also fired at Clamp 3 at Carter's Grove.

Kurt Russ and John McDaniel (1988) also discuss an interesting product of the Liberty Hall brick kiln site. They state that "The Toy class of the Activities Group is dominated by clay marbles found in the flues of the brick kiln during its excavation" (1988: 9). They further conclude that the great concentration of marbles "suggests that. . .clay marbles were fired in the kiln" (1988: 9).

Although the other reports do not contain information suggesting that other items were fired in the clamps, we do see that at least some clamps were responsible for more than the firing of bricks. These items were not only made for utilitarian purposes (such as the roofing tiles and pipes) but also for pleasure (such as the marbles at Liberty Hall).

Issues

Although they are almost monotonous in their uniformity, brick kilns and clamps are nonetheless useful subjects for excavation. (Heite 1973: 52)

After having presented information dealing with clamp excavations in the state of Virginia, I want to deal with the following issues raised by Russ and McDaniel (1988):

1. "The relationship of kiln type and size to the size of

the building to be constructed" (1988: 3)

2. "The relationship of kiln type and specific structural attributes to the period of use intended for the kiln" (1988: 3)

In examining the information concerning brick clamp excavations, I think there is definite evidence suggesting a positive correlation between clamp size and building size. Certainly, Heite demonstrates the validity of this relationship with his comment about the brick clamp excavated at Shirley: such a ". . . small clamp could not have been the only source of brick for such a large building site project as Shirley" (Heite 1973: 52).

Because there were at least four clamps at the Fort Belvoir site, we see further support for a positive correlation. In other words, the construction of the Manor House as well as outbuildings which must have been associated was no small undertaking. As Russ and McDaniel (1988) note, the exact ". . . dimensions provided (for the structure) . . . were undoubtedly relevant to the brickmaker as he determined the size and type of kiln appropriate for manufacturing the bricks necessary to construct the building" (1988: 5).

Despite the fact that there is indeed some relationship between clamp size and the size of structural undertaking, I think there must also be other variables to consider. I suggest that among these variables are speed and manpower.

If a certain project had to be completed within a specified time frame, not only would a large kiln be necessary but also a

greater number of kilns would be needed. This similar relationship exists with the available manpower. Time would also play a factor in determining the needed manpower. However, the greater the manpower available or required, the larger a kiln could be and the more kilns that could be operated.

I support the above hypotheses with the example of Lower Westover Church. Obviously, the sheer size of this structure was not so great as to require kilns of such large dimensions. Since this is the case, there must have been some other intervening variable or variables at work.

In considering the second issue: the way in which kiln type (and structural attributes) relate to the period of use intended for the kiln (Russ and McDaniel 1988: 3), it is certainly first important to consider the previous section concerning the definition of "clamp." Obviously, no clamp was designed to last infinitely.

Despite the fact that clamps were not extremely durable structures, archaeological evidence does suggest that some were designed (and needed) to last for a greater period of time. The two examples which stand out are the kilns at Jamestown and Carter's Grove.

Structure 127 is the Jamestown kiln which interests me most. Unlike most temporary clamp structures which were built on the ground, Structure 127 was built within a pit (Cotter 1958: 145). Building a clamp in such a way would certainly prevent much of the erosion which would occur if the bricks were placed directly

on leveled ground.

The postholes excavated in the Carter's Grove clamps certainly suggest that the clamps may have been protected by some type of covering. As Kelso notes, "It is probable that the central posts supported the ridge pole and the side holes the eaves of a crude roof or cover" (1970-71: 45). Thus, these clamps were designed to enjoy a longer life span than most others.

Many of the other clamps were not needed to last for any period of time. For example, the Liberty Hall kiln was constructed specifically for the building of the Rector's House (Russ and McDaniel 1988: 1). It was needed only until the construction was completed.

Since a clamp was not excessively difficult to repair, it seems quite likely that brickmakers did not devote a great deal of time in their construction. As Heite states in reference to the amount of care devoted to kiln construction, "Sometimes, the entire floor of the clamp was paved, and the charge was placed on the brick floor. Very few clamps were built with such care" (1970: 44).

The Myth of Imported "English" Bricks
And
Brick Size: Variation Through Time

In collecting information of early American houses, one is impressed with the almost universal assumption that the bricks used in their construction were made in England.

(Ewan 1970: 1)

It is remarkable that the idea that the size of bricks can be correlated with the time of their manufacture is so strongly held by the general public, whereas little interest is shown in the ceramic types, which are much more valid indicators of time. (South 1964: 67)

In this final section, I will be dealing with an examination and evaluation of several hypotheses formulated by Ewan (1970), South (1964), Lazarus (1965), and Heite (1970). These individuals hypothesize that the popular myth of bricks first being brought from England as ship ballast is untrue (South 1964: 67). They further state that the idea of brick size as an indicator of date is not valid. In other words, there is no true chronological variation of brick size (South 1964: 67). Examination of the evidence presented will certainly indicate how valid their beliefs are.

Ewan provides us with an interesting and convincing explanation for the widely held belief that Colonial bricks were brought from England. A law passed in 1683 by New Jersey's General Assembly set a standard for brick size. The bricks were to be 9 1/2 by 4 1/2 by 2 3/4 inches (Ewan 1970: 1). This fact alone is not impressive. However, when we consider the idea that this size was also that of the ". . . regulation English made product" (Ewan 1970: 1), it becomes ". . . plausible that these legalized bricks became known. . . as 'English brick' (and were) . . . later. . . accepted as genuinely imported brick" (Ewan 1970: 1).

Ewan continues with his rationalist outlook. He notes that we need to consider the particular time frame during which this alleged shipping occurred. As he points out, ships could only carry up to 300 tons of cargo, they took much time to arrive, and they were always full of both passengers and other necessary cargo (1970: 2). "The heavily loaded vessels needed no further weight than their own essential cargoes to keep them stable on the ocean voyage" (Ewan 1970: 2).

Heite also brings in important historical evidence suggesting that most bricks were not brought from England. As he states, "In 1611, Sir Thomas Dale began building a city of brick on the upper James River" (1970: 43). It is certain that a project of such magnitude would have required a ". . . large quantity of brick (which) would not have come from England" (Heite 1970: 43).

Heite also supports his position with the example of brick used in houses of Colonial Jamestown. As he notes, "The sheer mass of brick used in Colonial houses precludes such assumptions" (of brick being brought from England) (1970: 43).

South first supports the concept that, rather than being brought from England, ". . . the large percentage (of bricks) were fired locally, in or near the town where they were used" (1964: 67). He cites both Jamestown and Williamsburg as examples illustrating (and failing to confirm) this popular myth of brick import. Obviously these two colonies could not have imported all the brick necessary for establishing permanent structures.

The next issue which the authors address is that of brick size as it varies through time. According to most of them, there is no way for brick size to be a truly valuable dating tool.

According to South, both Jamestown and Williamsburg have produced "evidence (which) . . . has indicated that the size of bricks is generally of little value as a sensitive indicator for dating historic ruins" (1964: 67).

South elaborates upon Harrington's study of Jamestown. Harrington ". . . has concluded that the bricks from the first half of the seventeenth century are slightly thinner and longer than those of the last half, with a trend toward shorter, narrower and thicker bricks during the eighteenth century" (South 1964: 67).

According to South, the chronological variations in brick dimensions noted by Harrington cannot be seen as truly significant. As South states in defense of his position: there was such great ". . . variation in sizes. . . within one period, and within one building due to differential clays, molds, and firing techniques" (1964: 67-68).

Heite notes that the problem of "English" bricks is nothing compared to the ". . . more persistent misconception (which) centers around the use of brick dimensions as dating tools" (1970: 43). Heite also considers that Forman (1938) in Jamestown and St. Mary's Buried Cities of Romance could not prove that there was a relationship between brick size and date of manufacture.

In further backing up his position, Heite points out: "Indeed, Richard Neve in 1726 catalogued no less than five different traditions then current in England" (1970: 43). By this, Heite means that with so many different traditions being popular at one time and at one place, there would be no way to create a clear relationship between brick size and date of manufacture.

Heite's belief that there were so many differing traditions in Colonial America is an important idea to note. However, the evidence demonstrating that "The early brick varied much in size in the same structure and differences in length of one-half inch were not unusual," (Claiborne 1957: iii) makes it even more convincing that exact date of brick manufacture is difficult to determine.

Despite the fact that there does not seem to be any validity to bricks as dating tools, South does believe that they can be valuable. According to him, brick dimensions may have some value for comparative research (1964: 68).

South donates particular attention to the example of Brunswick Town in North Carolina. As he states, this area represents ". . . a time capsule of fifty years duration that should be of value in comparative studies, and as a control on other sites of unknown age" (1964: 68).

South notes that at Brunswick Town there were two distinct sizes of brick. One size ranged from 8 1/2" to 9" in length, 4" to 4 1/2" in width, and 2 1/2" in thickness. The other brick

ranged from 6 3/4" to 7 3/4" in length, 3 1/4" to 3 3/4" in width, and 1 1/2" to 2" in thickness. South does point out that there is the usual size variation within each of these two size traditions. However, he also relates that the differences are not so great as to cause confusion over the particular style (South 1964: 68).

After realizing the importance of bricks as comparative tools, South devised a method of reducing the length, width, and thickness measurements to one number. He decided to represent these measurements in eighths of an inch. Thus, each measurement is converted to eighths and all three are added together to create the South Index Number (South 1964: 68-69).

Lazarus (1965) also found brick dimensions to be useful. He originally undertook his study ". . .to correlate the available data on bricks in the Pensacola area with that reported for Colonial American sites in Virginia and the Carolinas" (1965: 69). In other words, his research was centered around the comparative concept which South advocates.

After utilizing the South Index Number, Lazarus concluded that ". . .good identification of bricks as to manufacturer, site of manufacture, and relative time of manufacture. . .may be of great assistance to historical archaeologists. Excavations at old brick yards could be very significant if historical data is available for time correlation" (Lazarus 1965: 81).

The conclusion which Lazarus reaches leaves us with two interesting considerations. First, we can see how brick size can

indeed be an important tool. However, Lazarus also points out the importance of excavations of brick clamps. These excavations furnish data (artifacts) necessary to either date the bricks produced or confirm the date already presented by historical information.

Conclusions

Certainly Virginia is one of the most interesting areas in which to study brickmaking activities. The fact that brickmaking entered the colony almost as soon as the colonists entered provides us with a rich history of Virginia brickmaking.

The synthesis of brick clamp excavations demonstrates that brickmaking has enjoyed a prolific period. The information provided on clamp excavations include clamps ranging through several centuries. The clamps encompass a time frame extending from the seventeenth century in Colonial Jamestown to the nineteenth century. It seems logical that the industry was growing during the nineteenth century, and there was less need for temporary clamp structures. However, the clamp did endure for many years (and centuries) in the state of Virginia.

Not only did the clamp concept last for many years, but it was popular in many different areas of Virginia. The reports include clamps from the towns of Lexington and Jamestown. However, they also cover a wide range of Virginia counties. The counties include Charles City County, James City County, Surry County, York County, Clarke County, Bath County, and Fairfax County. Although many of these counties are located near the

coast of Virginia, not all are located in this area. Because these clamps were operated in many different areas, we can see that the clamp was definitely an important instrument to the brickmakers of Virginia. Obviously, brick clamps were important not only for the firing of bricks, but also for firing other items such as the previously mentioned roofing tiles, pipes, and marbles.

These excavations have not only allowed us to gain historical insights. We have also been able to address several important issues raised by Russ and McDaniel (1988).

We have discovered that the sheer dimensions of the building to be constructed may not have been the only variable determining the size of the clamp. Size is certainly one variable which must be considered. For example, a small kiln (such as the Shirley and Drewry Point clamps discussed by South) obviously had limited production capabilities.

Clamps such as those at Jamestown and Carter's Grove could produce more bricks. However, the amount of time or the deadline for construction becomes an important variable here. These individuals were certainly trying to create a lot of product in less time. Thus, the building could be finished sooner or the products could be marketed more effectively for greater profit.

The concept of manpower also becomes important to the size of a kiln and the number of kilns constructed. A large work force would tend to create a need for either more kilns or bigger kilns.

Examination of the information on clamp excavations has also demonstrated that the period of use intended for a clamp was important in determining how well the kiln would be constructed.

As we can see from Kelso's report on Carter's Grove, these kilns were part of a large brickmaking operation. Thus, the individuals would pay more attention to protecting their kilns from the forces of erosion which attack clamps readily.

If a clamp was built only for a specific undertaking, the builder certainly had no reason to build the clamp on permanent foundations. The Liberty Hall clamp which was built specifically to produce bricks needed to construct the Rector's house is a perfect example. There was no need for an elaborate, high-tech kiln, and if more brick was needed at a later date, brickmakers could either rebuild the deteriorated kiln or construct another.

Consideration of the misconceptions surrounding bricks has demonstrated that most Colonial bricks were not the "English" brick. Rather, as historical information, the archaeological record, and plain rationalism have shown, the colonists hurriedly set about brickmaking activities.

The idea of brick size as an important guide to the chronology of sites is definitely another part of the legend surrounding brickmaking. South (1964) and Heite (1970) have certainly demonstrated that brick size does not have a regular pattern of variation.

As South has noted, variation in size was frequently so great that it is now difficult to date bricks with accuracy.

Heite backs up South's idea and adds that the presence of so many different traditions during one time period further confuses today's dating accuracy.

Despite the fact that brick size is difficult to attach to a specific date, South and Lazarus have determined that brick size does have a use as a comparative tool.

As all the information has shown, the ideas surrounding bricks and brickmaking vary immensely. Some people fail to realize the important role which brickmaking played in Colonial Virginia. They do not realize that rather than being a boring subject, brickmaking can reveal much and can allow us to address questions already asked as well as questions yet to be asked. Brickmaking's historical and archaeological implications should not be overlooked.

Bibliography

- Claiborne, Herbert A. Comments on Virginia Brickwork Before 1800. Portland, Maine: The Walpole Society, 1957.
- Cotter, John L. Archeological Excavations at Jamestown, Virginia. Washington: National Park Service, 1958.
- Ewan, N. R. Early Brickmaking in the Colonies. Camden, New Jersey: Camden County Historical Society, 1970.
- Geier, Clarence R., Hank Mullen, and Cindy Schroer. "The Moses McClintic/Jacob Greaver Mill Site". James Madison University Occasional Papers in Anthropology, Number 8. 1982.
- General Shale Products Corporation. Brick. . .Its History and How It is Made. Johnson City, Tennessee: General Shale Products Corporation, 1986.
- Gurcke, Karl. Bricks and Brickmaking. Moscow, Idaho: University of Idaho Press, 1987.
- Harrington, J. C. "The Manufacture and Use of Bricks at the Raleigh Settlement on Roanoke Island". The North Carolina Historical Review, Volume 44, 1967.
- _____ "Seventeenth Century Brickmaking and Tilemaking at Jamestown, Virginia". The Virginia Magazine of History and Biography, Volume 58, 1950.
- Heite, Edward F. "Colonial Brick Technology". The Conference on Historic Site Archaeology Papers, Volume 3, 1970.
- _____ Excavations at the Site of Lower Westover Church. Charles City County, Virginia: Westover Parish, 1967.
- _____ "Several Virginia Brick Clamps: A Summary of Brickmaking". Quarterly Bulletin Archeological Society of Virginia, Volume 28, 1973.
- Kelso, William. A Report on Exploratory Excavations at Carter's Grove Plantation/ James City County, Virginia. Williamsburg, Virginia: Colonial Williamsburg Foundation, 1970-71.
- Lazarus, William C. "A Study of Dated Bricks in the Vicinity of Pensacola, Florida". The Florida Anthropologist, Volume 16, 1965.
- Noel Hume, Ivor. Here Lies Virginia. New York: Alfred.A.Knopf, 1963.

_____ Historical Archaeology. New York: Alfred. A. Knopf, 1968.

Russ, Kurt C. and John M. McDaniel. "Archaeological Residues of Domestic Brickmaking: An Example from the Liberty Hall Academy Site Complex". Paper to Archaeological Society of Virginia, 1988.

South, Stanley. "Some Notes on Bricks". The Florida Anthropologist, Volume 16, 1965.

Shott, George C., Jr. U. S. Army Engineer Museum Archaeological Investigations of Belvoir Historic Site, Fort Belvoir, Virginia. Fort Belvoir, Virginia: U. S. Army Engineer Museum, 1978.

Virginia Division of Historic Landmarks. Site Survey Forms (44Y0394 and 44Y0395). Richmond, Virginia, 1984.